



**CITY OF HERMOSA BEACH CONTRACT  
DOCUMENTS AND SPECIFICATIONS FOR**

**CIP NO. 682  
PARKING LOT “D” IMPROVEMENTS  
PROJECT**

**OCTOBER 2024**

## City of Hermosa Beach

### NOTICE INVITING BIDS

Notice is hereby given that the City of Hermosa Beach will receive electronic bids until **2:00 PM on Tuesday, October 29, 2024**; at which time the electronic bids will be publicly opened at the City Council Chambers at 1315 Valley Drive, Hermosa Beach, CA 90254 and posted on Planet Bids for **CIP No. 682 Parking Lot “D” Improvements Project**.

The project includes, but is not limited to, removal of existing improvements including on-site and offsite concrete improvements, landscaping, asphalt concrete pavement with base and subbase, light poles and fixtures and construction of new improvements including concrete curb, curb and gutter, driveway approach, ADA curb ramp, sidewalk, retaining walls, ADA ramp, pervious pavement, new electrical system including light posts and fixtures, installation of stormwater capture devices, construction a canopy with mounted solar panels and installation of EV vehicles charging stalls, installation of a pay station and installation of a new irrigation system and landscaping including street trees.

The engineer’s cost estimate for the project is **\$1,450,000**. License requirement is a valid **State of California Contractors License Class “A”**.

All sidewalk and access ramp removals shall be replaced within 48 hours. Traffic control plans are required as part of this project to maintain uninterrupted safe vehicular and pedestrian traffic throughout the work areas.

The duration of the project is **90 working days**. All bids must be submitted electronically on Planet Bids Portal, accessible through the City’s webpage at <https://www.hermosabeach.gov/our-government/city-clerk/bids-and-proposals> where you must first register as a vendor through our Planet Bids Portal. Contract Documents, plans, and specifications will be available for review on Planet Bids. All relevant materials shall be obtained from the link above.

Each proposal must be accompanied by a cash deposit, a certified or cashier's check, or a Bidder's bond, made payable to the City of Hermosa Beach, in an amount not less than 10 percent of the total bid submitted.

The successful Bidder will be required to furnish a faithful performance bond in the amount of 100 percent of the Contract price, a payment bond in the amount of 100 percent of the Contract price, and a warranty bond all in the attached form satisfactory to the City Attorney. The successful Bidder will also be required to pay the State of California prevailing wage scale as determined by the Department of Industrial Relations, available at <http://www.dir.ca.gov/dlse/dlsePublicWorks.html>.

The Contractor must be registered with the Department of Industrial Relations at the time of bid. Contractor’s registration information is available at: <https://www.dir.ca.gov/Public-Works/Contractor-Registration.html>

The City reserves the right to reject any or all bids and to waive any informality or irregularity in any bid received and to be the sole judge of the merits of the respective

bids received. The award, if made, will be made to the lowest responsive and responsible Bidder.

Please submit any questions related to this bid on Planet Bids portal no later than **2:00 PM on Monday, October 21, 2024.**

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**City of Hermosa Beach**

**CIP NO. 682  
PARKING LOT “D” IMPROVEMENTS  
PROJECT**

**I. PROJECT DESCRIPTION AND UNDERSTANDING**

The project includes, but is not limited to, removal of existing improvements including on-site and offsite concrete improvements, landscaping, asphalt concrete pavement with base and subbase, light poles and fixtures and construction of new improvements including concrete curb, curb and gutter, driveway approach, ADA curb ramp, sidewalk, retaining walls, ADA ramp, pervious pavement, new electrical system including light posts and fixtures, installation of stormwater capture devices, construction a canopy with mounted solar panels and installation of EV vehicles charging stalls, installation of a pay station and installation of a new irrigation system and landscaping including street trees.

Construction of the proposed retaining walls is based on use of a pre-engineered wall system (Orco Block). Contractor should give consideration to the length of time it may take to procure this and other elements of the project including light poles and fixtures, and stormwater capture devices. This project also includes installation of a new electrical system which requires the Contractor to timely coordinate with Southern California Edison (SCE).

## II. NOTICE TO BIDDERS

**Prospective Bidder:** To be considered responsive, each Bidder must register on Planet Bids portal through the city's website at <https://www.hermosabeach.gov/our-government/city-clerk/bids-and-proposals>.

**Pre-bid Meeting:** There will be a pre-bid meeting at **11:00 AM on WEDNESDAY, OCTOBER 16, 2024; at 1331 Manhattan Avenue (southwest corner of Manhattan Avenue and 14<sup>th</sup> Street), Hermosa Beach, CA**. The City will respond to questions from prospective Bidders at that time. Each Bidder is strongly encouraged to attend the meeting. Regardless of attendance, each prospective Bidder shall familiarize itself with the plans and work site(s) to satisfy itself that it has the abilities and resources to complete the work. The City will respond to questions from prospective Bidders at that time.

**Bid Documents:** Bid Documents, including but not limited to specifications and proposal forms, will be available for download on Planet Bids Portal, accessible through the webpage at: <https://pbsystem.planetbids.com/portal/51313/bo/bo-search>.

To the extent required by Section 20103.7 of the Public Contract Code, upon request from a Contractor plan room service, the City shall provide an electronic copy of the Contract Documents at no charge to the Contractor plan room.

It is the responsibility of each prospective Bidder to download and print all bid documents for review and to verify the completeness of Bid Documents before submitting a bid. The City does not assume any liability or responsibility based on any defective or incomplete copying, excerpting, scanning, faxing, downloading, or printing of the Bid Documents.

**Questions:** All questions regarding this bid shall be submitted through Planet Bids no later than **OCTOBER 21, 2024; at 2:00 PM**. Proposers shall not contact City personnel or Elected Officials with any questions or clarifications concerning this Invitation for Bids other than through Planet Bids. Any City response for this Bid that is not posted through Planet Bids is unauthorized and will be considered invalid.

**Submittal of Bids:** Electronic bids shall be submitted through Planet Bids until **OCTOBER 29, 2024; at 2:00 PM** at which time they will be publicly opened and read in the City Council Chambers at 1315 Valley Drive, Hermosa Beach, CA. All bids shall be valid for a period of 90 calendar days after the bid opening date.

**Bidder's Guarantee:** Each bid must be accompanied by cash or a certified check or a cashier's check or Bidder's bond made payable to the City of Hermosa Beach for an amount equal to at least ten percent (10%) of the bid price. In accordance with Public Contract Code Section 20170, the Bidder's Bond shall be issued by a surety company admitted to do business in the State of California. Further, in accordance with Public Contract Code Section 20172, such guarantee shall be forfeited should the Bidder to whom the Contract is awarded fail to enter into the Contract within the specified time.

**Payment, Performance Bonds:** The successful Bidder will be required to furnish a Faithful Performance Bond and a Labor and Material Payment Bond, each in an amount equal to one hundred percent (100%) of the Contract Price. Each bond shall be in the forms set forth

herein and shall be secured from a surety company that meets all State of California bonding requirements, as defined in California Code of Civil Procedure Section 995.120, and that is a California admitted surety insurer.

**Substitution of Securities:** Pursuant to Section 22300 of the Public Contract Code of the State of California, the successful Bidder may substitute certain securities for funds withheld by the City to ensure its performance under the Contract.

**Contractor License:** In accordance with provisions of Section 3300 of the California Public Contract Code, City of Hermosa Beach has determined that the **Contractor shall possess a valid "A" California Contractor's License**. Failure to possess such license may render the bid as non-responsive and bar the award of the Contract to that non-responsive Bidder.

**Prevailing Wages:** Pursuant to Labor Code Section 1773, the Contractor shall pay the prevailing rate of per diem wages and the prevailing wage rate for holiday and overtime work applicable in Los Angeles County from the Director of the Department of Industrial Relations for each craft, classification, or type of worker needed to execute this Contract. A copy of these prevailing wage rates may be obtained by visiting: <https://www.dir.ca.gov/Public-Works/Prevailing-Wage.html>

In addition, a copy of the prevailing rate of per diem wages will be made available at the City's Public Works Department upon request. The successful Bidder shall post a copy of the prevailing wage rates at each job site. It shall be mandatory for the Bidder to whom the Contract is awarded, and for any subcontractors, to comply with all Labor Code provisions, which include but are not limited to the payment of not less than the said specified prevailing wage rates to all workers employed by them in the execution of the Contract, employment of apprentices, hours of labor, and debarment of Contractors and subcontractors.

**Contractor's Registration with the Department of Industrial Relations (DIR):** The Bidder's attention is directed to Labor Code Section 1725.5, which provides that a Contractor or subcontractor shall not be qualified to bid on, be listed in a Bid proposal, subject to the requirements of Public Contract Code Section 4104, or engage in the performance of any Contract that is subject to Labor Code Section 1720 et seq., unless currently registered and qualified to perform public work pursuant to Labor Code Section 1725.5. No Bid will be accepted, nor any Contract entered into without proof of the Contractor's and subcontractors' current registration with the DIR to perform public work. If awarded a Contract, the Bidder and its subcontractors, of any tier, shall maintain active registration with the DIR for the duration of the Project.

**Compliance Monitoring and Enforcement:** Contractor's performance of the Work described in the Notice Inviting Bids is subject to compliance monitoring and enforcement by the California Department of Industrial Relations. In bidding on this Project, it shall be the Bidder's sole responsibility to evaluate and include the cost of complying with all labor compliance requirements under this Contract and applicable law in its Bid.

**Award of Contract:** The City shall award the Contract for the Project to the lowest responsive, responsible Bidder as determined by the City from the total base bid. City reserves the right to reject any or all bids or to waive any irregularities or informalities in any bids or in the bidding process.

### III. INSTRUCTION TO BIDDERS

**Form of Proposal:** The proposal shall be fully executed and submitted on the forms provided by the City. Proposal forms can be obtained from Planet Bids.

**Signatures:** All places where signatures are required must be fully executed.

**Proposal:** Documents which shall be signed and returned to the City with the Bid Proposal are:

- A. Proposal
- B. Bid Schedule
- C. Bid Bond
- D. Bidder's Assurance
- E. Bidder's Declaration
- F. Certificate of Non-Discrimination by Contractors
- G. Certification of Principal
- H. Declaration of Eligibility to Contract
- I. Non-Collusion Declaration
- J. References for Work
- K. SubContractor List
- L. Iran Contracting Act Certification
- M. Public Works Contractor Registration Certification
- N. Addenda (if applicable)

**Contract:** Documents which shall be signed and returned to the City by the successful Bidder within 10 days of notification of intent to award Contract:

- A. Contract Agreement
- B. Agreement of Indemnification and Hold Harmless and Waiver of Subrogation and Contribution
- C. Equals
- D. Faithful Performance Bond
- E. Payment Bond (Labor and Materials)
- F. Guarantee to the City of Hermosa Beach
- G. General Comprehensive Liability Additional Insured Endorsement
- H. Automobile Liability Additional Insured Endorsement
- I. Instructions for Completing, Executing, and Submitting Evidence of Insurance to the Owner
- J. Worker's Compensation Insurance Certificate
- K. Supplemental Information to be Completed by Principal
- L. W-9 Form
- M. Copy of City Business License

**Delivery of Proposal:** Each Bid prepared by Bidder shall be completed in itself and shall be submitted electronically through Planet Bids.

**Prevailing Wage:** In accordance with the provisions of Section 1770 et seq., of the Labor Code, the Director of the Department of Industrial Relations of the State of California has

ascertained the general prevailing rate of wages which is the minimum amount which shall be paid to all workers employed to perform the work. A copy of the determination is on file in the office of the City Clerk and is hereby incorporated herein and made a part hereof as though fully set forth herein.

A copy of the determination will be made available to any interested person upon request and shall be posted at the job site.

**Overtime:** As per Labor Code Section 1810 et seq., eight (8) hours is the legal working day. The Contractor shall pay overtime for each worker who works in excess of the legal working day.

**Payment:** Refer to the Contract Agreement for payment information. Contractor shall submit progress payment requests on City approved form.

**Required Bonds:** Prior to the execution of the Contract, the successful Bidder shall file with the City surety bonds in the amounts and for the purposes noted below. The surety insurer shall be a California admitted surety insurer, as defined in Code of Civil Procedure section 995.120. Contractor shall pay all premiums and costs thereof and incidental thereto.

Per Civil Code section 3247, a Payment Bond is required if the Contract is for more than \$25,000.

The successful Bidder shall give three (3) surety bonds with good and sufficient sureties:

"Payment Bond – Labor and Materials" shall be so conditioned as to insure to the benefit of persons furnishing materials for or performing labor upon the work. Bond to be in the sum of not less than 100% of the Contract price to assure the claims of materialmen supplying materials to Contractor, and for payment to laborers and subcontractors employed on the project.

"Faithful Performance Bond" in the sum of not less than 100% of the Contract price to assure the faithful performance of the Contract; shall be conditioned as to assure the faithful performance by the Contractor of all work under said Contract, in a manner that is satisfactory and acceptable to the City; that all materials and workmanship supplied by him will be free from original or developed defects; and that should original or developed defects or failures appear, the Contractor shall, at his own expense, make good such defects and failures and make all replacements and adjustments required, within a reasonable time after being notified by the City to do so, and to the satisfaction of the City.

**Rejection of Proposals:** The City reserves the right to reject any and all proposals and to waive any minor or technical discrepancies or irregularities. Proposals may be rejected if they show any alteration of form, additions not called for, conditional bids, incomplete bids, erasures, or irregularities of any kind.

**Agents:** When proposals are signed by an agent, other than the officer or officers of a corporation authorized to sign Contracts on its behalf or a member of a partnership, a "Power of Attorney" must be on file with the City prior to opening bids or shall be submitted with the proposal; otherwise, the proposal will be rejected as irregular and unauthorized.

**Withdrawal of Proposals:** Any bid may be withdrawn at any time prior to the time fixed in the public notice for the opening of bids only by written request for the withdrawal of the bid

filed with the City Engineer. The request shall be executed by the Bidder or their duly authorized representative. The withdrawal of a bid does not prejudice the right of the Bidder to file a new bid. Bids are opened exactly at the time fixed in the public notice for opening bids. A bid will not be received after that time, nor may any bid be withdrawn after that time. No Bidder may withdraw his bid within ninety (90) days after the actual date of the opening thereof.

**Insurance:** Without limiting Contractor's indemnification, Contractor shall maintain in force at all times during the performance of this agreement the insurance provisions set out in the Contract Agreement.

**City Business License and Permits:** The successful Bidder shall obtain a valid City of Hermosa Beach Business License prior to commencing work under this Contract.

The successful Bidder will be required to obtain City Right of Way Permit to work in public right-of-way, issued at no fee for the project.

**Increased or Decreased Quantities:** The City reserves the right to increase, or decrease, or to entirely eliminate items or portions of items from work if found desirable or expedient.

**Approximate Estimate:** The quantities in the Bid Schedule are approximate only, being given as a basis for the comparison of bids. The City does not, expressly or by implication, agree that the actual amount of work will correspond therewith. The Contractor shall verify in the field the accuracy of the estimated quantities.

**Examination of Plans, Specifications, Contract, and Site of Work:** The Bidder shall examine carefully the site of the work contemplated, the Plans and Specifications, and the proposal and Contract forms therefor. The submission of a bid shall be conclusive evidence that the Bidder has investigated and is satisfied as to the conditions to be encountered, as to the character, quality and scope of work to be performed, the quantities of materials to be furnished, and as to the requirements of the proposal, Plans, Specifications, and the Contract.

Where the City may have made investigations of subsurface conditions in areas where work is to be performed under the Contract, such investigations are made only for the purpose of study and design. Where such investigations have been made, Bidders or Contractors may, upon written request, inspect the records of the City as to such investigations subject to and upon the conditions hereinafter set forth. Such inspection of records may be made at the office of the City Engineer.

The records of such investigations are not a part of the Contract and are shown solely for the convenience of the Bidder or Contractor. It is expressly understood and agreed that the City assumes no responsibility whatsoever in respect to the sufficiency or accuracy of the investigations thus made, the records thereof, or of the interpretations set forth therein or made by the City in its use thereof and there is no warranty or guaranty, either expressed or implied, that the conditions indicated by such investigations or records thereof are representative of those existing throughout such areas, or any part thereof, or that unlooked for developments may not occur, or that materials other than, or in proportions different than these indicated, may not be encountered.

Bidders shall satisfy themselves by personal examination of the locations of the proposed

work, and by such other means as they may choose as to actual conditions and requirements and as to the accuracy of the quantities stated in the Proposal forms. Information derived from the maps, plans, specifications, profiles, or drawings, or from the Engineer or his assistants (or the Architects or their assistants), shall not relieve the Bidder of this responsibility, and the interpretation of the data disclosed by borings or other preliminary investigations is not guaranteed nor is any liability assumed by the City.

If a prospective Bidder is in doubt as to the true meaning or intent of any part of the Contract Documents including the Specifications, or discovers discrepancies in, or omissions from, the Specifications or Drawings, they may submit to the Engineer a written request for an interpretation or a correction thereof via Planet Bids. Interpretations or corrections of the Contract Documents including the Specifications and Drawings, shall be made only by addendum duly issued by the Engineer, and a copy of such addendum will be uploaded on Planet Bids and such addendum shall be considered a part of and incorporated in the Contract Documents.

**Relief of Bidders:** If the Bidder claims a mistake was made in their bid, the Bidder shall give the City written notice within five (5) days after the opening of the bids of the alleged mistake, specifying in the notice in detail how the mistake occurred.

**Disqualification of Bidders:** More than one proposal from an individual, firm, partnership, corporation, or combination thereof under the same or different names will not be considered. Reasonable grounds for believing that any individual, firm, partnership, corporation, or combination thereof is interested in more than one proposal for the work contemplated may cause the rejection of all proposals in which such individual, firm, partnership, corporation, or combination thereof is interested. If there is reason for believing that collusion exists among the Bidders, any or all proposals may be rejected. Proposals in which the prices obviously are unbalanced due to mathematical errors may be rejected.

**Award of Contract:** The award of the Contract, if it be awarded, will be to the lowest responsible Bidder whose proposal complies with all of the requirements prescribed. Such award, if made, will normally be made within in ninety (90) calendar days of the opening of the proposals.

If the lowest responsible Bidder refuses or fails to execute the Contract, the City may award the Contract to the second lowest responsible Bidder. If the second lowest responsible Bidder refuses or fails to execute the Contract, the City may award the Contract to the third lowest responsible Bidder.

**Execution of Contract:** The Contract shall be signed by the successful Bidder and returned, together with the Contract bonds, insurance endorsements and certificates, and all other required documents within ten (10) business days after the Bidder has received notice of intent to award.

**Failure to Execute Contract:** Failure of the lowest responsible Bidder, the second lowest responsible Bidder, or the third lowest responsible Bidder to execute the Contract and file acceptable bonds as provided herein within ten (10) business days after such Bidder has received notice that the Contract has been awarded to them shall be just cause for the forfeiture of the proposal guaranty. The successful Bidder may file with the City Engineer a written notice, signed by the Bidder, or his authorized representative, specifying that the Bidder will refuse to execute the Contract if presented to him. The filing of such notice shall

have the same force and effect as the failure of the Bidder to execute the Contract and furnish acceptable bonds within the time herein above prescribed.

**Return of Proposal Guaranties:** Within ten (10) business days after the award of the Contract to the lowest responsible Bidder, the City will return the proposal guaranties, other than Bidder's bonds, accompanying such of the proposals as are not to be further considered in making the award. Retained proposal guaranties will be held until the Contract has been finally executed, after which all proposal guaranties, except Bidder's bonds and any guaranties which have been forfeited, will be returned to the respective Bidders whose proposals they accompany.

**Qualifications of Bidders:** Each Bidder shall be skilled and regularly engaged in the general class or type of work called for under the Contract. A statement setting forth their experience shall be submitted by each Bidder on the References of Work form provided herein.

Each Bidder shall possess valid active Contractor's License issued by the Contractor's State License Board at the time their bid is submitted. The class of license shall be applicable to the work specified in the Contract. Each Bidder shall also have no less than five (5) years' experience in the magnitude and the character of the work bid.

Pursuant to section 1103 of the Public Contract Code, City staff has determined that the following non-exhaustive experience is reasonably necessary to satisfactorily perform the public works Contract:

The Contractor shall have a minimum of five (5) projects of similar type of construction and magnitude with other public agencies within the past five (5) years.

The Contractor shall have been in the business under the same name and California Contractor's License for a minimum of five (5) continuous years prior to the bid opening date for this project. The license used to satisfy this requirement shall be of the same type as that required by the Contract.

The Contractor shall perform above 50% of the Contract with its own forces.

Bidders must be thoroughly competent and capable of satisfactorily performing the work covered by the proposal. They shall have had project experience similar to the project scope of work. When requested, they shall furnish such statements relative to previous experience on similar work, the plan or procedure proposed, and the organization, machinery, plant, and other equipment available for the contemplated work, and the financial condition and resources of the Bidder, as may be deemed necessary by the City Engineer in determining such competence and capability.

The City of Hermosa Beach will not enter into a Contract with any Bidder who is not properly licensed to do the work of this Contract under the provisions of Section 7000 et seq., of the Business and Professions Code, unless particularly exempted by the terms thereof. A bid by a Contractor who is not properly licensed shall be considered non-responsive and will be rejected. The Contractor must hold all sub-Contractors to these same Contract requirements.

The sheet for Bidder's signature in the Bid Proposal shall clearly show the Contractor's name, date, signature, and State of California Contractor's license number.

**Completeness of Bids:** Bids are required for the entire work. The amount of the bid for comparison purposes will be the total bid price of all items. The Bidder shall set forth the bid price for each item in the respective spaces provided for these purposes.

In case of discrepancy between the unit price and the total set forth for the item, the unit price shall prevail, provided, however, if the amount set forth as a unit price is ambiguous, unintelligible or uncertain for any cause, or is omitted, or in the case where the unit price is the same amount as the entry in the "Total" column, then the amount set forth in the "Total" column for the item shall prevail in accordance with the following:

- a) As to lump sum items, the amount set forth in the "Total" column shall be the unit price.
- b) As to unit price items, the amount set forth in the "Total" column shall be divided by the estimated quantity for the item and the price thus obtained shall be the unit price.

The City may waive technical or non-substantive inconsistencies in any bid.

**Non-discrimination:** Pursuant to the provisions of 31 CFR, Part 51, Section 51.55, the Revenue Sharing Act, notice is hereby given of the following policy, effective immediately:

The City of Hermosa Beach does not discriminate on the basis of handicapped status in admission or access to, or treatment of, or employment in, its programs and activities. The office that will coordinate compliance is that of Human Resources.

**Workers' Compensation Insurance:** Before execution of this Agreement by the City, the Contractor shall file with the City's Risk Manager the following signed certification:

"I am aware of, and will comply with, Section 3700 of the Labor Code, requiring every employer to be insured against liability for Workers' Compensation or to undertake self-insurance before commencing any of the work."

The Contractor shall also comply with Section 3700 of the Labor Code by securing, paying for and maintaining in full force and effect for the duration of this Agreement, complete Workers' Compensation Insurance, and shall furnish a Certificate of Insurance to the City's Risk Manager reflecting such insurance before this Agreement becomes effective. Contractor shall fully indemnify and hold harmless City, its attorneys, agents, officers, and employees for any claims in law or equity occasioned by the failure of Contractor to comply with the terms of this section. Every Workers' Compensation Insurance policy required hereunder, shall bear an endorsement, or shall have attached a rider, providing that in the event of expiration or proposed cancellation of such policy for any reason whatsoever, the City's Risk Manager shall be notified of such action by registered mail, postage prepaid, return receipt requested, at least 30 days before such expiration or cancellation becomes effective.

**Indemnification:** Bidders are instructed to refer to the Contract Agreement.

**Subcontractors:** Bidders must list the name, address of the place of business, Contractor license number, and DIR registration number for each subcontractor to be responsible for more than 1/2 of 1% of the total bid, and the portion of the job for which that subcontractor is responsible. Only one subcontractor may be listed for each portion of the job.

**Unfair Business Practices Claims:** In entering into a public works Contract or a subcontract to supply goods, services, or materials pursuant to a public works Contract, the Contractor or sub-Contractor offers and agrees to assign to the awarding body all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Section 15) or under the Cartwright Act (Chapter 2, (commencing with Section 16700) of Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, services, or materials pursuant to the public works Contract or the subcontract. This assignment shall be made and become effective at the time the awarding body renders final payment to the Contractor without further acknowledgment by the parties. (Section 7103.5, California Public Contract Code.)

**Bidder Registration Requirement:** Pursuant to Labor Code sections 1725.5 and 1771.1, all Contractors and subcontractors that wish to bid on, be listed in a bid proposal, or enter into a Contract to perform public work must be registered with the Department of Industrial Relations (DIR). No bid will be accepted, nor any Contract entered into without proof of the Contractor's and subcontractors' current registration with the DIR to perform public work. If awarded a Contract, the Bidder and its subcontractors, of any tier, shall maintain active registration with the DIR for the duration of the Project. To this end, Bidder shall sign and submit with its bid proposal the Public Works Contractor Registration Certification on the form provided, attesting to the facts contained therein. Failure to submit this form may render the bid non-responsive. In addition, each Bidder shall provide the registration number for each listed subcontractor in the space provided in the Subcontractors List form.

**Claim Procedures:** Bidders are instructed to refer to the Contract Documents, including by way of illustration and not by limitation the Contract Agreement.

**Protest Procedures:** Bidders may file a "protest" of a bid proposal with the City's City Manager. In order for a Bidder's protest to be considered valid, the protest must:

- A. Be filed in writing within five (5) calendar days after the bid opening date;
- B. Clearly identify the specific irregularity or accusation;
- C. Clearly identify the specific City staff determination or recommendation being protested;
- D. Specify in detail the grounds for protest and the facts supporting the protest;
- E. Include all relevant supporting documentation with the protest at time of filing; and
- F. Be transmitted concurrently to all other parties with a direct financial interest that may be adversely affected by the outcome of the protest. Such parties shall include all other Bidders or proposers who appear to have a reasonable prospect of receiving an award depending upon the outcome of the protest.

If the protest does not comply with each of these requirements, the City may reject the protest with or without further review.

If the protest is timely and complies with the above requirements, the City Manager, or other designated City staff member, shall review the protest, any response from the challenged

Bidder(s), and all other relevant information, and will provide a written decision to the protestor.

The City Manager or designee shall have up to ten calendar days to decide whether to approve or reject the protest. The written decision of the City Manager or designee on the protest shall be served upon the protesting Bidder and any Bidder subject to the protest within fourteen (14) calendar days of receipt of the bid protest. The City Manager or designee may extend the ten (10) calendar days if necessary, to review additional information requested from any Bidder.

If the protester wishes to further contest the protest, it shall appeal this decision to the City Council by filing a statement of appeal with the City Clerk within five (5) days of the issuance of the City Manager's decision. Said statement of appeal shall include all information required of the original bid protest, as well as a short and plain statement setting forth why Protester disputes the City Manager's decision and the legal and factual basis for such dispute. Any person or entity may present a formal protest to the City with respect to solicitations being conducted by staff.

A Bidder whose bid has been protested by another Bidder may submit to the City Manager a written response to the protest by email or by personal delivery or overnight mail to City Hall, 1315 Valley Drive, Hermosa Beach, California 90254, so that it is received by the City no later than seven calendar days after the protest has been served by the protesting Bidder.

1. Definitions

- a. "Bidder" means any person or firm providing a timely, written response to the City solicitation.
- b. "Bid Protest" means any protest with regard to the response submitted by another Bidder.
- c. "Response" means the written response to the City solicitation provided by a person or firm.
- d. "Solicitation Protest" means a statement of protest, dispute, challenge, disagreement, disapproval or other objection regarding documents, determinations or actions taken or contemplated by the City with respect to a solicitation.
- e. "Solicitation" means the document by which the City identifies goods, equipment, services, or public construction projects for which it seeks a response.

2. Format – The protest must be in writing and include the following information at a minimum:

- a. The name, address, and phone number of the protester, or the authorized representative of the protester;
- b. The signature of the protester or authorized representative of the protester;
- c. The project number and title under which the protest is submitted;

- d. A detailed description of the legal and/or factual grounds for the protest and all supporting documentation. For protests containing elements not based on publicly released information the protest must contain documentation clearly showing the date on which the protester received the information; and
  - e. The form of relief requested.
3. State or Federal Funding

If the subject matter of the solicitation or project is receiving any state or federal funds which requires a protest procedure different than the procedures stated above, then that protest procedure shall control.

In the event there is any lawsuit filed against the City relating to any federally funded project, the City will provide prompt notice of that lawsuit to all agencies who participated in the funding of the project.

4. Mandatory Procedure

This administrative procedure and the time limits set forth herein are mandatory. Failure to comply with these mandatory procedures shall constitute a waiver of any right to pursue the bid protest, including filing a Government Code claim or any legal proceedings or actions.

**IV. BID DOCUMENTS**

**A. PROPOSAL**

**CIP NO. 682  
PARKING LOT “D” IMPROVEMENTS PROJECT**

CONTRACTOR: \_\_\_\_\_ Date: \_\_\_\_\_

TO: City of Hermosa Beach  
Honorable Mayor and Members of the City Council City Hall  
Hermosa Beach, California, 90254

Ladies and Gentlemen:

The undersigned declares that he/she has carefully examined the location of the proposed work and that he/she has examined the Plans and Specifications, has read the Contract Documents, and hereby agrees to furnish all labor, materials, equipment, tools, transportation, and services to do all work required for:

**CIP NO. 682  
PARKING LOT “D” IMPROVEMENTS PROJECT**

In accordance with the Plans and Specifications prepared by the Engineer, in accordance with the Special Provisions, the Contract Documents, and in accordance with the Standard Specifications for Public Works Construction 2021, Unified Building Code for Construction (current edition) (except Sections 1-9), and the requirements of the Engineer under said documents, for the prices shown herein.

**The Contractor also certifies that he/she is registered with the Department of Industrial Relations.**

**All work shall be completed within 90 working days from the date the Notice to Proceed is issued by the Engineer.**

\_\_\_\_\_  
Contractor Signature .....  
\_\_\_\_\_  
Contractor License Number

## B. BID SCHEDULE

### CIP NO. 682 PARKING LOT "D" IMPROVEMENTS PROJECT

Item No.	Est. Quantity		Description	Unit Price	Total
			<b>GENERAL ITEMS</b>		
1	1	LS	Mobilization & Demobilization (Not to Exceed 5% of Bid)	\$	\$
2	1	LS	Temporary Construction Fencing / Site Securing	\$	\$
3	1	LS	Site Maintenance/SWPPP/BMP's/Erosion Control	\$	\$
4	1	LS	Const. Survey and Re-Establishment of Centerline Ties and Monuments	\$	\$
5	1	LS	Traffic Control	\$	\$
			<b>SITE DEMOLITION</b>		
6	1	LS	General Clearing and Grubbing	\$	\$
7	43	LF	Remove and Dispose of Existing Concrete Curb & Gutter	\$	\$
8	127	LF	Remove and Dispose of Concrete Curb Only	\$	\$
9	139	SF	Remove and Dispose of Concrete Driveway Approach	\$	\$
10	740	SF	Remove and Dispose of Existing Concrete Sidewalk	\$	\$
11	31	SF	Remove and Dispose of Existing Concrete Curb Ramp	\$	\$
12	7000	SF	Remove and Dispose of Existing AC Pavement	\$	\$
13	1	LS	Remove and Dispose of Existing Combination Timber and Concrete Retaining Wall	\$	\$
14	1	LS	Remove and Dispose of Existing Timber Planter / Retaining Wall	\$	\$
15	3	EA	Remove and Dispose of Existing Light Standard	\$	\$
16	6	EA	Remove and Salvage Existing Restricted Parking and Smoke Free Zone Signs	\$	\$
17	5	EA	Remove and Salvage Existing "Do Not Enter", "One Way" & Street Name Signs	\$	\$
18	11	EA	Remove and Dispose of Existing Parking Meters and Foundation	\$	\$
19	17	EA	Remove and Dispose of Existing Wheel Stop	\$	\$
20	76	LF	Remove and Dispose of Existing Chain Link Fence, Fence Post, and Foundation	\$	\$
21	2	EA	Remove and Dispose of Existing Bollard	\$	\$
22	1	EA	Remove and Salvage Existing Grease Trap for Reuse	\$	\$
23	1	EA	Remove and Dispose of Existing Irrigation Detector Check	\$	\$
24	1	EA	Remove and Dispose Existing Electrical Pull Box	\$	\$
25	13	SF	Remove and Dispose of Existing Concrete Collar	\$	\$

Item No.	Est. Quantity		Description	Unit Price	Total
26	5	EA	Remove and Dispose of Existing Tree	\$	\$
27	2	EA	Remove Existing Handicap and No Parking Signs. Handicap Sign to be Salvaged and Relocated per Signage and Striping Plan	\$	\$
28	2	EA	Remove and Salvage Existing R-1 "Stop" Sign. See Signage and Striping Plan for New Location	\$	\$
29	2	EA	Remove and Salvage Existing 4-Yard Trash Container (50-1/2" x 72") for Reuse	\$	\$
30	2	LS	Remove and Dispose of Existing Cactus	\$	\$
			<b>SITE GRADING</b>		
31	9800	SF	Soils Preparation	\$	\$
32	390	CY	Site Grading, Cut-Volume	\$	\$
33	180	CY	Site Grading, Fill-Volume	\$	\$
34	220	CY	Earthwork Exports / Haul	\$	\$
			<b>HARDSCAPE IMPROVEMENTS</b>		
35	2535	SF	Construct 3" AC over 4" AB Per Soils Engineer's Recommendations	\$	\$
36	143	SF	Construct Full Depth AC Paving	\$	\$
37	45	SF	Construct New AC Paving. New Paving to Match Existing Adjacent Pavement Section	\$	\$
38	192	SF	Construct AC Pavement Join with Existing AC Pavement Cold Plane and Overlay Per Detail on Sht. 7	\$	\$
39	3461	SF	Construct Permeable Concrete Pavers in Parking Areas Per Detail on Sheet 7	\$	\$
40	66	LF	Construct Concrete Drainage Swale, Type F Per City of Hermosa Beach Standard Plan No. 101. Modify Swale Width From 2'-0" To 2'-4"	\$	\$
41	1475	SF	Construct 4" Concrete Sidewalk Per City of Hermosa Beach Standard Plan No. 106	\$	\$
42	220	SF	Construct Concrete Residential Driveway Approach Per City of Hermosa Beach Standard Plan No. 102	\$	\$
43	323	SF	Construct 6" Thick Concrete Pavement Per Soils Engineer's Recommendations. Construct Weakened Plane Joints for Pavement Per Detail on Sheet 8	\$	\$
44	23	LF	Construct 8" Concrete Curb Only, Type A Per City of Hermosa Beach Standard Plan No. 100	\$	\$
45	200	LF	Construct 6" Concrete Curb Only, Type B Per City of Hermosa Beach Standard Plan No. 100	\$	\$
46	83	LF	Construct 4" Concrete Curb Only Per Detail on Sheet 8	\$	\$
47	102	LF	Construct Variable Height Concrete Curb & Gutter Per Detail on Sheet 8	\$	\$

Item No.	Est. Quantity		Description	Unit Price	Total
48	3	EA	Install 36" Square Tree well Neenah Foundary R-8704- A with 16" Diameter Opening and Type "P" Frame	\$	\$
49	150	LF	Construct Concrete Band Per Detail on Sheet 8	\$	\$
50	63	LF	Construct Heavy Duty Concrete Curb Per Detail on Sheet 7	\$	\$
51	30	LF	Construct Modified Concrete Curb & Gutter, Type A Per City of Hermosa Beach Standard Plan No. 101 and Detail on Sheet 8	\$	\$
52	10	LF	Construct Concrete Curb & Gutter with Slot Drain Per Detail on Sheet 7	\$	\$
53	65	LF	Construct Concrete Drainage Swale, Type E Per City of Hermosa Beach Standard Plan No. 101	\$	\$
54	22	LF	Construct Extended Depth Sidewalk Edge Per Detail on Sheet 8	\$	\$
55	2	EA	Install Detectable Warning Surface Per Detail on Sht. 8	\$	\$
56	22	EA	Install Precast Concrete Wheel Stop Per Detail on Sht. 8	\$	\$
57	47	LF	Construct Extended Depth Sidewalk Edge Adjacent to Permeable Pavers Per Detail on Sheet 8	\$	\$
58	1	LS	Adjust Existing Water Meter Box and Valve Box to Proposed Grade	\$	\$
59	1	LS	Construct Bio-Swale Per Detail on Sheet 7	\$	\$
60	327	SF	Construct Non-Permeable Concrete Pavers in Pedestrian Areas Per Detail on Sheet 8	\$	\$
61	77	SF	Construct 4" Thick Concrete Paving with River Rock Per Detail on Sheet 8	\$	\$
62	17	LF	Construct Variable Height Concrete Curb and Gutter, Modified Type A Per City of Hermosa Beach Standard Plan No. 101. Curb Height Per Plan	\$	\$
			<b>RET. / SCREEN WALLS AND TRASH ENCLOSURE</b>		
63	125	SF	Construct Retaining Block Wall "A" Per Detail 1 on Sheet 9	\$	\$
64	418	SF	Construct Retaining Block Wall "B" Per Detail 2 on Sheet 9	\$	\$
65	158	SF	Construct Retaining Block Wall "C" Per Detail 3 on Sheet 9	\$	\$
66	552	SF	Construct Retaining and Screen Wall "D" Per Detail 4 on Sheet 10	\$	\$
67	64	SF	Construct Screen Wall "E.1" Per Detail 5 on Sheet 10	\$	\$
68	46	SF	Construct Retaining Wall "F1" Per Detail 6 on Sheet 10	\$	\$
69	57	SF	Construct Retaining and Screen Wall "F2.1" Per Detail 7 on Sheet 10	\$	\$
70	78	SF	Construct Retaining Wall "F3" Per Detail 8 on Sheet 11	\$	\$

Item No.	Est. Quantity		Description	Unit Price	Total
71	2	EA	Install Gate Pole for Trash Enclosure Gate. Pole To Be Attached to Wall Per Detail 9 on Sheet 11. See Trash Enclosure Details on Sheet 5 For Pole Location	\$	\$
72	1	EA	Install Gate Pole for Trash Enclosure Gate. Pole To Be Freestanding Per Detail 10 on Sheet 11. See Trash Enclosure Details on Sheet 5 For Pole Location	\$	\$
73	1	LS	Construct Trash Enclosure Gates and Roofing Per Details on Sheet 5	\$	\$
<b>SIGNING AND STRIPING</b>					
74	1	LS	Parking Lot Striping and Markings	\$	\$
75	5	EA	Install Salvaged R5-1, R6-1R, R6-1L, and Street Name Signs	\$	\$
76	3	EA	Install R1-1 Stop Sign	\$	\$
77	1	EA	Install R6-1L One Way Sign. Mount Sign 36" Above Top of New Curb	\$	\$
78	1	EA	Install Salvaged Handicap Parking Sign	\$	\$
79	1	EA	Install Handicap Van Accessible Sign Below Salvaged Handicap Parking Sign	\$	\$
80	2	EA	Install Electric Vehicle Parking Sign	\$	\$
81	6	EA	Install Salvaged Restricted Parking Sign	\$	\$
82	6	EA	Install Salvaged Smoke Free Zone Sign Below Salvaged No Parking Sign	\$	\$
83	2	EA	Install Neighborhood Electric Vehicle (NEV) Parking Sign	\$	\$
84	1	LS	Paint Curb Red	\$	\$
85	3	EA	Catch Basin Stenciling on Curb Per City of Hermosa Beach Standards	\$	\$
<b>STORM DRAIN FACILITIES</b>					
86	239	LF	Install 4" PVC (SCH 40) Subdrain Pipe for Retaining Walls Per Soils Engineer's Recommendations	\$	\$
87	11	LF	Construct Concrete Trench Drain Per Detail on Sheet 8	\$	\$
88	195	LF	Install 4" PVC (SCH 40) Area Drain Pipe	\$	\$
89	68	LF	Install 6" PVC (SCH 40) Area Drain Pipe	\$	\$
90	48	LF	Install 8" PVC (SCH 40) Area Drain Pipe	\$	\$
91	1	EA	Install 6"x4" PVC Reducer	\$	\$
92	3	EA	Install Area Drain Cleanout	\$	\$
93	36	LF	Install 4" Perforated PVC (SCH 40) Subdrain Pipe Per Detail on Sheet 8	\$	\$
94	30	LF	Install NDS 500 Mini Channel Drain Per Detail on Sht. 3	\$	\$
95	1	EA	Install 18" Square Brooks Box 1818 Catch Basin with Galvanized Steel Traffic Grate Per Detail on Sheet 7	\$	\$

Item No.	Est. Quantity		Description	Unit Price	Total
96	1	EA	Install 24" Square Brooks Box Catch Basin 2424 With Galvanized Steel Traffic Grate Per Detail on Sheet 3	\$	\$
97	1	LS	Install Infiltration Trench System Per Detail on Sheet 7	\$	\$
98	10	LF	Install Slot Drain Per Detail on Sheet 7	\$	\$
99	16	LF	Install 4" PVC (SCH 80) Area Drain Pipe	\$	\$
100	22	LF	Install 6" PVC (SCH 80) Area Drain Pipe	\$	\$
101	16	LF	Install 8" PVC (SCH 80) Area Drain Pipe	\$	\$
102	14	LF	Construct Slurry Backfill Under Trash Enclosure Slab Per Detail on Sheet 3	\$	\$
103	1	EA	Install FloGard Model FF-18D Grated Inlet Catch Basin Filter Frame with Filter Per Details on Sheet 12	\$	\$
104	1	EA	Install FloGard Model FF-24D Grated Inlet Catch Basin Filter Frame with Filter Per Details on Sheet 12	\$	\$
105	1	EA	Install Flogard Model FG-TDOF12-5 Trench Drain Insert Filter Per Details on Sheet 12	\$	\$
106	1	EA	Install Flogard Model SK-0955-12 Outlet Trash Screen Per Details on Sheet 12	\$	\$
			<b>SITE AMENITIES</b>		
107	220	LF	Install Guardrail per Detail on Sheet 13. Guardrail to be Core Mounted in Wall	\$	\$
108	78	LF	Install Handrail per Detail on Sheet 13. Handrail Height to be 36" From Finish Surface to Top of Rail	\$	\$
109	270	SF	Weed Control Fabric	\$	\$
110	15	EA	Boulder (Installation Included)	\$	\$
111	2	TN	Grouted River Rock (Installation Included)	\$	\$
112	3	EA	Wall Water Scupper	\$	\$
113	2	EA	Electric Vehicle Charging Station	\$	\$
114	2	EA	Multi-Space Meter / Pay-Stations	\$	\$
115	8	kW	Solar Photovoltaic System	\$	\$
116	1	EA	Solar Battery System	\$	\$
			<b>SITE FURNITURE</b>		
117	6	EA	Bicycle Rack	\$	\$
118	1	EA	Concrete Pebble Seat - Large	\$	\$
119	1	EA	Concrete Pebble Seat	\$	\$
120	1	EA	Waste Receptacle	\$	\$
121	1	LS	Skate stopper	\$	\$

Item No.	Est. Quantity	Description	Unit Price	Total
		<b>IRRIGATION</b>		
122	645	Automatic Irrigation System	\$	\$
123	1	Automatic Irrigation Controller	\$	\$
124	6	Tree Bubblers	\$	\$
125	7	Vine Bubbler	\$	\$
126	3	Scupper Bubbler	\$	\$
		<b>PLANTING</b>		
127	645	Soil Preparation and Weed Abatement	\$	\$
128	645	3" Thick Layer of Mulch	\$	\$
129	3	36" Box Street Tree	\$	\$
130	3	24" Box Parking Lot Tree	\$	\$
131	7	5 Gallon Vine	\$	\$
132	58	5 Gallon Shrub	\$	\$
133	77	1 Gallon Shrub	\$	\$
134	4	Flats	\$	\$
135	1	90-Day Post Installation Establishment (645 SF)	\$	\$
		<b>ELECTRICAL AND LIGHTING</b>		
136	3	Type F1 Light Fixture (area cobra head)	\$	\$
137	16	Type F2 Light Fixture (recessed wall)	\$	\$
138	1	Pedestal Panelboard	\$	\$
139	10	Concrete Pull Boxes	\$	\$
140	700	Schedule 80 PVC conduit	\$	\$
141	21	12 AWG conductors	\$	\$

142	2	10 AWG conductors	\$	\$
143	4	8 AWG conductors	\$	\$

(Total Bid in Figures) \_\_\_\_\_  
 \_\_\_\_\_

(Total Bid in Words) \_\_\_\_\_  
 \_\_\_\_\_

Contractor Name: \_\_\_\_\_  
 \_\_\_\_\_

+++++unit price and the total amount for any item are not in agreement, the unit price alone shall be considered to represent the Bidder's intention and all totals will be corrected to conform thereto. Attached hereto is cash, a certified check, a cashier's check, or a Bidder's bond in the amount of

\_\_\_\_\_ Dollars, said amount being not less than ten (10) percent of the amount bid. It is agreed a portion equal to the difference between the low bid and second low bid shall be retained as liquidated damages by the City if the undersigned fails or refuses to execute the Contract and furnish the required bonds and certificates of insurance within the time provided.

Contractor Signature: \_\_\_\_\_

PW Registration #: \_\_\_\_\_

State License #: \_\_\_\_\_

Contractor Company Name: \_\_\_\_\_

**C. BID BOND**

KNOW ALL MEN BY THESE PRESENTS:

WHEREAS, \_\_\_\_\_, (hereinafter referred to as "Contractor") intends to submit a bid to the City of Hermosa Beach, California, a Municipal Corporation, for the performance of certain work as required in the City of Hermosa Beach **CIP NO. 682 PARKING LOT "D" IMPROVEMENTS PROJECT** said work being: **CIP NO. 682 PARKING LOT "D" IMPROVEMENTS PROJECT** as shown in this specification, and in compliance with the specifications therefore under an invitation of said City contained in a notice or advertisement for bids or proposals.

NOW, THEREFORE, we, the Contractor, as Principal, and \_\_\_\_\_ a corporation organized and existing under the laws of the State of \_\_\_\_\_, duly authorized to transact business under the laws of the State of California as Surety, are held and firmly bound unto the City of Hermosa Beach, as Oblige, in the sum of \_\_\_\_\_ Dollars (\$ \_\_\_\_\_) lawful money of the United States of America, said sum being not less than ten percent (10%) of the bid amount for the payment of which sum well and truly to be made, the said Principal, and said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH THAT: If the bid of the said Principal is rejected by the said Oblige; or if the said Oblige shall accept the bid of the said Principal and said Principal shall enter into an Agreement with said Oblige in accordance with the terms of the bid, and shall give such bond or bonds as may be specified in the bidding or Contract Documents with good and sufficient surety for the faithful performance of such Agreement and for the prompt payment of labor and material furnished in the prosecution thereof; or in the event of the failure of said Principal to enter such Agreement and give such bond or bonds, if said Principal shall pay to said Oblige the difference not to exceed the penalty thereof between the amount specified in said bid and such larger amount for which said Oblige may in good faith Contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect. In case suit is brought upon this bond, the court shall fix and award and the surety shall pay, in addition to the face amount hereof, costs and reasonable attorney's fees incurred by the City of Hermosa Beach in successfully enforcing said obligation.

IN WITNESS THEREOF, we have hereunto, set our hands and seals this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
Principal  
By \_\_\_\_\_  
Title \_\_\_\_\_

---

Surety

By \_\_\_\_\_

---

Title

# Notary Acknowledgment

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

STATE OF CALIFORNIA  
 COUNTY OF \_\_\_\_\_

On \_\_\_\_\_, 20\_\_\_\_, before me, \_\_\_\_\_, Notary Public, personally appeared \_\_\_\_\_, who proved to me on the basis of satisfactory

evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature of Notary Public \_\_\_\_\_

### OPTIONAL

*Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.*

#### CAPACITY CLAIMED BY SIGNER

#### DESCRIPTION OF ATTACHED DOCUMENT

- .. Individual
- .. Corporate Officer

\_\_\_\_\_ Title(s)

\_\_\_\_\_ Title or Type of Document

- .. Partner(s)                      .. Limited
- .. General

\_\_\_\_\_ Number of Pages

- .. Attorney-In-Fact
- .. Trustee(s)
- .. Guardian/Conservator
- .. Other:

\_\_\_\_\_ Date of Document

Signer is representing:  
 Name Of Person(s) Or Entity(ies)

\_\_\_\_\_  
 \_\_\_\_\_

\_\_\_\_\_ Signer(s) Other Than Named Above

**D. BIDDER'S ASSURANCE**

**CIP NO. 682  
PARKING LOT "D" IMPROVEMENTS PROJECT**

FROM:

Name of Bidder: \_\_\_\_\_

Business Address: \_\_\_\_\_

\_\_\_\_\_

Telephone No: \_\_\_\_\_

TO:

Members of the City Council  
c/o City Hall  
City of Hermosa Beach, California

Members of the City Council:

Pursuant to your published Notice Inviting Bids for: **CIP NO. 682 PARKING LOT "D" IMPROVEMENTS PROJECT**

The undersigned declares that he/she has carefully examined the location of the proposed work; that he/she has carefully examined the Plans and Specifications, and read the accompanying Instructions to Bidders and hereby proposes to furnish all materials, machinery, tools, labor, and services and do all the work necessary to complete the project in accordance with said Plans and Specifications and other Contract Documents at the item prices on the Bid Schedule.

BY: \_\_\_\_\_

TITLE: \_\_\_\_\_

## **E. BIDDER'S DECLARATION**

**CIP NO. 682**

### **PARKING LOT "D" IMPROVEMENTS PROJECT**

It is understood and agreed that:

1. The undersigned has carefully examined all documents which will form a part of the Contract; namely, the Notice Inviting Bids, the Instructions to Bidders, this Proposal, the Bid Bond, the Contract, the Faithful Performance Bond, Warranty Bond, the Payment Bond, the federal requirements, if any, the Plans and Specifications, the Special Provisions, and the Technical Provisions.

2. The undersigned has, by investigation at the site of the work and otherwise, satisfied himself as to the nature and location of the work and fully informed himself as to all conditions and matters, which can in any way affect the work or the cost thereof.

3. The undersigned fully understands the scope of work and has checked carefully all words and figures inserted in this Proposal and he further understands that the City will not be responsible for any errors or omissions in the preparation of the Proposal.

4. The undersigned agrees and acknowledges that he is aware of the provisions of Section 3700 of the Labor Code which requires every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that Code, and that the undersigned will comply with such provisions before commencing the performance of the Contract if it is awarded to the undersigned.

The undersigned will execute the Contract and furnish the required statutory bonds and certificates of insurance within the period of time specified in the Contract Documents.

The undersigned will begin work after award of Contract and a Notice to Proceed has been given as herein specified and will complete said work within the time specified in the Bid Documents .

5. The undersigned certifies that this Proposal is genuine and not sham or collusive, or made in the interest or on behalf of a person not herein named, and the undersigned has not directly or indirectly induced or solicited any other Bidder to put in a sham bid nor induced any other person, firm, or corporation to refrain from bidding.

6. The undersigned will accept an award and enter into a Contract for all work scheduled herein on which he puts in a bid. The awards for such work are to be entirely at the discretion of the Owner after evaluation of the bids as submitted. The undersigned agrees that the Owner shall recover or retain as liquidated damages an amount equal to the difference between the low bid and amount of the bid of the Bidder with whom the City enters into a Contract, and the surplus, if any, shall be returned to the lowest Bidder in accordance with the provisions of the Public Contract Code section 20174 in the event of his failure to execute a Contract and furnish required bonds and insurance therefor within the time provided.

7. This bid will not be withdrawn within a period of ninety (90) days after the date of its



**F. CERTIFICATE OF NON-DISCRIMINATION BY CONTRACTORS**

**CIP NO. 682  
PARKING LOT “D” IMPROVEMENTS PROJECT**

As suppliers of goods or services to the City, the firm listed below certifies that it does not discriminate in its employment with regard to race, color, religion, sex, or national origin; that it is in compliance with all applicable federal, state, and local directives, and executive orders regarding non-discrimination in employment; and that it agrees to pursue positively and aggressively the principle of equal opportunity in employment.

We agree specifically:

1. To establish or observe employment policies which affirmatively promote opportunities for minority persons at all job levels.
2. To communicate this policy to all persons concerned, including all company employees, outside recruiting services, especially those serving minority communities, and to the minority communities at large.
3. To take affirmative steps to hire minority employees within the company.

FIRM \_\_\_\_\_

TITLE OF PERSON SIGNING \_\_\_\_\_

SIGNATURE \_\_\_\_\_

DATE \_\_\_\_\_

Please include any additional information available regarding equal opportunity employment programs now in effect within your company:

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**G. CERTIFICATION OF PRINCIPAL**  
**CIP NO. 682**  
**PARKING LOT “D” IMPROVEMENTS PROJECT**

I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for Workers' Compensation or to undertake self-insurance in accordance with the provisions of that Code, and I will comply with such provisions before commencing the performance of the work of this Contract. (Section 1861, Labor Code.)

Signature: \_\_\_\_\_

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Name of Company: \_\_\_\_\_

**H. DECLARATION OF ELIGIBILITY TO CONTRACT**  
**[Labor Code Section 1777.1; Public Contract Code Section 6109]**

**CIP NO. 682**  
**PARKING LOT “D” IMPROVEMENTS PROJECT**

The undersigned, a duly authorized representative of the Contractor, certifies and declares that:

1. The undersigned Contractor is aware of Section 1771.1 and 1777.7 of the California Labor Code, which prohibit a Contractor or subcontractor who has been found by the Labor Commissioner or the Director of Industrial Relations to be in violation of certain provisions of the Labor Code, from bidding on, being awarded, or performing work as a subcontractor on a public works project for specified periods of time.

2. The undersigned Contractor is not ineligible to bid on, be awarded or perform work as a subcontractor on a public works project by virtue of the foregoing provisions of Sections 1771.1 or 1777.7 of the California Labor Code or any other provision of law.

3. The undersigned Contractor is aware of California Public Contract Code Section 6109, which states:

“(a) A public entity, as defined in Section 1100 [of the Public Contract Code], may not permit a Contractor or subcontractor who is ineligible to bid or work on, or be awarded, a public works project pursuant to Section 1777.1 or 1777.7 of the Labor Code to bid on, be awarded, or perform work as a subcontractor on, a public works project. Every public works project shall contain a provision prohibiting a Contractor from performing work on a public works project with a subcontractor who is ineligible to perform work on the public works project pursuant to Section 1771.1 or 1777.7 of the Labor Code.”

“(b) Any Contract on a public works project entered into between a Contractor and a debarred subcontractor is void as a matter of law. A debarred subcontractor may not receive any public money for performing work as a subcontractor on a public works Contract, and any public money that may have been paid to a debarred subcontractor by a Contractor on the project shall be returned to the awarding body. The Contractor shall be responsible for the payment of wages to workers of a debarred subcontractor who has been allowed to work on the project.”

4. The undersigned Contractor has investigated the eligibility of each and every subcontractor the undersigned Contractor intends to use on this public works project, and determined that none of them is ineligible to perform work as a subcontractor on a public works project by virtue of the foregoing provisions of the Public Contract Code, Sections 1771.1 or 1777.7 of the Labor Code, or any other provision of law.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct. Executed this \_\_\_\_\_ day of \_\_\_\_\_, at \_\_\_\_\_ (place of execution), California.

Signature: \_\_\_\_\_

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Name of Company: \_\_\_\_\_

**I. NON-COLLUSION DECLARATION**

**CIP NO. 682  
PARKING LOT “D” IMPROVEMENTS PROJECT**

The undersigned declares:

I am the \_\_\_\_\_ of \_\_\_\_\_, the party making the foregoing Bid.

The Bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation. The Bid is genuine and not collusive or sham. The Bidder has not directly or indirectly induced or solicited any other Bidder to put in a false or sham bid. The Bidder has not directly or indirectly colluded, conspired, connived, or agreed with any Bidder or anyone else to put in a sham bid, or to refrain from bidding. The Bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the Bid Price of the Bidder or any other Bidder, or to fix any overhead, profit, or cost element of the Bid Price, or of that of any other Bidder. All statements contained in the Bid are true. The Bidder has not, directly or indirectly, submitted his or her Bid Price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid, and has not paid, and will not pay, any person or entity for such purpose.

Any person executing this declaration on behalf of a Bidder that is a corporation, partnership, joint venture, limited liability company, limited liability partnership, or any other entity, hereby represents that he or she has full power to execute, and does execute, this declaration on behalf of the Bidder.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct and that this declaration is executed on \_\_\_\_\_ [date], at \_\_\_\_\_ [city], \_\_\_\_\_ [state].

\_\_\_\_\_  
NAME OF BIDDER

\_\_\_\_\_  
SIGNATURE OF BIDDER

\_\_\_\_\_  
ADDRESS OF BIDDER

\_\_\_\_\_  
CITY                      STATE                      ZIP

**J. REFERENCES OF WORK**

**CIP NO. 682  
PARKING LOT "D" IMPROVEMENTS PROJECT**

Date: \_\_\_\_\_

The following are the names, addresses and phone numbers/ email addresses for at least three public agencies for which Bidder has performed similar work **within the past five years.**

All contact information must be current.

\_\_\_\_\_  
Name and Address of Public Agency

\_\_\_\_\_  
Name and Telephone Number of Project Manager

\_\_\_\_\_  
Name and Description of Project

\_\_\_\_\_  
Contract Amount

\_\_\_\_\_  
Date Completed

\_\_\_\_\_  
Name and Address of Public Agency

\_\_\_\_\_  
Name and Telephone Number of Project Manager

\_\_\_\_\_  
Name and Description of Project

\_\_\_\_\_  
Contract Amount

\_\_\_\_\_  
Date Completed

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Name and Address of Public Agency

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Name and Telephone Number of Project Manager

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Name and Description of Project

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Contract Amount

Date Completed

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Name and Address of Public Agency

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Name and Telephone Number of Project Manager

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Name and Description of Project

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Contract Amount

Date Completed

For additional References, please add separate sheets.

**K. SUBCONTRACTORS LIST**

**CIP NO. 682**

**PARKING LOT “D” IMPROVEMENTS PROJECT**

In compliance with the "Subletting and Subcontracting Fair Practices Act" being Sections 4100-4113 of the Government Code of the State of California, and any amendments thereto, each Bidder shall set forth below: (a) the name and location of the place of business, (b) the California Contractor license number, (c) the DIR public works Contractor registration number unless exempt pursuant to Labor Code Sections 1725.5 and 1771.1, and (d) the portion of the work which will be done by each subcontractor who will perform work or labor or render service to the prime Contractor in or about the construction of the work or improvement in an amount in excess of one-half (1/2) of one percent (1%) of the prime Contractor's total bid, and shall further set forth the portion of the work which will be done by each subcontractor. Only one subcontractor for each such portion shall be listed.

Notwithstanding the foregoing, if the work involves the construction of streets and highways, then the Bidder shall list each subcontractor who will perform work or labor or render service to the Bidder in or about the work in an amount in excess of one-half of one percent (0.5%) of the Bidder’s Total Bid Price or \$10,000, whichever is greater. No additional time shall be granted to provide the below requested information.

If the Contractor fails to specify a subcontractor for any portion of the work to be performed under the Contract, he shall be deemed to have agreed to perform such portion himself, and he shall not be permitted to subcontract that portion of the work except under the conditions hereinafter set forth.

Subletting or subcontracting of any portion of the work to which subcontractor was designated in the original bid shall only be permitted in cases of public emergency or necessity, and then only after a finding reduced to writing as a public record of the legislative body of the Owner.

**We propose to use the following listed subcontractors as per Public Contract Code Section 4100 et seq.: List all Subcontractors. The subcontractor shall be licensed for the type of work they are performing.**

<b>Sub-Contractors Name:</b>	<b>Address:</b>
<b>Description of Work:</b>	
<b>CSLB Contractor License No.</b>	<b>DIR Registration No.</b>
<b>Phone No.</b>	<b>Dollar Amount of Work &amp; % of Work</b>

<b>Sub-Contractors Name:</b>	<b>Address:</b>
<b>Description of Work:</b>	
<b>CSLB Contractor License No.</b>	<b>DIR Registration No.</b>
<b>Phone No.</b>	<b>Dollar Amount of Work &amp; % of Work</b>

<b>Sub-Contractors Name:</b>	<b>Address:</b>
<b>Description of Work:</b>	
<b>CSLB Contractor License No.</b>	<b>DIR Registration No.</b>
<b>Phone No.</b>	<b>Dollar Amount of Work &amp; % of Work</b>

<b>Sub-Contractors Name:</b>	<b>Address:</b>
<b>Description of Work:</b>	
<b>CSLB Contractor License No.</b>	<b>DIR Registration No.</b>
<b>Phone No.</b>	<b>Dollar Amount of Work &amp; % of Work</b>

<b>Sub-Contractors Name:</b>	<b>Address:</b>
<b>Description of Work:</b>	
<b>CSLB Contractor License No.</b>	<b>DIR Registration No.</b>
<b>Phone No.</b>	<b>Dollar Amount of Work &amp; % of Work</b>

Percent of work to be performed by sub-Contractors: \_\_\_\_\_%  
(Note: 50% of work is required to be performed by general Contractor)  
For additional Sub-Contractors, please add additional sheet(s)

**L. IRAN CONTRACTING ACT CERTIFICATION**  
**(Public Contract Code Section 2200 et seq.)**

As required by California Public Contract Code Section 2204, the Contractor certifies subject to penalty for perjury that the option checked below relating to the Contractor's status in regard to the Iran Contracting Act of 2010 (Public Contract Code Section 2200 *et seq.*) is true and correct:

The Contractor is not:

- (1) identified on the current list of person and entities engaged in investment activities in Iran prepared by the California Department of General Services in accordance with subdivision (b) of Public Contract Code Section 2203; or
- (2) a financial instruction that extends, for 45 days or more, credit in the amount of \$20,000,000 or more to any other person or entity identified on the current list of persons and entities engaging in investment activities in Iran prepared by the California Department of General Services in accordance with subdivision (b) of Public Contract Code Section 2203, if that person or entity uses or will use the credit to provide goods or services in the energy sector in Iran.

The City has exempted the Contractor from the requirements of the Iran Contracting Act of 2010 after making a public finding that, absent the exemption, the City will be unable to obtain the goods and/or services to be provided pursuant to the Contract.

The amount of the Contract payable to the Contractor for the Project does not exceed \$1,000,000.

Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Title: \_\_\_\_\_

Firm Name: \_\_\_\_\_

Date: \_\_\_\_\_

Note: In accordance with Public Contract Code Section 2205, false certification of this form shall be reported to the California Attorney General and may result in civil penalties equal to the greater of \$250,000 or twice the Contract amount, termination of the Contract and/or ineligibility to bid on Contracts for three years.

**M. PUBLIC WORKS CONTRACTOR REGISTRATION CERTIFICATION**

Pursuant to Labor Code sections 1725.5 and 1771.1, all Contractors and subcontractors that wish to bid on, be listed in a bid proposal, or enter into a Contract to perform public work must be registered with the Department of Industrial Relations. See <http://www.dir.ca.gov/Public-Works/PublicWorks.html> for additional information.

No bid will be accepted nor any Contract entered into without proof of the Contractor’s and subcontractors’ current registration with the Department of Industrial Relations to perform public work.

Bidder hereby certifies that it is aware of the registration requirements set forth in Labor Code sections 1725.5 and 1771.1 and is currently registered as a Contractor with the Department of Industrial Relations.<sup>1</sup>

Name of Bidder: \_\_\_\_\_

DIR Registration Number: \_\_\_\_\_

DIR Registration Expiration: \_\_\_\_\_

Small Project Exemption: \_\_\_\_\_ Yes or \_\_\_\_\_ No

Unless Bidder is exempt pursuant to the small project exemption, Bidder further acknowledges:

1. Bidder shall maintain current DIR registration for the duration of the project.
2. Bidder shall maintain a current DIR registration for the duration of the project.
3. Bidder shall include the requirements of Labor Code sections 1725.5 and 1771.1 in its Contract with subcontractors and ensure that all subcontractors are registered at the time of bid opening and maintain registration status for the duration of the project.
4. Failure to submit this form or comply with any of the above requirements may result in a finding that the bid is non-responsive.

Name of Bidder \_\_\_\_\_

Signature \_\_\_\_\_

Name and Title \_\_\_\_\_

Dated \_\_\_\_\_

<sup>1</sup> If the Project is exempt from the Contractor registration requirements pursuant to the small project exemption under Labor Code Sections 1725.5 and 1771.1, please mark “Yes” in response to “Small Project Exemption.”

**V. CONTRACT DOCUMENTS**

**CIP NO. 682**

**PARKING LOT “D” IMPROVEMENTS PROJECT**

## A. CONTRACT AGREEMENT

This Construction Agreement (“Agreement”) is made and entered into as of the date executed by the Mayor and attested to by the City Clerk, by and between [INSERT CONTRACTOR NAME] (hereinafter referred to as "CONTRACTOR") and the City of Hermosa Beach, California, a municipal corporation (hereinafter referred to as "CITY").

### R E C I T A L S

- A. Pursuant to the Notice Inviting Sealed Bids for CIP NO. [INSERT NUMBER] [INSERT PROJECT NAME] (“Project”), bids were received, publicly opened, and declared on the date specified in the notice; and
- B. On [INSERT DATE], City’s City Council declared CONTRACTOR to be the lowest responsible Bidder and accepted the bid of CONTRACTOR; and
- C. The City Council has authorized the Mayor to execute a written Contract with CONTRACTOR for furnishing labor, equipment, and material for the CIP No. [INSERT NUMBER], [INSERT PROJECT NAME] in the City of Hermosa Beach.

NOW, THEREFORE, in consideration of the foregoing and the mutual covenants herein contained, it is agreed:

- 1. GENERAL SCOPE OF WORK: CITY agrees to engage CONTRACTOR and CONTRACTOR agrees to furnish all necessary labor, tools, materials, appliances, and equipment for and do the work for the CIP NO. [INSERT NUMBER] [INSERT PROJECT NAME] in the City of Hermosa Beach. The work shall be performed in accordance with the Plans and Specifications dated [INSERT DATE], (the “Specifications”) on file in the office of the City Clerk and in accordance with bid prices set forth in CONTRACTOR’S Bid Proposal and in accordance with the instructions of the City Engineer.
- 2. INCORPORATED DOCUMENTS TO BE CONSIDERED COMPLEMENTARY: The Contract documents for the aforesaid project shall consist of the Notice Inviting Bids, Instructions to Bidders, Bid Proposal, Builders General Provisions, Standard Specifications for Public Works Construction 2024 edition, Special Provisions, Exhibit A, [LIST ALL EXHIBITS HERE] , and all referenced specifications, details, standard drawings, and appendices; together with this Agreement and all required bonds, insurance certificates, permits, notices and affidavits; and also, including any and all addenda or supplemental agreements clarifying, amending, or extending the work contemplated as may be required to insure its completion in an acceptable manner. All of the provisions of said Contract documents are made a part hereof as though fully set forth herein. This Contract is intended to require a complete and finished piece of work and anything necessary

to complete the work properly and in accordance with the law and lawful governmental regulations shall be performed by CONTRACTOR whether set out specifically in the Contract or not. Should it be ascertained that any inconsistency exists between the aforesaid documents and this written agreement, the provisions of this Agreement, the Builders General Provisions and the Standard Specifications, in that order, shall control. Collectively, these Contract documents constitute the complete agreement between CITY and CONTRACTOR and supersede any previous agreements or understandings.

3. COMPENSATION: CONTRACTOR agrees to receive and accept the prices set forth in its Bid Proposal [INSERT VALUE] as full compensation for furnishing all materials, performing all work, and fulfilling all obligations hereunder. Said compensation shall cover all expenses, losses, damages, and consequences arising out of the nature of the work during its progress or prior to its acceptance including those for well and faithfully completing the work and the whole thereof in the manner and time specified in the aforesaid Contract documents; and also including those arising from actions of the elements, unforeseen difficulties or obstructions encountered in the prosecution of the work, suspension or discontinuance of the work, and all other unknowns or risks of any description connected with the work.
4. TIME OF PERFORMANCE: CONTRACTOR agrees to complete the work within [INSERT VALUE] working days from the date of the notice to proceed. By signing this Agreement, CONTRACTOR represents to CITY that the Contract time is reasonable for completion of the work and that CONTRACTOR will complete such work within the Contract time.
5. LIQUIDATED DAMAGES: In accordance with Government Code section 53069.85, it is agreed that CONTRACTOR will pay to CITY the sum set forth in the Special Provisions for each and every calendar day of delay beyond the time prescribed in the Contract Documents for finishing the Work, as Liquidated Damages and not as a penalty or forfeiture. In the event this is not paid, CONTRACTOR agrees CITY may deduct that amount from any money due or that may become due CONTRACTOR under the Contract. This Article does not exclude recovery of other damages specified in the Contract Documents.
6. SUBSTITUTION OF SECURITIES: Pursuant to section 22300 of the Public Contract Code of the State of California, CONTRACTOR may request CITY to make retention payments directly to an escrow agent or may substitute securities for any money withheld by CITY to ensure performance under the Contract. At the request and expense of CONTRACTOR, securities equivalent to the amount withheld shall be deposited with CITY or with a state or federally chartered bank as the escrow agent who shall return such securities to CONTRACTOR upon satisfactory completion of the Contract. Deposit of securities with an escrow agent shall be subject to a written agreement substantially in the form provided in section 22300 of the Public Contract Code.
7. PREVAILING WAGES AND CALIFORNIA LABOR LAWS.

Pursuant to Labor Code §§ 1720 *et seq.*, and as specified in 8 California Code of Regulations § 16000 (“Prevailing Wage Laws”), CONTRACTOR must pay its workers prevailing wages. It is CONTRACTOR’s responsibility to interpret and implement any prevailing wage requirements,

and CONTRACTOR agrees to pay any penalty or civil damages resulting from a violation of the prevailing wage laws. CONTRACTOR shall defend, indemnify and hold the CITY, its officials, officers, employees and agents free and harmless from any claim or liability arising out of any failure or alleged failure to comply with the Prevailing Wage Laws. CONTRACTOR and any subcontractor shall forfeit a penalty of up to \$200 per calendar day or portion thereof for each worker paid less than the prevailing wage rates.

In accordance with Labor Code § 1773.2, copies of the prevailing rate of per diem wages are available upon request from CITY's Engineering Division or the website for State of California Prevailing wage determination at <http://www.dir.ca.gov/DLSR/PWD>. CONTRACTOR must post a copy of the prevailing rate of per diem wages at the job site.

CITY directs CONTRACTOR's attention to Labor Code §§ 1777.5, 1777.6 and 3098 concerning the employment of apprentices by CONTRACTOR or any subcontractor.

Labor Code § 1777.5 requires CONTRACTOR or subcontractor employing tradesmen in any apprenticeship occupation to apply to the joint apprenticeship committee nearest the site of the public works project and which administers the apprenticeship program in that trade for a certificate of approval. The certificate must also fix the ratio of apprentices to journeymen that will be used in the performance of the Contract. The ratio of apprentices to journeymen in such cases will not be less than one to five except:

When CONTRACTOR provides evidence that CONTRACTOR employs registered apprentices on all of his Contracts on an annual average of not less than one apprentice to five journeymen.

When unemployment in the area of coverage by the joint apprenticeship committee has exceeded an average of 15 percent in the 90 days before the request for certificate, or

When the number of apprentices in training in the area exceeds a ratio of one to five, or

When the trade can show that it is replacing at least 1/30 of its membership through apprenticeship training on an annual basis state-wide or locally, or

Assignment of an apprentice to any work performed under a public works Contract would create a condition that would jeopardize his or her life or the life, safety, or property of fellow employees or the public at large, or the specific task to which the apprentice is to be assigned is of a nature that training cannot be provided by a journeyman.

CONTRACTOR is required to make contributions to funds established for the administration of apprenticeship programs if CONTRACTOR employs registered apprentices or journeymen in any apprenticeable trade on such Contracts and if other Contractors on the public works site are making such contributions.

CONTRACTOR and any subcontractor must comply with Labor Code §§ 1777.5 and 1777.6 in the employment of apprentices.

Information relative to apprenticeship standards, wage schedules and other requirements may be obtained from the Director of Industrial Relations, ex-officio the Administrator of Apprenticeship, San Francisco, California, or from the Division of Apprenticeship Standards and its branch offices.

The CONTRACTOR or any subcontractor that is determined by the Labor Commissioner to have knowingly violated Section 1777.5 shall forfeit as a civil penalty an amount not exceeding \$100 for each full calendar day of noncompliance, or such greater amount as provided by law.

CONTRACTOR and each subcontractor shall keep an accurate payroll record, showing the name, address, social security number, work classification, straight time and overtime hours worked each day and week, and the actual per diem wages paid to each journeyman, apprentice, worker, or other employee employed by him or her in connection with the public work. The payroll records shall be certified and shall be available for inspection at all reasonable hours at the principal office of CONTRACTOR in the manner provided in Labor Code section 1776. In the event of noncompliance with the requirements of this section, CONTRACTOR shall have 10 days in which to comply subsequent to receipt of written notice specifying in what respects such CONTRACTOR must comply with this section. Should noncompliance still be evident after such 10-day period, CONTRACTOR shall, as a penalty to CITY, forfeit not more than \$100.00 for each calendar day or portion thereof, for each worker, until strict compliance is effectuated. The amount of the forfeiture is to be determined by the Labor Commissioner. A Contractor who is found to have violated the provisions of law regarding wages on Public Works with the intent to defraud shall be ineligible to bid on Public Works Contracts for a period of one to three years as determined by the Labor Commissioner. Upon the request of the Division of Apprenticeship Standards or the Division of Labor Standards Enforcement, such penalties shall be withheld from progress payments then due. The responsibility for compliance with this section is on CONTRACTOR. The requirement to submit certified payroll records directly to the Labor Commissioner under Labor Code section 1771.4 shall not apply to work performed on a public works project that is exempt pursuant to the small project exemption specified in Labor Code Section 1771.4.

Any ineligible Contractor or subcontractor pursuant to Labor Code Sections 1777.1 and 1777.7 may not perform work on this Project.

By executing this Contract, CONTRACTOR verifies that it fully complies with all requirements and restrictions of state and federal law respecting the employment of undocumented aliens, including, but not limited to, the Immigration Reform and Control Act of 1986, as may be amended from time to time, and shall require all subcontractors and sub-subcontractors to comply with the same.

8. LEGAL HOURS OF WORK: Eight (8) hours of labor shall constitute a legal day's work for all workmen employed in the execution of this Contract, and CONTRACTOR and any subcontractor under it shall comply with and be governed by the laws of the State of California having to do with working hours set forth in Division 2, Part 7, Chapter 1, Article 3 of the Labor Code of the State of California as amended.

CONTRACTOR shall forfeit, as a penalty to City, twenty-five dollars (\$25.00) for each laborer, workman or mechanic employed in the execution of the Contract, by him or any subcontractor under it, upon any of the work hereinbefore mentioned, for each calendar day during which the laborer, worker or mechanic is required or permitted to labor more than eight (8) hours in any one calendar day or 40 hours in any one calendar week in violation of the Labor Code.

9. PUBLIC WORKS CONTRACTOR REGISTRATION: Pursuant to Labor Code sections 1725.5 and 1771.1, all Contractors and subcontractors that wish to bid on, be listed in a bid proposal, or enter into a Contract to perform public work must be registered with the Department of Industrial Relations (DIR). No bid will be accepted nor any Contract entered into without proof of the Contractor's and subcontractors' current registration with the DIR to perform public work. Notwithstanding the foregoing, the Contractor registration requirements mandated by Labor Code Sections 1725.5 and 1771.1 shall not apply to work performed on a public works project that is exempt pursuant to the small project exemption specified in Labor Code Sections 1725.5 and 1771.1.
10. LABOR COMPLIANCE AND STOP ORDERS: This Project is subject to compliance monitoring and enforcement by the DIR. It shall be CONTRACTOR's sole responsibility to evaluate and pay the cost of complying with all labor compliance requirements under this Contract and applicable law. Any stop orders issued by the DIR against CONTRACTOR or any subcontractor that affect CONTRACTOR's performance of Work, including any delay, shall be CONTRACTOR's sole responsibility. Any delay arising out of or resulting from such stop orders shall be considered CONTRACTOR caused delay subject to any applicable liquidated damages and shall not be compensable by the CITY. CONTRACTOR shall defend, indemnify and hold CITY, its officials, officers, employees and agents free and harmless from any claim or liability arising out of stop orders issued by the DIR against CONTRACTOR or any subcontractor.
11. DEBARMENT OF CONTRACTORS AND SUBCONTRACTORS: Contractors or subcontractors may not perform work on a public works project with a subcontractor who is ineligible to perform work on a public project pursuant to Labor Code section 1777.1 or 1777.7. Any Contract on a public works project entered into between a Contractor and a debarred subcontractor is void as a matter of law. A debarred subcontractor may not receive any public money for performing work as a subcontractor on a public works Contract. Any public money that is paid, or may have been paid to a debarred subcontractor by a Contractor on the Project shall be returned to the CITY. CONTRACTOR shall be responsible for the payment of wages to workers of a debarred subcontractor who has been allowed to work on the project.
12. LABOR/EMPLOYMENT SAFETY: CONTRACTOR shall comply with all applicable laws and regulations of the federal, state, and local government, including Cal/OSHA requirements and requirements for verification of employees' legal right to work in the United States

CONTRACTOR shall maintain emergency first aid treatment for its employees which complies with the Federal Occupational Safety and Health Act of 1970 (29 U.S.C. § 651 *et seq.*), and California Code of Regulations, Title 8, Industrial Relations Division 1, Department of Industrial Relations, Chapter 4. CONTRACTOR shall ensure the availability of emergency medical services for its employees in accordance with California Code of Regulations, Title 8, Section 1512.

CONTRACTOR shall submit the Illness and Injury Prevention Program and a Project site specific safety program to CITY prior to beginning Work at the Project site. CONTRACTOR shall maintain a confined space program that meets or exceeds the CITY Standards. CONTRACTOR shall adhere to CITY's lock out tag out program

13. TRAVEL AND SUBSISTENCE PAY: CONTRACTOR agrees to pay travel and subsistence pay to each worker needed to execute the work required by this Agreement as such travel and subsistence payments are defined in the applicable collective bargaining agreements filed in accordance with Labor Code Section 1773.8.
14. CONTRACTOR'S LIABILITY: The City of Hermosa Beach and its officers, agents and employees ("Indemnitees") shall not be answerable or accountable in any manner for any loss or damage that may happen to the work or any part thereof, or for any of the materials or other things used or employed in performing the work; or for injury or damage to any person or persons, either workers or employees of CONTRACTOR, of its subcontractors or the public, or for damage to adjoining or other property from any cause whatsoever arising out of or in connection with the performance of the work. CONTRACTOR shall be responsible for any damage or injury to any person or property resulting from defects or obstructions or from any cause whatsoever.

To the fullest extent permitted by law, CONTRACTOR will indemnify Indemnitees against and will hold and save Indemnitees harmless from any and all actions, claims, damages to persons or property, penalties, obligations or liabilities that may be asserted or claimed by any person, firm, entity, corporation, political subdivision, or other organization arising out of or in connection with the work, operation, or activities of CONTRACTOR, its agents, employees, subcontractors or invitees provided for herein, whether or not there is concurrent passive negligence on the part of City. In connection therewith:

a. CONTRACTOR will defend any action or actions filed in connection with any such claims, damages, penalties, obligations or liabilities and will pay all costs and expenses, including attorneys' fees, expert fees and costs incurred in connection therewith.

b. CONTRACTOR will promptly pay any judgment rendered against CONTRACTOR or Indemnitees covering such claims, damages, penalties, obligations and liabilities arising out of or in connection with such work, operations or activities of CONTRACTOR hereunder, and CONTRACTOR agrees to save and hold the Indemnitees harmless therefrom.

c. In the event Indemnitees are made a party to any action or proceeding filed or prosecuted against CONTRACTOR for damages or other claims arising out of or in connection with the work, operation or activities hereunder, CONTRACTOR agrees to pay to Indemnitees and any all costs and expenses incurred by Indemnitees in such action or proceeding together with reasonable attorneys' fees.

Contractor's obligations under this section apply regardless of whether or not such claim, charge, damage, demand, action, proceeding, loss, stop notice, cost, expense, judgment, civil fine

or penalty, or liability was caused in part or contributed to by an Indemnitee. However, without affecting the rights of City under any provision of this agreement, to the extent required by Civil Code section 2782, Contractor shall not be required to indemnify and hold harmless City for liability attributable to the active negligence of City, provided such active negligence is determined by agreement between the parties or by the findings of a court of competent jurisdiction. In instances where City is shown to have been actively negligent and where City active negligence accounts for only a percentage of the liability involved, the obligation of Contractor will be for that entire portion or percentage of liability not attributable to the active negligence of City.

So much of the money due to CONTRACTOR under and by virtue of the Contract as shall be considered necessary by City may be retained by City until disposition has been made of such actions or claims for damages as aforesaid.

It is expressly understood and agreed that the foregoing provisions are intended to be as broad and inclusive as is permitted by the law of the State of California. This indemnity provision shall survive the termination of the Agreement and is in addition to any other rights or remedies which Indemnitees may have under the law.

This indemnity is effective without reference to the existence or applicability of any insurance coverage which may have been required under this Agreement or any additional insured endorsements which may extend to Indemnitees.

CONTRACTOR, on behalf of itself and all parties claiming under or through it, hereby waives all rights of subrogation and contribution against the Indemnitees, while acting within the scope of their duties, from all claims, losses and liabilities arising out of or incident to activities or operations performed by or on behalf of the CONTRACTOR regardless of any prior, concurrent, or subsequent passive negligence by the Indemnitees.

15. THIRD PARTY CLAIMS. In accordance with Public Contract Code § 9201, CITY will promptly inform CONTRACTOR regarding third-party claims against CONTRACTOR, but in no event later than (14) calendar days after CITY receives such claims. Such notification will be in writing and forwarded in accordance with the "Notice" section of this Agreement. As more specifically detailed in the Contract documents, CONTRACTOR agrees to indemnify and defend the City against any third-party claim.
16. WORKERS COMPENSATION: In accordance with California Labor Code Sections 1860 and 3700, CONTRACTOR and each of its subcontractors will be required to secure the payment of compensation to its employees. In accordance with the provisions of California Labor Code Section 1861, CONTRACTOR, by signing this Contract, certifies as follows: "I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for worker's compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this Contract.
17. INSURANCE: CONTRACTOR shall procure and maintain for the duration of the Agreement, and for 1 year thereafter, insurance against claims for injuries to persons or damages to property

which may arise from or in connection with the performance of the work hereunder by the CONTRACTOR, its agents, representatives, employees, or subcontractors.

- a. Minimum Scope and Limit of Insurance. Coverage shall be at least as broad as:
  - i. Commercial General Liability (CGL): Insurance Services Office (ISO) Form CG 00 01 covering CGL on an “occurrence” basis, including products and completed operations, property damage, bodily injury and personal & advertising injury with limits no less than \$5,000,000 per occurrence. If a general aggregate limit applies, either the general aggregate limit shall apply separately to this project/location (ISO CG 25 03 or 25 04) or the general aggregate limit shall be twice the required occurrence limit.
  - ii. Automobile Liability: Insurance Services Office Form CA 0001 covering Code 1 (any auto), with limits no less than \$5,000,000 per accident for bodily injury and property damage.
  - iii. Workers’ Compensation insurance as required by the State of California, with Statutory Limits, and Employers’ Liability insurance with a limit of no less than \$1,000,000 per accident for bodily injury or disease.
  - iv. Builder’s Risk (Course of Construction) insurance utilizing an “All Risk” (Special Perils) coverage form, with limits equal to the completed value of the project and no coinsurance penalty provisions.
  - v. Professional Liability (if Design/Build), with limits no less than \$2,000,000 per occurrence or claim, and \$2,000,000 policy aggregate.
  - vi. Contractors’ Pollution Legal Liability and/or Asbestos Legal Liability and/or Errors and Omissions (if project involves environmental hazards) with limits no less than \$1,000,000 per occurrence or claim, and \$2,000,000 policy aggregate.
  - vii. If the Contractor maintains broader coverage and/or higher limits than the minimums shown above, the CITY requires and shall be entitled to the broader coverage and/or the higher limits maintained by CONTRACTOR. Any available insurance proceeds in excess of the specified minimum limits of insurance and coverage shall be available to the CITY.
- b. Self-Insured Retentions. Self-insured retentions must be declared to and approved by the CITY. At the option of the CITY, either: the CONTRACTOR shall obtain coverage to reduce or eliminate such self-insured retentions as respects the CITY, its officers, officials, employees, and volunteers; or the CONTRACTOR shall provide a financial guarantee satisfactory to the CITY guaranteeing payment of losses and related investigations, claim administration, and defense expenses. The policy language shall provide, or be endorsed to provide, that the self-insured retention may be satisfied by either the named insured or CITY.
- c. Other Insurance Provisions. The insurance policies are to contain, or be endorsed to contain, the following provisions:
  - i. The CITY, its officers, officials, employees, and volunteers are to be covered as additional insureds on the CGL policy with respect to liability arising out of work or operations performed by or on behalf of the CONTRACTOR including materials, parts, or equipment furnished in connection

with such work or operations and automobiles owned, leased, hired, or borrowed by or on behalf of the CONTRACTOR. General liability coverage can be provided in the form of an endorsement to the CONTRACTOR's insurance (at least as broad as ISO Form CG 20 10, CG 11 85 or both CG 20 10, CG 20 26, CG 20 33, or CG 20 38; and CG 20 37 forms if later revisions used).

- ii. For any claims related to this project, the CONTRACTOR's insurance coverage shall be primary insurance coverage at least as broad as ISO CG 20 01 04 13 as respects the CITY, its officers, officials, employees, and volunteers. Any insurance or self-insurance maintained by the CITY, its officers, officials, employees, or volunteers shall be excess of the CONTRACTOR's insurance and shall not contribute with it.
- iii. Each insurance policy required by this clause shall provide that coverage shall not be canceled, except with notice to the CITY.
- d. Builder's Risk (Course of Construction) Insurance.
  - i. CONTRACTOR may submit evidence of Builder's Risk insurance in the form of Course of Construction coverage. Such coverage shall name the CITY as a loss payee as their interest may appear.
  - ii. If the Project does not involve new or major reconstruction, at the option of the CITY, an Installation Floater may be acceptable. For such projects, a Property Installation Floater shall be obtained that provides for the improvement, remodel, modification, alteration, conversion or adjustment to existing buildings, structures, processes, machinery, and equipment. The Property Installation Floater shall provide property damage coverage for any building, structure, machinery or equipment damaged, impaired, broken, or destroyed during the performance of the Work, including during transit, installation, and testing at the CITY's site.
- e. Claims Made Policies. If any coverage required is written on a claims-made coverage form:
  - i. The retroactive date must be shown, and this date must be before the execution date of the Contract or the beginning of Contract work.
  - ii. Insurance must be maintained and evidence of insurance must be provided for at least five (5) years after completion of Contract work.
  - iii. If coverage is cancelled or non-renewed, and not replaced with another claims-made policy form with a retroactive date prior to the Contract effective, or start of work date, the CONTRACTOR must purchase extended reporting period coverage for a minimum of five (5) years after completion of Contract work.
  - iv. A copy of the claims reporting requirements must be submitted to the CITY for review.
  - v. If the services involve lead-based paint or asbestos identification/remediation, the Contractors Pollution Liability policy shall not contain lead-based paint or asbestos exclusions. If the services involve mold identification/remediation, the Contractors Pollution Liability policy shall not contain a mold exclusion, and the definition of Pollution shall include microbial matter, including mold.

- f. Acceptability of Insurers. Insurance is to be placed with insurers authorized to conduct business in the state with a current A.M. Best rating of no less than A: VII, unless otherwise acceptable to the CITY.
  - g. Waiver of Subrogation. CONTRACTOR hereby agrees to waive rights of subrogation which any insurer of CONTRACTOR may acquire from CONTRACTOR by virtue of the payment of any loss. CONTRACTOR agrees to obtain any endorsement that may be necessary to affect this waiver of subrogation. The Workers' Compensation policy shall be endorsed with a waiver of subrogation in favor of the CITY for all work performed by the CONTRACTOR, its employees, agents and subcontractors.
  - h. Verification of Coverage. CONTRACTOR shall furnish the CITY with original Certificates of Insurance including all required amendatory endorsements (or copies of the applicable policy language effecting coverage required by this clause) and a copy of the Declarations and Endorsement Page of the CGL policy listing all policy endorsements to CITY before work begins. However, failure to obtain the required documents prior to the work beginning shall not waive the CONTRACTOR's obligation to provide them. The CITY reserves the right to require complete, certified copies of all required insurance policies, including endorsements, required by these specifications, at any time.
  - i. Subcontractors. CONTRACTOR shall require and verify that all subcontractors maintain insurance meeting all requirements stated herein, and CONTRACTOR shall ensure that CITY is an additional insured on insurance required from subcontractors. For CGL coverage, subcontractors shall provide coverage with a form at least as broad as CG 20 38 04 13.
  - j. Special Risks or Circumstances. CITY reserves the right to modify these requirements, including limits, based on the nature of the risk, prior experience, insurer, coverage, or other circumstances.
18. ASSIGNMENT: This Contract is not assignable nor the performance of either party's duties delegable without the prior written consent of the other party. Any attempted or purported assignment or delegation of any of the rights or obligations of either party without the prior written consent of the other shall be void and of no force and effect.
19. INDEPENDENT CONTRACTOR: CONTRACTOR is and shall at all times remain as to the CITY, a wholly independent Contractor. Neither the CITY nor any of its agents shall have control of the conduct of CONTRACTOR or any of CONTRACTOR'S employees, except as herein set forth. CONTRACTOR shall not at any time or in any manner represent that it or any of its agents or employees are in any manner agents or employees of CITY.
20. TAXES: CONTRACTOR is responsible for paying all retail sales and use, transportation, export, import, special or other taxes and duties applicable to, and assessable against any work, materials, equipment, services, processes and operations incidental to or involved in this Contract. CONTRACTOR is responsible for ascertaining and arranging to pay them. The prices established in the Contract shall include compensation for any taxes CONTRACTOR is required to pay by laws and regulations in effect at the bid opening date.

21. LICENSES: CONTRACTOR represents and warrants to CITY that it has all licenses, permits, qualifications, insurance, and approvals of whatsoever nature which are legally required of CONTRACTOR to practice its profession. CONTRACTOR represents and warrants to CITY that CONTRACTOR shall, at its sole cost and expense, keep in effect or obtain at all times during the term of this Agreement any licenses, permits, insurance, and approvals which are legally required of CONTRACTOR to practice its profession. CONTRACTOR shall maintain a City of Hermosa Beach business license, if required under CITY ordinance.

Contractors are required by law to be licensed and regulated by the Contractors' State License Board which has jurisdiction to investigate complaints against Contractors if a complaint regarding a patent act or omission is filed within five (5) years of the date of the alleged violation. A complaint regarding a latent act or omission pertaining to structural defects must be filed within ten (10) years of the date of the alleged violation. Any questions concerning a Contractor may be referred to the Registrar, Contractors' State License Board, P.O. Box 26000, Sacramento, California 95826.

22. RECORDS: CONTRACTOR shall maintain accounts and records, including personnel, property, and financial records, adequate to identify and account for all costs pertaining to this Agreement and such other records as may be deemed necessary by CITY or any authorized representative, and will be retained for four years after the expiration of this Agreement. All such records shall be made available for inspection or audit by CITY at any time during regular business hours.
23. SEVERABILITY. If any portion of these Contract documents are declared by a court of competent jurisdiction to be invalid or unenforceable, then such portion will be deemed modified to the extent necessary in the opinion of the court to render such portion enforceable and, as so modified, such portion and the balance of this Agreement will continue in full force and effect.
24. WHOLE AGREEMENT: This Agreement supersedes any and all other agreements either oral or written, between the parties and contains all of the covenants and agreements between the parties pertaining to the work of improvements described herein. Each party to this Contract acknowledges that no representations, inducements, promises or agreements, orally or otherwise, have been made by any party, or anyone acting on behalf of any party, which are not embodied herein, and that any other agreement, statements or promise not contained in this Contract shall not be valid or binding. Any modifications of this Contract will be effective only if signed by the party to be charged.
25. AUTHORITY: CONTRACTOR affirms that the signatures, titles, and seals set forth hereinafter in execution of this Agreement represent all individuals, firm members, partners, joint ventures, and/or corporate officers having a principal interest herein. Each party warrants that the individuals who have signed this Agreement have the legal power, right, and authority to make this Agreement and to bind each respective party. This Agreement may be modified by written amendment. CITY's city manager may execute any such amendment on CITY's behalf.
26. NOTICES: All notices permitted or required under this Agreement shall be in writing, and shall be deemed made when delivered to the applicable party's representative as provided in this Agreement. Additionally, such notices may be given to the respective parties at the following addresses, or at such other addresses as the parties may provide in writing for this purpose. Such

notices shall be deemed made when personally delivered or when mailed forty-eight (48) hours after deposit in the U.S. mail, first-class postage prepaid, and addressed to the party at its applicable address.

CITY OF HERMOSA BEACH  
1315 Valley Drive  
Hermosa Beach, CA 90254

Attention: \_\_\_\_\_ Project Manager

CONTRACTOR:

\_\_\_\_\_  
\_\_\_\_\_

Attention: \_\_\_\_\_

27. DISPUTES. Effective January 1, 1991, Section 20104 et seq., of the California Public Contract Code prescribes a process utilizing informal conferences, non-binding judicial supervised mediation, and judicial arbitration to resolve disputes on construction claims of \$375,000 or less. Effective January 1, 2017, Section 9204 of the Public Contract Code prescribes a process for negotiation and mediation to resolve disputes on construction claims. The intent of this Section is to implement Sections 20104 et seq. and Section 9204 of the California Public Contract Code. This Section shall be construed to be consistent with said statutes.

Claims. For purposes of this Section, “Claim” means a separate demand by CONTRACTOR, after a change order duly requested in accordance with the terms of this Contract has been denied by the CITY, for (A) a time extension, (B) payment of money or damages arising from Work done by or on behalf of CONTRACTOR pursuant to the Contract, or (C) an amount the payment of which is disputed by the CITY. A “Claim” does not include any demand for payment for which CONTRACTOR has failed to provide notice, request a change order, or otherwise failed to follow any procedures contained in the Contract Documents. Claims governed by this Section may not be filed unless and until CONTRACTOR completes all procedures for giving notice of delay or change and for the requesting of a time extension or change order, including but not necessarily limited to the change order procedures contained herein, and CONTRACTOR’s request for a change has been denied in whole or in part. Claims governed by this Section must be filed no later than fourteen (14) calendar days after a request for change has been denied in whole or in part or after any other event giving rise to the Claim. The Claim shall be submitted in writing to the CITY and shall include on its first page the following in 16 point capital font: “THIS IS A CLAIM.” Furthermore, the claim shall include the documents necessary to substantiate the claim. Nothing in this Section is intended to extend the time limit or supersede notice requirements otherwise provided by Contract for the filing of claims, including all requirements pertaining to compensation or payment for extra Work, disputed Work, and/or changed conditions. Failure to follow such Contractual requirements shall bar any claims or subsequent lawsuits for compensation or payment thereon.

Supporting Documentation. The CONTRACTOR shall submit all claims in the following format:

Summary of claim merit and price, reference Contract Document provisions pursuant to which the claim is made

List of documents relating to claim:

Specifications

Drawings

Clarifications (Requests for Information)

Schedules

Other

Chronology of events and correspondence

Analysis of claim merit

Analysis of claim cost

Time impact analysis in CPM format

If CONTRACTOR's claim is based in whole or in part on an allegation of errors or omissions in the Drawings or Specifications for the Project, CONTRACTOR shall provide a summary of the percentage of the claim subject to design errors or omissions and shall obtain a certificate of merit in support of the claim of design errors and omissions.

Cover letter and certification of validity of the claim, including any claims from subcontractors of any tier, in accordance with Government Code section 12650 *et seq.*

City's Response. Upon receipt of a claim pursuant to this Section, CITY shall conduct a reasonable review of the claim and, within a period not to exceed 45 calendar days, shall provide CONTRACTOR a written statement identifying what portion of the claim is disputed and what portion is undisputed. Any payment due on an undisputed portion of the claim will be processed and made within 60 calendar days after the public entity issues its written statement.

If CITY needs approval from its governing body to provide the CONTRACTOR a written statement identifying the disputed portion and the undisputed portion of the claim, and the governing body does not meet within the 45 calendar days or within the mutually agreed to extension of time following receipt of a claim sent by registered mail or certified mail, return receipt requested, CITY shall have up to three calendar days following the next duly publicly noticed meeting of the governing body after the 45-day period, or extension, expires to provide CONTRACTOR a written statement identifying the disputed portion and the undisputed portion.

Within 30 calendar days of receipt of a claim, CITY may request in writing additional documentation supporting the claim or relating to defenses or claims CITY may have against the CONTRACTOR. If additional information is thereafter required, it shall be requested and provided pursuant to this subdivision, upon mutual agreement of CITY and the CONTRACTOR.

CITY's written response to the claim, as further documented, shall be submitted to CONTRACTOR within 30 calendar days (if the claim is less than \$50,000, within 15 calendar days) after receipt of the further documentation, or within a period of time no greater than that taken by CONTRACTOR in producing the additional information or requested documentation, whichever is greater.

Meet and Confer. If the CONTRACTOR disputes CITY's written response, or CITY fails to respond within the time prescribed, the CONTRACTOR may so notify CITY, in writing, either within 15 calendar days of receipt of CITY's response or within 15 calendar days of CITY's failure to respond within the time prescribed, respectively, and demand an informal conference to meet and confer for settlement of the issues in dispute. Upon receipt of a demand, CITY shall schedule a meet and confer conference within 30 calendar days for settlement of the dispute.

Mediation. Within 14 calendar days following the conclusion of the meet and confer conference, if the claim or any portion of the claim remains in dispute, CITY shall provide the CONTRACTOR a written statement identifying the portion of the claim that remains in dispute and the portion that is undisputed. Any payment due on an undisputed portion of the claim shall be processed and made within 60 calendar days after CITY issues its written statement. Any disputed portion of the claim, as identified by CONTRACTOR in writing, shall be submitted to nonbinding mediation, with CITY and CONTRACTOR sharing the associated costs equally. CITY and CONTRACTOR shall mutually agree to a mediator within 14 calendar days after the disputed portion of the claim has been identified in writing unless the parties agree to select a mediator at a later time.

If the Parties cannot agree upon a mediator, each Party shall select a mediator and those mediators shall select a qualified neutral third party to mediate with regard to the disputed portion of the claim. Each Party shall bear the fees and costs charged by its respective mediator in connection with the selection of the neutral mediator.

For purposes of this section, mediation includes any nonbinding process, including, but not limited to, neutral evaluation or a dispute review board, in which an independent third party or board assists the Parties in dispute resolution through negotiation or by issuance of an evaluation. Any mediation utilized shall conform to the timeframes in this section.

Unless otherwise agreed to by CITY and CONTRACTOR in writing, the mediation conducted pursuant to this section shall excuse any further obligation under Section 20104.4 to mediate after litigation has been commenced.

The mediation shall be held no earlier than the date CONTRACTOR completes the Work or the date that CONTRACTOR last performs Work, whichever is earlier. All unresolved claims shall be considered jointly in a single mediation unless a new unrelated claim arises after mediation is completed.

Procedures After Mediation. If following the mediation, the claim or any portion remains in dispute, CONTRACTOR must file a claim pursuant to Chapter 1 (commencing with Section 900) and Chapter 2 (commencing with Section 910) of Part 3 of Division 3.6 of Title 1 of the Government Code. For purposes of those provisions, the running of the period of time within which a claim must be filed shall be tolled from the time CONTRACTOR submits his or her

written claim pursuant to subdivision (a) until the time the claim is denied, including any period of time utilized by the meet and confer conference or mediation.

Civil Actions. The following procedures are established for all civil actions filed to resolve claims subject to this Section:

Within 60 calendar days, but no earlier than 30 calendar days, following the filing or responsive pleadings, the court shall submit the matter to non-binding mediation unless waived by mutual stipulation of both parties or unless mediation was held prior to commencement of the action in accordance with Public Contract Code section 9204 and the terms of these procedures.. The mediation process shall provide for the selection within 15 calendar days by both parties of a disinterested third person as mediator, shall be commenced within 30 calendar days of the submittal, and shall be concluded within 15 calendar days from the commencement of the mediation unless a time requirement is extended upon a good cause showing to the court.

If the matter remains in dispute, the case shall be submitted to judicial arbitration pursuant to Chapter 2.5 (commencing with Section 1141.10) of Title 3 of Part 3 of the Code of Civil Procedure, notwithstanding Section 1114.11 of that code. The Civil Discovery Act of 1986 (Article 3 (commencing with Section 2016) of Chapter 3 of Title 3 of Part 4 of the Code of Civil Procedure) shall apply to any proceeding brought under this subdivision consistent with the rules pertaining to judicial arbitration.

In addition to Chapter 2.5 (commencing with Section 1141.10) of Title 3 of Part 3 of the Code of Civil Procedure, (A) arbitrators shall, when possible, be experienced in construction law, and (B) any party appealing an arbitration award who does not obtain a more favorable judgment shall, in addition to payment of costs and fees under that chapter, also pay the attorney's fees on appeal of the other party.

Government Code Claims. In addition to any and all Contract requirements pertaining to notices of and requests for compensation or payment for extra work, disputed work, claims and/or changed conditions, CONTRACTOR must comply with the claim procedures set forth in Government Code sections 900 et seq. prior to filing any lawsuit against the CITY. Such Government Code claims and any subsequent lawsuit based upon the Government Code claims shall be limited to those matters that remain unresolved after all procedures pertaining to extra work, disputed work, claims, and/or changed conditions have been followed by CONTRACTOR. If no such Government Code claim is submitted, or if any prerequisite Contractual requirements are not otherwise satisfied as specified herein, CONTRACTOR shall be barred from bringing and maintaining a valid lawsuit against the CITY. A Government Code claim must be filed no earlier than the date the work is completed or the date CONTRACTOR last performs work on the Project, whichever occurs first. A Government Code claim shall be inclusive of all unresolved claims unless a new unrelated claim arises after the Government Code claim is submitted.

Non-Waiver. CITY's failure to respond to a claim from CONTRACTOR within the time periods described in this Section or to otherwise meet the time requirements of this Section shall result in the claim being deemed rejected in its entirety. CITY's failure to respond shall not waive CITY's rights to any subsequent procedures for the resolution of disputed claims.

24. NON-DISCRIMINATION: Contractor represents that it is an equal opportunity employer and that it shall not discriminate against any employee or applicant for employment because of race, religion, color, national origin, ancestry, sex, age or other interests protected by the State or Federal Constitutions. Such non-discrimination shall include, but not be limited to, all activities related to initial employment, upgrading, demotion, transfer, recruitment or recruitment advertising, layoff or termination. A violation of this section exposes CONTRACTOR to the penalties provided for in Labor Code Section 1735.
25. TERMINATION: This Contract may be terminated by CITY at any time, either with or without cause, by giving CONTRACTOR three (3) calendar days advance written notice. In the event of termination by CITY for any reason other than the fault of CONTRACTOR, CITY shall pay CONTRACTOR for all Work performed up to that time as provided herein. In the event of breach of the Contract by Contractor, CITY may terminate the Contract immediately without notice, may reduce payment to CONTRACTOR in the amount necessary to offset CITY's resulting damages, and may pursue any other available recourse against CONTRACTOR. CONTRACTOR may not terminate this Contract except for cause. In the event this Contract is terminated in whole or in part as provided, CITY may procure, upon such terms and in such manner as it may determine appropriate, services similar to those terminated. Further, if this Contract is terminated as provided, CITY may require CONTRACTOR to provide all finished or unfinished documents, data, diagrams, drawings, materials or other matter prepared or built by CONTRACTOR in connection with its performance of this Contract.
26. ANTI-TRUST CLAIMS: This provision shall be operative if this Contract Agreement is applicable to California Public Contract Code Section 7103.5. In entering into this Contract Agreement to supply goods, services or materials, Contractor hereby offers and agrees to assign to the Agency all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Section 15) or under the Cartwright Act (Chapter 2, commencing with Section 16700, of Part 2 of Division 7 of the Business and Professions Code) arising from purchases of goods, services, or materials pursuant to the Contract Agreement. This assignment shall be made and become effective at the time the Agency tender final payment to Contractor, without further acknowledgment by the Parties.
27. NO THIRD-PARTY BENEFICIARY. This Contract and every provision herein are for the exclusive benefit of the Contractor and the City and not for the benefit of any other party. There will be no incidental or other beneficiaries of any of the Contractor's or the City's obligations under this Contract.
28. TIME IS OF ESSENCE. Time is of the essence for each and every provision of the Contract Documents.
29. FORCE MAJEURE. If CONTRACTOR is delayed in the performance or progress of the work by a Force Majeure Event, then the CONTRACTOR shall be entitled to a time extension, as provided in the Contract documents, when the work stopped is on the critical path and shall not be charged liquidated damages. Such a non-compensable adjustment shall be CONTRACTOR's sole and exclusive remedy for such delays and the CONTRACTOR will not receive an adjustment to the Contract price or any other compensation. Contractor must submit a timely request in accordance with the requirements of the Contract documents. A Force Majeure Event shall mean

an event that materially affects a party's performance and is one or more of the following: (1) Acts of God or other natural disasters occurring at the project site; (2) terrorism or other acts of a public enemy; (3) orders of governmental authorities (including, without limitation, unreasonable and unforeseeable delay in the issuance of permits or approvals by governmental authorities that are required for the work); (4) pandemics, epidemics or quarantine restrictions; and (5) strikes and other organized labor action occurring at the project site and the effects thereof on the work, only to the extent such strikes and other organized labor action are beyond the control of CONTRACTOR and its subcontractors, of every tier, and to the extent the effects thereof cannot be avoided by use of replacement workers. For purposes of this section, "orders of governmental authorities," includes ordinances, emergency proclamations and orders, rules to protect the public health, welfare and safety, and other actions of the City in its capacity as a municipal authority.

- 30. PROVISIONS REQUIRED BY LAW AND CONTRACTOR COMPLIANCE. Each and every provision of law required to be included in these Contract Documents shall be deemed to be included in these Contract Documents. The Contractor shall comply with all requirements of applicable federal, state and local laws, rules and regulations, including, but not limited to, the provisions of the California Labor Code and California Public Contract Code which are applicable to this Work.
- 31. ACCEPTANCE OF FACSIMILE SIGNATURES. The Parties agree that this Contract, agreements ancillary to this Contract, and related documents to be entered into in connection with this Contract will be considered signed when the signature of a party is delivered by facsimile transmission. Such facsimile signature will be treated in all respects as having the same effect as an original signature.
- 32. GOVERNING LAW: This Agreement shall be governed by the laws of the State of California, and exclusive venue for any action involving this Contract will be in Los Angeles County.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement with all the formalities required by law on the respective dates set forth opposite their signatures.

State of California  
CONTRACTOR'S License No. \_\_\_\_\_

CONTRACTOR

\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
Date

By: \_\_\_\_\_  
TITLE

CITY OF HERMOSA BEACH, CALIFORNIA

\_\_\_\_\_ By: \_\_\_\_\_  
Date MAYOR

ATTEST:

\_\_\_\_\_ By: \_\_\_\_\_  
Date CITY CLERK

CONTRACTOR'S Business Phone \_\_\_\_\_

Emergency Phone at which CONTRACTOR can be reached at any time: ( ) \_\_\_\_\_

APPROVED AS TO FORM:

\_\_\_\_\_  
CITY ATTORNEY

\_\_\_\_\_  
Date

**B. AGREEMENT OF INDEMNIFICATION  
AND HOLD HARMLESS AND WAIVER OF SUBROGATION AND CONTRIBUTION**

**CIP No. 682  
PARKING LOT "D" IMPROVEMENTS PROJECT**

Contract/Agreement/License/Permit No. or description: \_\_\_\_\_

Indemnitor(s) (list all names): \_\_\_\_\_

To the fullest extent permitted by law, Indemnitor hereby agrees, at its sole cost and expense, to defend, protect, indemnify, and hold harmless the City of Hermosa Beach and its respective elected officials, officers, attorneys, agents, employees, volunteers, successors, and assigns (collectively "Indemnitees") from and against any and all damages, costs, expenses, liabilities, claims, demands, causes of action, proceedings, expenses, judgments, penalties, liens, and losses of any nature whatsoever, including fees of accountants, attorneys, or other professionals and all costs associated therewith (collectively "Liabilities"), arising or claimed to arise, directly or indirectly, out of, in connection with, resulting from, or related to any act, failure to act, error, or omission of Indemnitor or any of its officers, agents, servants, employees, subcontractors, materialmen, suppliers or their officers, agents, servants or employees, arising or claimed to arise, directly or indirectly, out of, in connection with, resulting from, or related to the above-referenced Contract, agreement, license, or permit (the "Agreement") or the performance or failure to perform any term, provision, covenant, or condition of the Agreement, including this indemnity provision. This indemnity provision is effective regardless of any prior, concurrent, or subsequent active or passive negligence by Indemnitees and shall operate to fully indemnify Indemnitees against any such negligence. This indemnity provision shall survive the termination of the Agreement and is in addition to any other rights or remedies which Indemnitees may have under the law. Payment is not required as a condition precedent to an Indemnitee's right to recover under this indemnity provision, and an entry of judgment against an Indemnitee shall be conclusive in favor of the Indemnitee's right to recover under this indemnity provision. Indemnitor shall pay Indemnitees for any attorney fees and costs incurred in enforcing this indemnification provision. Notwithstanding the foregoing, nothing in this instrument shall be construed to encompass (a) Indemnitees' sole negligence or willful misconduct to the limited extent that the underlying Agreement is subject to Civil Code 2782(a), or (b) the Contracting public agency's active negligence to the limited extent that the underlying Agreement is subject to Civil Code 2782(b). This indemnity is effective without reference to the existence or applicability of any insurance coverages which may have been required under the Agreement or any additional insured endorsements which may extend to Indemnitees.

Indemnitor, on behalf of itself and all parties claiming under or through it, hereby waives all rights of subrogation and contribution against the Indemnitees, while acting within the scope of their duties, from all claims, losses and liabilities arising out of or incident to activities or operations performed by or on behalf of the Indemnitor regardless of any prior, concurrent, or subsequent active or passive negligence by the Indemnitees. Accountants, attorneys, or other professionals employed by Indemnitor to defend Indemnitees shall be selected by Indemnitees.

In the event there is more than one person or entity named in the Agreement as an Indemnitor, then all obligations, liabilities, covenants and conditions under this instrument shall be joint and several.

"Indemnitor"

Name \_\_\_\_\_

Name \_\_\_\_\_

By: \_\_\_\_\_

By: \_\_\_\_\_

**C. EQUALS**

**CIP No. 682**

**PARKING LOT “D” IMPROVEMENTS PROJECT**

The undersigned desires to use the material, product, thing, or service described below, as “an equal” to such item as specified.

In accordance with the provisions under the Contract Documents, if the City shall find any item so described equal to the respective item specified, then the undersigned may furnish such item, together with all necessary labor, materials, equipment and incidentals required to perform and complete the work.

\_\_\_\_\_  
Contractor’s Name

\_\_\_\_\_  
Date

\_\_\_\_\_  
Address

\_\_\_\_\_  
Telephone Number

<b>Materials, apparatus or equipment specified for which Bidder proposes “an equal”</b>	<b>Complete description of the materials, apparatus or equipment the Bidder desires to use as “an equal” and name of Contractor if different</b>
<i>Specify page number</i>	
1.	
2.	
3.	

**D. FAITHFUL PERFORMANCE BOND**

**CIP No. 682**

**PARKING LOT “D” IMPROVEMENTS PROJECT**

KNOW ALL PERSONS BY THESE PRESENTS:

THAT WHEREAS, the City of Hermosa Beach, (hereinafter referred to as “City”) has awarded to \_\_\_\_\_, (hereinafter referred to as the “Contractor”) an agreement for **Contract No.** \_\_\_\_\_, (hereinafter referred to as the “Project”).

WHEREAS, the work to be performed by the Contractor is more particularly set forth in the Contract Documents for the Project dated \_\_\_\_\_, (hereinafter referred to as “Contract Documents”), the terms and conditions of which are expressly incorporated herein by reference; and

WHEREAS, the Contractor is required by said Contract Documents to perform the terms thereof and to furnish a bond for the faithful performance of said Contract Documents.

NOW, THEREFORE, we, \_\_\_\_\_, the undersigned Contractor and \_\_\_\_\_ as Surety, a corporation organized and duly authorized to transact business under the laws of the State of California, are held and firmly bound unto the City in the sum of \_\_\_\_\_ DOLLARS, (\$\_\_\_\_\_), said sum being not less than one hundred percent (100%) of the total amount of the Contract, for which amount well and truly to be made, we bind ourselves, our heirs, executors and administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that, if the Contractor, his or its heirs, executors, administrators, successors or assigns, shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions and agreements in the Contract Documents and any alteration thereof made as therein provided, on its part, to be kept and performed at the time and in the manner therein specified, and in all respects according to their intent and meaning; and shall faithfully fulfill all obligations including the one (1) year guarantee of all materials and workmanship; and shall indemnify and save harmless the City, its officials, officers, employees, and authorized volunteers, as stipulated in said Contract Documents, then this obligation shall become null and void; otherwise it shall be and remain in full force and effect.

As a part of the obligation secured hereby and in addition to the face amount specified therefore, there shall be included costs and reasonable expenses and fees including reasonable attorney’s fees, incurred by City in enforcing such obligation.

As a condition precedent to the satisfactory completion of the Contract Documents, unless otherwise provided for in the Contract Documents, the above obligation shall hold good for a period of one (1) year after the acceptance of the work by City, during which time if Contractor shall fail to make full, complete, and satisfactory repair and replacements and totally protect the

The obligations of Surety hereunder shall continue so long as any obligation of Contractor remains. Nothing herein shall limit the City's rights or the Contractor or Surety's obligations under the Contract, law or equity, including, but not limited to, California Code of Civil Procedure Section 337.15.

Whenever Contractor shall be, and is declared by the City to be, in default under the Contract Documents, the Surety shall remedy the default pursuant to the Contract Documents, or shall promptly, at the City's option:

- i. Take over and complete the Project in accordance with all terms and conditions in the Contract Documents; or
- ii. Obtain a bid or bids for completing the Project in accordance with all terms and conditions in the Contract Documents and upon determination by Surety of the lowest responsive and responsible Bidder, arrange for a Contract between such Bidder, the Surety and the City, and make available as work progresses sufficient funds to pay the cost of completion of the Project, less the balance of the Contract price, including other costs and damages for which Surety may be liable. The term "balance of the Contract price" as used in this paragraph shall mean the total amount payable to Contractor by the City under the Contract and any modification thereto, less any amount previously paid by the City to the Contractor and any other set offs pursuant to the Contract Documents.
- iii. Permit the City to complete the Project in any manner consistent with California law and make available as work progresses sufficient funds to pay the cost of completion of the Project, less the balance of the Contract price, including other costs and damages for which Surety may be liable. The term "balance of the Contract price" as used in this paragraph shall mean the total amount payable to Contractor by the City under the Contract and any modification thereto, less any amount previously paid by the City to the Contractor and any other set offs pursuant to the Contract Documents.

Surety expressly agrees that the City may reject any Contractor or subcontractor which may be proposed by Surety in fulfillment of its obligations in the event of default by the Contractor.

Surety shall not utilize Contractor in completing the Project nor shall Surety accept a bid from Contractor for completion of the Project if the City, when declaring the Contractor in default, notifies Surety of the City's objection to Contractor's further participation in the completion of the Project.

The Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract Documents or to the Project to be performed thereunder shall in any way affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract Documents or to the Project.

By their signatures hereunder, Surety and Contractor hereby confirm under penalty of perjury that surety is an admitted surety insurer authorized to do business in the State of California.

[REMAINDER OF PAGE LEFT INTENTIONALLY BLANK]

IN WITNESS WHEREOF, we have hereunto set our hands and seals this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
Contractor/ Principal

By \_\_\_\_\_

Title \_\_\_\_\_

\_\_\_\_\_  
Surety

By \_\_\_\_\_  
Attorney-in-Fact

Title \_\_\_\_\_

The rate of premium on this bond is \_\_\_\_\_ per thousand. The total amount of premium charges is \$ \_\_\_\_\_.  
(The above must be filled in by corporate attorney.)

THIS IS A REQUIRED FORM

Any claims under this bond may be addressed to:

(Name and Address of Surety) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(Name and Address of Agent or Representative for service of process in California, if different from above) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(Telephone number of Surety and Agent or Representative for service of process in California) \_\_\_\_\_



## Notary Acknowledgment

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

STATE OF CALIFORNIA  
 COUNTY OF \_\_\_\_\_

On \_\_\_\_\_, 20\_\_\_, before me, \_\_\_\_\_, Notary Public, personally appeared \_\_\_\_\_, who proved to me on the basis of satisfactory

evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature of Notary Public \_\_\_\_\_

### OPTIONAL

*Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.*

#### CAPACITY CLAIMED BY SIGNER

#### DESCRIPTION OF ATTACHED DOCUMENT

- .. Individual
- .. Corporate Officer

- |               |            |
|---------------|------------|
|               | Title(s)   |
| .. Partner(s) | .. Limited |
|               | .. General |

	Title or Type of Document
	Number of Pages

- .. Attorney-In-Fact
- .. Trustee(s)
- .. Guardian/Conservator
- .. Other:

	Date of Document
--	------------------

Signer is representing:  
 Name Of Person(s) Or Entity(ies)

\_\_\_\_\_  
 \_\_\_\_\_

Signer(s) Other Than Named Above

NOTE: This acknowledgment is to be completed for the Attorney-in-Fact. The Power-of Attorney to local representatives of the bonding company must also be attached.

**END OF PERFORMANCE BOND**

**E. PAYMENT BOND (LABOR AND MATERIALS)**

**CIP NO. 682**

**PARKING LOT “D” IMPROVEMENTS PROJECT**

KNOW ALL MEN BY THESE PRESENTS That

WHEREAS, the City of Hermosa Beach (hereinafter designated as the “City”), by action taken or a resolution passed \_\_\_\_\_, 20\_\_\_\_, has awarded to \_\_\_\_\_ hereinafter designated as the “Principal,” a Contract for the work described as follows: **Contract No.** \_\_\_\_\_ (the “Project”); and

WHEREAS, said Principal is required to furnish a bond in connection with said Contract; providing that if said Principal or any of its Subcontractors shall fail to pay for any materials, provisions, provender, equipment, or other supplies used in, upon, for or about the performance of the work Contracted to be done, or for any work or labor done thereon of any kind, or for amounts due under the Unemployment Insurance Code or for any amounts required to be deducted, withheld, and paid over to the Employment Development Department from the wages of employees of said Principal and its Subcontractors with respect to such work or labor the Surety on this bond will pay for the same to the extent hereinafter set forth.

NOW THEREFORE, we, the Principal and \_\_\_\_\_ as Surety, are held and firmly bound unto the City in the penal sum of \_\_\_\_\_ Dollars (\$\_\_\_\_\_) lawful money of the United States of America, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that if said Principal, his or its subcontractors, heirs, executors, administrators, successors or assigns, shall fail to pay any of the persons named in Civil Code Section 9100, fail to pay for any materials, provisions or other supplies, used in, upon, for or about the performance of the work Contracted to be done, or for any work or labor thereon of any kind, or amounts due under the Unemployment Insurance Code with respect to work or labor performed under the Contract, or for any amounts required to be deducted, withheld, and paid over to the Employment Development Department or Franchise Tax Board from the wages of employees of the Contractor and his subcontractors pursuant to Revenue and Taxation Code Section 18663, with respect to such work and labor the Surety or Sureties will pay for the same, in an amount not exceeding the sum herein above specified, and also, in case suit is brought upon this bond, all litigation expenses incurred by the City in such suit, including reasonable attorneys’ fees, court costs, expert witness fees and investigation expenses.

This bond shall inure to the benefit of any of the persons named in Civil Code Section 9100 so as to give a right of action to such persons or their assigns in any suit brought upon this bond.

It is further stipulated and agreed that the Surety on this bond shall not be exonerated or released from the obligation of this bond by any change, extension of time for performance, addition, alteration or modification in, to, or of any Contract, plans, specifications, or agreement pertaining or relating to any scheme or work of improvement herein above described, or pertaining or relating

to the furnishing of labor, materials, or equipment therefore, nor by any change or modification of any terms of payment or extension of the time for any payment pertaining or relating to any scheme or work of improvement herein above described, nor by any rescission or attempted rescission or attempted rescission of the Contract, agreement or bond, nor by any conditions precedent or subsequent in the bond attempting to limit the right of recovery of claimants otherwise entitled to recover under any such Contract or agreement or under the bond, nor by any fraud practiced by any person other than the claimant seeking to recover on the bond and that this bond be construed most strongly against the Surety and in favor of all persons for whose benefit such bond is given, and under no circumstances shall Surety be released from liability to those for whose benefit such bond has been given, by reason of any breach of Contract between the owner or City and original Contractor or on the part of any obligee named in such bond, but the sole conditions of recovery shall be that claimant is a person described in Civil Code Section 9100, and has not been paid the full amount of his claim and that Surety does hereby waive notice of any such change, extension of time, addition, alteration or modification herein mentioned, including but not limited to the provisions of sections 2819 and 2845 of the California Civil Code.

By their signatures hereunder, Surety and Principal hereby confirm under penalty of perjury that surety is an admitted surety insurer authorized to do business in the State of California.

IN WITNESS WHEREOF, we have hereunto set our hands and seals this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
Contractor/ Principal

By \_\_\_\_\_

Title \_\_\_\_\_

\_\_\_\_\_  
Surety

By

\_\_\_\_\_  
Attorney-in-Fact

Title \_\_\_\_\_

# Notary Acknowledgment

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

STATE OF CALIFORNIA  
 COUNTY OF \_\_\_\_\_

On \_\_\_\_\_, 20\_\_\_, before me, \_\_\_\_\_, Notary Public, personally appeared \_\_\_\_\_, who proved to me on the basis of satisfactory

evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature of Notary Public \_\_\_\_\_

### OPTIONAL

*Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.*

#### CAPACITY CLAIMED BY SIGNER

#### DESCRIPTION OF ATTACHED DOCUMENT

- .. Individual
- .. Corporate Officer

- |               |            |
|---------------|------------|
|               | Title(s)   |
| .. Partner(s) | .. Limited |
|               | .. General |

Title or Type of Document
Number of Pages

- .. Attorney-In-Fact
- .. Trustee(s)
- .. Guardian/Conservator
- .. Other:

Date of Document
------------------

Signer is representing:  
 Name Of Person(s) Or Entity(ies)

\_\_\_\_\_  
 \_\_\_\_\_

Signer(s) Other Than Named Above
----------------------------------

NOTE: This acknowledgment is to be completed for Contractor/Principal.

## Notary Acknowledgment

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

STATE OF CALIFORNIA  
 COUNTY OF \_\_\_\_\_

On \_\_\_\_\_, 20\_\_\_, before me, \_\_\_\_\_, Notary Public, personally appeared \_\_\_\_\_, who proved to me on the basis of satisfactory

evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature of Notary Public \_\_\_\_\_

### OPTIONAL

*Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.*

#### CAPACITY CLAIMED BY SIGNER

#### DESCRIPTION OF ATTACHED DOCUMENT

- Individual
- Corporate Officer

- |  |  |
|--|--|
|  | Title(s)   |
| <input type="checkbox"/> Partner(s) <input type="checkbox"/> Attorney-In-Fact<br><input type="checkbox"/> Trustee(s)<br><input type="checkbox"/> Guardian/Conservator<br><input type="checkbox"/> Other: | <input type="checkbox"/> Limited<br><input type="checkbox"/> General |

	Title or Type of Document
	Number of Pages
	Date of Document

Signer is representing:  
 Name Of Person(s) Or Entity(ies)

\_\_\_\_\_  
 \_\_\_\_\_

Signer(s) Other Than Named Above

NOTE: This acknowledgment is to be completed for the Attorney-in-Fact. The Power-of-Attorney to local representatives of the bonding company must also be attached.

**END OF PAYMENT BOND**

**F. GUARANTEE TO THE CITY OF HERMOSA BEACH**

**CIP No . 682  
PARKING LOT “D” IMPROVEMENTS PROJECT**

As a material inducement to the City to award the Contract for CIP No. \_\_\_\_\_ to the \_\_\_\_\_, the undersigned (“Guarantor”) has agreed to enter into this guarantee. The Guarantor hereby unconditionally guarantees to the fullest extent allowed by law the following work included in this project: \_\_\_\_\_ (“the work”).

Guarantor guarantees that the materials and equipment used by itself and its sub-Contractors will be free from defects and that the work will conform to the plans and specifications. Should any of the materials or equipment prove defective or should the work as a whole, or any part thereof, prove defective for any reason whatsoever (except due to intentional torts by the City), or should the work as a whole or any part thereof fail to operate properly or fail to comply with the plans and specifications, Guarantor will, at the City’s sole election: 1) reimburse the City, upon written demand, for all of the City’s expenses incurred replacing or restoring any such equipment or materials, including the cost of any work necessary to make such replacement or repairs; or 2) replace any such defective material or equipment and repair said work completely, all without any cost to the City. Guarantor further guarantees that any such repair work will conform to the plans and specifications for the project. This guarantee will remain in effect for one year from the date on which the Contract for the work is accepted by the City.

Guarantor understands and agrees that the City shall have the unqualified option to make any replacements or repairs itself or to have such replacement, repair, performed by the undersigned. The City shall have no obligation to consult with Guarantor before the City proceeds to perform any repair, replacement, or work itself. If the City elects to have Guarantor perform said repair, replacement, or work, Guarantor agrees that the repair, replacement, or work shall be performed within 15 days after receipt of a written demand from the City.

If the City elects to perform the replacement, repairs itself, Guarantor agrees to make reimbursement payment within 15 days after receipt of a written demand for payment from the City.

If the Guarantor fails or refuses to comply with this guarantee, the City shall be entitled to all costs and expenses, including attorneys and expert fees, reasonably incurred by reason of Guarantor’s failure or refusal.

Guarantor

\_\_\_\_\_  
Contractor

\_\_\_\_\_  
Date

\_\_\_\_\_  
By

\_\_\_\_\_  
Title

**G. GENERAL COMPREHENSIVE LIABILITY ADDITIONAL INSURED  
ENDORSEMENT**

**CIP No. 682  
PARKING LOT "D" IMPROVEMENTS PROJECT**

---

NAME OF ADDRESS OF INSURED:

---

General description of agreement(s) and/or activity(ies) insured:

---

Notwithstanding any inconsistent statement in the policy to which this endorsement is attached or in any endorsement now or hereafter attached thereto, it is agreed as follows:

1. That the City of Hermosa Beach and its or their elected officials, officers, agents and employees are insureds thereunder in relation to those activities described generally above with regard to operations performed by or on behalf of the named insured.
2. Such insurance shall be primary, and not contributing with any other insurance maintained by \_\_\_\_\_ the \_\_\_\_\_ City.
3. The policy to which this endorsement is attached shall apply separately to each insured against whom claim is made or suit is brought except with respect to the limits of the company's \_\_\_\_\_ liability.
4. The policy to which this endorsement is attached shall not be subject to cancellation, change in coverage, reduction of limits or non-renewal except after written notice to Risk Management, City of Hermosa Beach, by certified mail, return receipt requested, not less than thirty (30) days prior to the effective date thereto.

CANCELLATION NOTICE AND ENDORSEMENT TO BE SENT TO:

Risk Management  
City of Hermosa Beach  
1315 Valley Dr. Hermosa  
Beach, CA 90254  
(310) 318-0202

Except as stated above and not in conflict with this endorsement, nothing contained herein shall be held to waive, alter or extend any of the limits, agreements, or exclusions of the policy to which this endorsement is attached.

Endorsement Effective Policy No.  
No. \_\_\_\_\_ Date \_\_\_\_\_

TYPE OF COVERAGES TO WHICH POLICY PERIOD  
LIMITS OF FROM TO  
THIS ENDORSEMENT ATTACHES \_\_\_\_\_  
LIABILITY

Scheduled items or locations are to be identified on an attached sheet.

The following inclusions relate to the above coverages includes:

- Premises & Operations
- Contractual Liability
- Independent Contractors
- Products/Completed Operations
- Broad Form Property Damage
- Broad Form Liability Endorsement
- Explosion Hazard
- Collapse
- Underground Hazard
- Personal Injury
- \_\_\_\_\_

A deductible or self-insured retention (strike out one) of \_\_\_\_\_  
applies to \_\_\_\_\_ coverage.

DEDUCTIBLE APPLIES PER CLAIM, \_\_\_\_\_ PER OCCURRENCE \_\_\_\_\_

\_\_\_\_\_  
INSURANCE COMPANY  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

I, \_\_\_\_\_, (print name) hereby declare under penalty of perjury, under the laws of the State of California, that I have the authority to bind the above-named insurance company to this endorsement and by my execution hereof, do so bind said company.

\_\_\_\_\_  
Signature of Authorized Representative (Original Signature  
only; No facsimile signature or initialed signature accepted)

Executed at \_\_\_\_\_, \_\_\_\_\_ on \_\_\_\_\_ 20 .

Phone No.: ( ) \_\_\_\_\_

**H. AUTOMOBILE LIABILITY ADDITIONAL INSURED ENDORSEMENT**

**CIP No. 682**

**PARKING LOT “D” IMPROVEMENTS PROJECT**

---

NAME OF ADDRESS OF INSURED:

---

General description of agreement(s) and/or activity(ies) insured:

---

Notwithstanding any inconsistent statement in the policy to which this endorsement is attached or in any endorsement now or hereafter attached thereto, it is agreed as follows:

1. That the City of Hermosa Beach and its or their elected officials, officers, agents and employees are insureds thereunder in relation to those activities described generally above with regard to operations performed by or on behalf of the named insured.
2. Such insurance shall be primary, and not contributing with any other insurance maintained by the City.
3. The policy to which this endorsement is attached shall apply separately to each insured against whom claim is made or suit is brought except with respect to the limits of the company's liability.
4. The policy to which this endorsement is attached shall not be subject to cancellation, change in coverage, reduction of limits or non-renewal except after written notice to Risk Management, City of Hermosa Beach, by certified mail, return receipt requested, not less than thirty (30) days prior to the effective date thereto.

CANCELLATION NOTICE AND ENDORSEMENT TO BE SENT TO:

Risk Management  
City of Hermosa Beach  
1315 Valley Dr. Hermosa  
Beach, CA 90254  
(310) 318-0202

Except as stated above and not in conflict with this endorsement, nothing contained herein shall be held to waive, alter or extend any of the limits, agreements, or exclusions of the policy to which this endorsement is attached.

Endorsement No. _____	Effective Date _____	Policy No. _____
--------------------------	-------------------------	------------------

TYPE OF COVERAGES TO WHICH LIMITS OF THIS ENDORSEMENT ATTACHES <u>LIABILITY</u>	POLICY PERIOD FROM _____ TO _____
--	--------------------------------------

Scheduled items or locations are to be identified on an attached sheet.

The following inclusions relate to the above coverages includes:

- Owned Automobiles
- Non-owned Automobiles
- Hired Automobiles
- Owned, Non-owned and Hired Automobiles

A deductible or self-insured retention (strike out one) of \_\_\_\_\_ applies to \_\_\_\_\_ coverage.

DEDUCTIBLE APPLIES PER CLAIM, \_\_\_\_\_ PER OCCURRENCE \_\_\_\_\_

\_\_\_\_\_  
INSURANCE COMPANY  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

I, \_\_\_\_\_, (print name) hereby declare under penalty of perjury, under the laws of the State of California, that I have the authority to bind the above-named insurance company to this endorsement and by my execution hereof, do so bind said company.

\_\_\_\_\_  
Signature of Authorized Representative (Original Signature  
only; No facsimile signature or initialed signature accepted)

Executed at \_\_\_\_\_, \_\_\_\_\_ on \_\_\_\_\_, \_\_\_\_\_ 20 .

Phone No.: ( ) \_\_\_\_\_

**I. INSTRUCTIONS FOR COMPLETING, EXECUTING, AND SUBMITTING  
EVIDENCE OF INSURANCE TO THE OWNER**

**CIP NO. 682  
PARKING LOT "D" IMPROVEMENTS PROJECT**

Insured: \_\_\_\_\_ Date: \_\_\_\_\_  
(Contractor, Lessee, Permittee, etc.)

**Insured**

- A. In order to reduce problems and time delays in providing evidence of insurance to the City, you are requested to give your insurance agent or broker a copy of the attached Insurance Requirements and endorsement forms along with these instructions for completing, executing, and submitting evidence of insurance.

If the agreement requires Workers' Compensation coverage and you have been authorized by the State of California to self-insure Workers' Compensation, then a copy of the certificate from the State authorizing self-insurance for Workers' Compensation shall meet the requirements for Workers' Compensation insurance covering activities within the State of California.

All questions relating to insurance should be directed to the department or office responsible for your Contract, lease, permit, or other agreement.

**Insurance Agent or Broker**

- B. The appropriate Endorsement Form shall be used. No changes in the terms of the Endorsement will be permitted. Certificates of Insurance alone will not be accepted by the City.

More than one insurance policy may be required to comply with the insurance requirements. Endorsement forms appropriate to your insured's Contract, lease or permit are checked below and enclosed.

- Workers' Compensation/Employers Liability
- General Liability
- Automobile Liability
- Excess/umbrella Liability
- Professional Liability
- Property insurance
- Fine Arts Property Insurance

You shall have an authorized representative of the insurance company sign the completed endorsement forms, note his phone number at the bottom of page 2 and have said representative

transmit the forms to the City. Signatures must be originals as the City will not accept facsimile (rubber stamp, photocopy, etc.) or initialed signatures.

The name of the Insurance Company underwriting the coverage and its address shall be noted on page 2 of the endorsement form.

The "General description of agreement(s) and/or activity(ies) insured" shall include reference to the activity and/or to either the specific City Contract number, lease number, permit number or construction approval number.

The coverages and limits for each type of insurance are specified in the attached sheet of insurance requirements. When coverage is on a scheduled basis, then a separate sheet is to be attached to the endorsement listing such scheduled locations, vehicles, etc., so covered.

Endorsements to excess policies will be required when primary insurance is insufficient in complying with the City's requirements.

If there is insufficient space on the form to note pertinent information, such as inclusions, exclusions or specific provisions, etc., a separate sheet may be attached.

When additional sheets are attached, change the number of pages at the bottom of the form.

Completed Endorsement(s) and questions relating to the required insurance are to be directed to:

Risk Management  
City of Hermosa Beach  
1315 Valley Dr. Hermosa  
Beach, CA 90254  
(310) 318-0202

Improperly completed Endorsements will be returned to your insured for correction by an authorized representative of the insurance company.

**DELAY IN SUBMITTING PROPERLY COMPLETED ENDORSEMENT FORMS MAY DELAY YOUR INSURED'S INTENDED OCCUPANCY OR OPERATION UNDER AGREEMENT WITH THE OWNER.**

For extensions or renewals of insurance policies which have the City's Endorsement Form(s) attached, the City will accept a copy of the endorsement (with an original signature) to extend the period of coverage as evidence of continued coverage.

**J. WORKER'S COMPENSATION INSURANCE CERTIFICATE**

**CIP No. 682  
PARKING LOT "D" IMPROVEMENTS PROJECT**

The Contractor shall execute the following form as required by the California Labor Code, Sections 1860 and 1861:

I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that Code, and I will comply with such provisions before commencing the performance of the work of the Contract.

DATED: \_\_\_\_\_

CONTRACTOR: \_\_\_\_\_

By: \_\_\_\_\_

Signature

\_\_\_\_\_  
Title

ATTEST:

By: \_\_\_\_\_

Signature

\_\_\_\_\_  
Title

**K. SUPPLEMENTAL INFORMATION TO BE COMPLETED BY PRINCIPAL**

**CIP No. 682  
PARKING LOT "D" IMPROVEMENTS PROJECT**

If an individual, so state. If a firm or co-partnership, state the firm and give the names of all individual co-partners composing the partnership. If a corporation, state legal name of corporation; state also the names of the president, secretary, treasurer, and manager thereof.

---

---

---

Business Address:

---

---

---

Telephone Number:

---

Date:

---

Print Name:

---

Principal

Signature:

---



**TECHNICAL  
SPECIFICATIONS**

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329320 Site Furniture and Amenities	
329600 Transplanting	
<b>PART V – ELECTRICAL SPECIFICATIONS .....</b>	<b>TS-142</b>
111200 Parking Control Equipment	
260000 General Electrical Requirements	
260519 Low Voltage Power Conductors & Cables	
260526 Grounding & Bonding for Electrical Systems	
260533 Raceways & Boxes for Electrical Systems	
260553 Identification for Electrical Systems	
262416 Panelboards	
262726 Wiring Devices	
262743 Electric Vehicle Service Equipment	
263100 Solar Energy Power Generation Equipment	
265619 LED Exterior Lighting	
<b>PART VI – ATTACHMENTS .....</b>	<b>TS-223</b>
Attachment 1: Geotechnical Report	
Attachment 2: ORCO Wall Structural Calculations	
Attachment 3: Trash Enclosure Roof Structural Calculations	

**PART I**

**PRODUCT AND VENDOR  
INFORMATION**

**Item 1**            **ORCO CMU Screen and Retaining Walls**

Color: Wheat MW, Texture: Burnish



All exposed wall materials shall receive anti-graffiti coating. Contractor shall provide sample to the Engineer, with color and texture noted for review and approval prior to purchase and construction. Contractor shall provide sample to the Engineer, with color and texture noted for review and approval prior to purchase and construction.

Contact:            ORCO Block & Hardscape  
Rep: Abdol Bahrami, Architectural Sales Representative – O.C.  
11100 Beach Blvd - PO Box E  
Stanton, CA 90680  
Office: (714) 527-2239  
Cell: (714) 412-6510  
[abdol.bahrami@orco.com](mailto:abdol.bahrami@orco.com) | [www.orco.com](http://www.orco.com)

**Item 2**            **CableView™ Cable & Railing Guardrail and Handrail**

Material: Aluminum            |            Color: Natural  
Mount Style: Core Mount       |            Top Rail: Shaped  
Hand Rail Type: Use Stainless Steel Option



Contact:            Stainless Cable & Railing, Inc.  
3315 N.E. 112th Ave. Suite 73  
Vancouver, WA 98682  
Toll Free Tel: 888-686-7245 (RAIL) | Tel: 360-314-4288  
Fax: 888-686-7245  
Email: [sales@stainlesscablerailing.com](mailto:sales@stainlesscablerailing.com)  
Web: <http://stainlesscablerailing.com>

**Item 3**            **Flogard Grated Inlet Catch Basin Filter Frame & Filter, Trench Drain Insert & Filter, and Outlet Trash Screen**

Contact:            Oldcastle Infrastructure  
Rebecca Gonzalez  
Sales Representative, SoCal  
P.O. Box 310039  
Fontana, CA 92337  
Direct: (909) 770-7056  
Cell: (909) 347-9221  
[Rebecca.Gonzalez@oldcastle.com](mailto:Rebecca.Gonzalez@oldcastle.com) | [oldcastleinfrastructure.com](http://oldcastleinfrastructure.com)

**Item 4**      **Covered Trash Enclosure**

A. Enclosure Walls: ORCO CMU Block (See Item #1)



B. Metal Enclosure Roofing:



Roofing deck (Verco or approved equal) shall consist of 1-1/2" deep x 20-gauge Type B (Grade 50) Zinalume / Galvalume coated steel panels (19'-2"L x 3'W with 6 ribs per panel). Roof panels shall be pre-cut with ribs running with the slope of the roof. Roofing shall be pre-finished with Dura Tech 5000 or equal paint finish. Color shall be Zinalume Plus (clear acrylic coating). Steel roof finish shall be warranted for thirty (30) years under a separate roof manufacturer's warranty. For additional information, please visit <https://vercodeck.com>.

Contact: Dave Hansen, District Sales Manager  
Verco Decking, Inc.  
714-939-9128 | Fax: 714-939-9109

C. Enclosure Gates, Posts and Beams:



Enclosure gates shall be 16-gauge ribbed metal with 2"x2"x1/4" steel angle iron frame and diagonal bracing. Continuous weld all joints. Square and rectangular hollow structural section (HSS) steel posts and beams shall conform to ASTM A500 specifications.

All enclosure gates and frame members shall be media blasted to a white finish removing all rust, scale, oil and grease. Powder coating for all gates and frame members shall be coated with TruZinc 7520-70138 zinc rich power-coating primer with a dry film thickness of 2.0 – 6.0 mils and hardness of 2H-3H with a Salt Spray Resistance of 6,000 hours, and TCI Polyester 9000 series Super Durable Gloss finish paint (2.5-3.5 mils) with a hardness of H-H2 and has 1,000-hour Salt Spray Resistance. Total of primer and finish paint shall be 4.5-9.5 mils of paint. Finish color shall be RAL 1015 Light Ivory / TCI Color 9840-11974R. Finish shall be a smooth uniform surface with no pits, runs or sags. Primer and finish shall be provisionally warranted for five (5) years after acceptance from owner against peeling, flaking and rusting. For additional information, please visit <https://tcipowder.com>.

Contact: Bill McGuire, Sales and Technical Representative  
TCI Power Coatings  
Mobile: 714-473-5539 | Fax: 909-464-9236  
Email: [bmcguire@tcipowder.com](mailto:bmcguire@tcipowder.com)

- D. Erection: Contractor shall provide complete layout and shop drawings for review prior to ordering and construction. A sample of current stocked material shall also be submitted to ensure color accuracy due to potential color variations of stocked materials. Avoid the use of black lead pencils for marking Zinalume to prevent surface etching and corrosion. Use a pencil of any other color. Provide touch up powder coat of similar color paint to prevent rusting. Separate incompatible materials to prevent galvanic corrosion.

**Item 5**

**Permeable Interlocking Concrete Pavers**



- A. Vehicular - Permeable (On-Site)  
Belgard - Aqualine 4.5 x 9 x 80mm Permeable – Toscana, formerly Aqua Roc  
Pattern: Herringbone  
Substitutions: No substitutions permitted.



- B. Pedestrian - Interlocking (On-Site)  
Belgard - Holland 4 x 8 x 60mm - Toscana  
Polymeric Sand: Techniseal- HP NexGel – Tan  
Substitutions: No substitutions permitted.



- C. Pedestrian – Interlocking (Manhattan Avenue Parkway)  
Belgard – Avalon Slate 3-pc small and large pattern, Color: Bella  
Substitutions: Substitutions for an approved equal product that closely matches the existing pavers along the Manhattan Avenue is permitted.  
Contractor to submit samples of proposed alternatives for approval.

Contact: Yvonna Garcia  
Belgard Architectural Consultant – Southern California  
10714 Poplar Ave., Fontana, CA 92337  
Cell: 949 281-9692

# **PART II**

## **GENERAL SPECIFICATIONS**

## SECTION 010000 - INITIAL SUBMITTAL REQUIREMENTS

### 1.01 INITIAL SUBMITTAL REQUIREMENTS

A. Submittal requirements shall be as stipulated in the General and Special Provision and as follows:

1. Within fifteen (15) days of receiving of Notice to Award, Contractor shall submit all insurance requirements, executed agreement and progress schedule.

B. Existing Site Conditions Video:

The Contractor and the City's representative shall video record all work areas prior to any equipment being moved to the site. Contractor shall utilize a video service such as "Video Fact" (<http://videofact.net/>) or approved equal. Video/photography of properties outside the immediate work area as designated by the plans, specifications, and ownership of City is prohibited, specifically adjacent private residences. The Contractor shall provide two copies of DVD's to the City as a construction submittal before the contractor mobilizes to the site.

These DVD's shall serve as a record of the existing conditions for disputes arising from restoration, and should therefore be taken along the line of construction and site access and staging areas at sufficient detail as necessary to clearly depict details of existing conditions. Videos shall be clear and descriptive. The DVD's shall be standard and in color. All DVD's shall be indexed and catalogued in such a manner that each videoed area is readily identifiable, and shall also indicate the date and time (hour, minutes, and seconds) on which the video was made. The Contractor shall also video any unusual conditions encountered during construction that are not already a matter of photographic record. In any areas where existing conditions cannot be determined by means of videos, the area shall be restored as approved by the Engineer at Contractor's expense. All DVD's shall become the property of the City. Cost of videoing shall be included as part of the mobilization bid item.

END OF SECTION 010000

## SECTION 010450 - EXISTING FACILITIES

### 1.01 DESCRIPTION

This section includes requirements for connection to and abandonment of existing sewer facilities.

### 1.02 LOCATION

- A. The Contractor shall be responsible for determining in advance the location of all existing pipelines to which connections are to be made.
- B. The Contractor shall notify Underground Service Alert of Southern California (Dig Alert) at least two working days prior to construction at 811.

### 1.03 CONDITION OF EXISTING FACILITIES

The City does not warranty the condition, size, material, and location of existing facilities. The Contractor shall be responsible for verifying the properties of the existing pipe that will be connected to the proposed piping.

### 1.04 PROTECTION OF EXISTING UTILITIES AND FACILITIES

- A. The Contractor shall be responsible for the care and protection of all existing sewer pipe, water pipe, gas mains, culverts, power or communications lines, sidewalks, curbs, pavement, or other facilities and structures that may be encountered in or near the area of the work.
- B. The Contractor shall submit a plan as to the method the Contractor will use to protect and support any utilities which will become exposed during excavation or that which are vulnerable to failure due to unsupported trenches or other construction activity.
- C. In the event of damage to any existing facilities during the progress of the work and of the failure of the Contractor to exercise the proper precautions, the Contractor will pay for the cost of all repairs and protection to said facilities. The Contractor's work may be stopped until repair operations are complete.

### 1.05 PROTECTION OF LANDSCAPING

- A. The Contractor shall be responsible for the protection of all the trees, shrubs, irrigation systems, fences, and other landscape items adjacent to or within the work area, unless they are directed to do otherwise on the plans.

1.06 MATERIALS

All materials used in making the connection or removing the facility from service shall be per the project plans

1.08 REMOVAL FROM SERVICE OF EXISTING MAINS AND APPURTENANCES

- A. General: Existing mains and appurtenances shall be removed from service at the locations shown on the plans or as directed by the City Representative.
- B. Storage of Removed Material: Removed pipe and appurtenances may be temporarily stockpiled on the job in a location that will not disrupt traffic or be a safety hazard, or it may be delivered to the City yard as directed by the City Representative. In all cases the Contractor shall be responsible for the final disposal of all removed materials, including asbestos cement pipe.
- C. Asbestos Cement Pipe (ACP): Asbestos cement pipe shall be removed at the joint or fitting, and disposed of in a proper manner. No field cutting of ACP shall be allowed. The Contractor shall be responsible for the proper manifesting of the ACP at an authorized disposal site.
- D. Maintenance of Service: Prior to performing any work to replace existing pipes and/or services, the Contractor shall make proper provisions for the maintenance and continuation of service as directed by the City Representative.

END OF SECTION 010450

## SECTION 011000 - CONSTRUCTION SURVEY STAKING

### ~~1.01 SURVEY STAKING FOR CLEARING LANDS AND RIGHTS OF WAY:~~

- ~~A. City shall provide field markers along both sides of the construction right of way (except where a side is contiguous with an improved road, street, or property) at horizontal curve BCs and ECs, at angle points, and at 100-foot maximum intervals in horizontal curves and 500-foot maximum intervals along horizontal tangent runs.~~
- ~~B. Markers will be wooden laths in open terrain and painted marks on structures and pavements.~~

### 1.02 SURVEY STAKING FOR CONSTRUCTING PIPELINES

- A. For use in constructing pipelines, construction stakes and grade sheets shall be provided by the City.
- B. For pipelines not installed in tunnels or casings, one stake will be set at 50-foot intervals for water lines and at all angle points and grade breaks. One additional reference stake and/or witness lath will be provided for each pipeline appurtenance. Stakes will be set at the surface of the ground or painted on the paved surface of the ground or painted on the paved surface along a mutually acceptable offset to the centerline of the pipeline. The offset shall be constant both as to side and distance from centerline for runs of not less than 2,000 feet where physically practicable with the provided easements. Station, offset, and cut/fill to flow line will appear on these stakes. The elevation of each point and the cut/fill to the pipe invert will be given on grade sheets. The Contractor shall exercise care in determining what offset is to be used, if sloping of the trench is anticipated. In no instance will the City's Representative stake safety sloping. It shall be the CONTRACTOR'S responsibility to accurately transfer the line and grade for the facility to the trench bottom. Pavement scoring, cutting, and removal shall be accomplished from this same set of construction stakes. No additional stakes will be set for such purpose.
- C. For pipe inside tunnels, two benchmarks and principal control monuments shall be provided for line and grade inside the tunnel or casing. The exact location of these benchmarks and monuments will be dictated by conditions at the site.

### 1.03 SURVEY STAKING FOR CONSTRUCTING STRUCTURES AND APPURTENANCES

- ~~A. City shall provide survey staking and reference points.~~

- B. Major structures will be controlled by two lines set at right angles to each other, along two faces of the structure, the ends of each line to be beyond the limits of the work, and with elevations only marked on at least two of these control points.
- C. Minor structures, manways, and appurtenances will have a stake set along the pipeline construction offset, with the respective pipeline station for its centerline shown.
- D. Stakes will be provided after site rough grading has been completed.

~~1.04 CONSTRUCTION STAKING PROVIDED BY THE CITY SHALL BE SUBJECT TO THE FOLLOWING CONDITIONS~~

- ~~A. The request for construction stakes shall be received in writing at least three (3) working days in advance of needed staking on the form provided in the Appendix.~~
- ~~B. The stakes, reference markers, and other survey points shall be carefully preserved. Otherwise, the Contractor will be charged for their replacement and will assume any expense resulting from their loss or disturbance. Should the City's Representative be required to reset construction stakes, the cost for such resetting will be at the then current per diem rates. The full charges will include additional administrative and supervisory time charges as billed to the City and will be deducted by the City from the progress payments to the Contractor for the month in which the surveying work is done, and thereon paid to the City's Representative.~~
- ~~C. Unless otherwise specified, the construction staking provided by the City's Representative will be only for those items specified to be constructed or reconstructed on the plans or in the specifications. Any additional construction stakes required for the replacement of existing improvements that have been removed or disturbed at the CONTRACTOR'S option shall be the CONTRACTOR'S responsibility.~~
- ~~D. City shall pay for one set of construction survey staking as requested by Contractor on the form included in the Appendix.~~

1.05 COMMENCEMENT OF WORK

- A. Work shall not proceed until construction stakes, which constitute instructions from the City's representative, are provided.

END OF SECTION 011000

## SECTION 011100 - COMPACTION TESTING

### 1.01 REQUIREMENTS

- A. The City shall perform all compaction tests on backfill.
- B. The request for compaction testing shall be made to the City in writing at least forty-eight (48) hours before the Contractor is ready for compaction tests to be taken.
- C. The Contractor shall make available construction equipment necessary to assist the CITY'S Representative in taking the tests.
- D. If the backfill should fail the compaction test, the Contractor shall pay the cost of retesting.
- E. If the Contractor is not ready to have compaction tests taken at the time and in the locations indicated on the written request, the Contractor shall be responsible for all standby charges and/or return visit costs to take the requested tests.
- F. If the Contractor plans to use imported sand or other imported material for backfill, a sample of the material to be used for the backfill shall be delivered to the \_\_\_\_\_ for testing, prior to the commencement of backfilling. If the test fails, the Contractor shall pay the cost of retesting.

END OF SECTION 011100

**SECTION 012000 - REQUESTS FOR INFORMATION (RFI)**

1.01 GENERAL

- A. CONTRACTOR shall submit a Request for Instruction (RFI) to CITY if CONTRACTOR:
1. requires instruction pursuant to General Provision Errors or Discrepancies Noted by CONTRACTOR,
  2. raises a question requiring clarification,
  3. requests product or material changes,
  4. requests design changes, or
  5. requires other information from CITY.

1.02 RFI SUBMITTAL PROCEDURE

All RFIs shall be submitted on CITY Forms and shall include all backup information. Backup information shall include, but not be limited to, CONTRACTOR verified field measurements, quantities, dimensions, installation requirements, materials, catalog number, and any other information that will assist the CITY in reviewing the RFI. A copy of RFI form can be found in the Appendix.

1.03 CITY RESPONSE

Within seven (7) days of receipt of RFI, CITY will either return a response to the RFI or notify CONTRACTOR when a response will be issued.

1.04 COMMENCEMENT OF RFI-RELATED WORK

No portion of the work requiring instruction from CITY shall begin until RFI has been reviewed by CITY and returned to CONTRACTOR with instruction or with notation indicating CITY response is not necessary.

END OF SECTION 012000

## SECTION 013000 - CONTRACTOR SUBMITTALS

### 1.01 GENERAL

- A. Wherever submittals are required hereunder, all such submittals by the Contractor shall be submitted to the City.
- B. Within 14 days after the date of commencement as stated in the Notice to Proceed, the Contractor shall submit the following items to the City for review.
  - 1. A preliminary schedule of Shop Drawing, Sample, and proposed Substitutes or "Or Equal" submittals.
  - 2. A list of all permits and licenses the Contractor shall obtain indicating the agency required to grant the permit and the expected date of submittal for the permit and required date for receipt of the permit.

### 1.02 SHOP DRAWINGS

- A. Wherever called for in the Contract, or where required by the City, the Contractor shall furnish to the City for review, six (6) copies of each shop drawing submittal. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, list, graphs, catalog sheets, data sheets, and similar items. Whenever the Contractor is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is to be built, unless otherwise directed.
- B. Except as may otherwise be indicated herein, the City will return two (2) prints of each submittal to the Contractor with its comments noted thereon, within 14 calendar days following their receipt by the City.
- C. If the submittal is returned to the Contractor marked "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required.
- D. If the submittal is returned to the Contractor marked "MAKE CORRECTIONS NOTED," formal revision and resubmission of said submittal will not be required.
- E. If the submittal is returned to the Contractor marked "REVISE-RESUBMIT," the Contractor shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the City.

- F. If the submittal is returned to the Contractor marked "REJECTED-RESUBMIT," the Contractor shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the City.
- G. Fabrication of an item shall be commenced only after the City has reviewed the pertinent submittals and returned copies to the Contractor marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis for changes to the contract requirements.
- H. All Contractor shop drawings submittals shall be carefully reviewed by an authorized representative of the Contractor, prior to submission to the City. Each submittal shall be dated, signed, and certified by the Contractor, as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed, and certified. No consideration for review by the City of any Contractor submittals will be made for any items which have not been so certified by the Contractor. All non-certified submittals will be returned to the Contractor without action taken by the City, and any delays caused thereby shall be the total responsibility of the Contractor.
- I. The City's review of Contractor shop drawings submittals shall not relieve the Contractor of the entire responsibility for the correctness of details and dimensions. The Contractor shall assume all responsibility and risk for any misfits due to any errors in Contractor submittals. The Contractor shall be responsible for the dimensions and the design of adequate connections and details.

#### 1.03 PROPOSED SUBSTITUTES OR "EQUAL" ITEM SUBMITTAL

- A. Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the naming of the item is intended to establish the type, function, and quality required. If the name is followed by the words "or equal" indicating that a substitution is permitted, materials or equipment of other Suppliers may be accepted by the Engineer if sufficient information is submitted by the Contractor to allow the Engineer to determine that the material or equipment proposed is equivalent or equal to that named, subject to the following requirements.
  - 1. The burden of proof as to the type, function, and quality of any such substitute material or equipment shall be upon the Contractor.
  - 2. The Engineer will be the sole judge as to the type, function, and quality of any such substitute material or equipment and Engineer's decision shall be final.

3. The Engineer may require the Contractor to furnish at the Contractor's expense additional data about the proposed substitute.
  4. The City may require the Contractor to furnish at the Contractor's expense a special performance guarantee or other surety with respect to any substitute.
  5. Acceptance by the Engineer of a substitute item proposed by the Contractor shall not relieve the Contractor of any responsibility for full compliance with the Contract Documents and for adequacy of the substitute item.
  6. The Contractor shall be responsible for resultant changes and all additional costs which the accepted substitution requires in the Contractor's work, the work of its subcontractors and of other contractors, and shall effect such changes without cost to the City.
- B. The procedure for review by the Engineer will include the following:
1. If the Contractor wishes to furnish or use a substitute item of material or equipment, the Contractor shall make written application to the Engineer on the "Substitutions Request Form" for acceptance thereof.
  2. Unless otherwise provided by law or authorized in writing by the Engineer the "Substitution Request Form(s)" shall be submitted within the 30 day period after award of the Contract.
  3. Wherever a proposed substitute material or equivalent has not been submitted within said 30 day period, or wherever the submission of a proposed substitute material or equipment has been judged to be unacceptable by the Engineer, the Contractor shall provide the material or equipment named in the Contract Documents.
  4. The Contractor shall certify that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar and of equal substance to that specified, and be suited to the same use as that specified.
  5. The Engineer will be allowed a reasonable time within which to evaluate each proposed substitute.
  6. As applicable, no shop drawing submittals will be made for a substitute item nor will any substitute item be ordered, installed, or utilized without the Engineer's prior written acceptance of the Contractor's "Substitution Request Form" which will be evidenced by a Change Order.

- C. The Contractor's application using the "Substitution Request Forms" shall contain the following statements and/or information which shall be considered by the Engineer in evaluating the proposed substitution:
  - 1. The evaluation and acceptance of the proposed substitute will not prejudice the Contractor's achievement of substantial completion on time.
  - 2. Whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents to adopt the design to the proposed substitute.
  - 3. Whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty.
  - 4. All variations of the proposed substitute for that specified will be identified.
  - 5. Available maintenance, repair, and replacement service will be indicated.
  - 6. Itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, including cost of redesign and claims or other contractors affected by the resulting change.

#### 1.04 SAMPLES SUBMITTAL

- A. Whenever in the Specifications samples are required, the Contractor shall submit not less than 3 samples of each item or material to the Engineer.
- B. Samples, as required herein, shall be submitted for acceptance a minimum of 21 days prior to ordering such material for delivery to the jobsite, and shall be submitted in any orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the Work.
- C. All samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and Manufacturer's name of identification and submitted to the Engineer for acceptance. Upon receiving acceptance of the Engineer, one set of the samples will be stamped and dated by the Engineer and returned to the Contractor, and one set of samples will be retained by the Engineer, and one set of samples shall remain at the job site until completion of the Work.
- E. Unless indicated otherwise, all colors and textures of specified items presented in sample submittals shall be from the manufacturer's standard colors and standard materials, products, or equipment lines.

#### 1.05 CRITICAL EQUIPMENT SUBMITTALS

The Contractor shall make submittals to the City in a timely manner for the Work to be completed within the specified Contract Time. For the following items, inquiry reveals that potentially long lead times for delivery are required, making these items critical for the completion of the Work within the Contract Time.

- Masonry Blocks, Burnished
- Decorative Permeable Pavers
- Drainage Pipes and Inlets
- Water Quality Filter Inserts and Screens
- Electric Vehicle Charging Systems
- Multi-Space Parking Pay Stations
- Lighting Poles, Wall Packs, etc.
- Guardrail and Handrail
- Trash Enclosure (Gates and Roofing)
- Solar Equipment (Canopy and Footing, Battery and Appurtenances)
- ~~Precast Concrete Water Quality Treatment Unit~~
- ~~Precast Concrete Vault~~
- ~~Precast Shade Structure~~
- ~~Pump systems~~

The preceding list does not necessarily include all critical equipment items. The Contractor shall be responsible for identification and timely submittal of all equipment items. The Engineer will endeavor to expedite submittal review of the critical equipment items to aid in reducing submittal-processing time.

#### 1.06 SHOP DRAWINGS

The Contractor shall furnish to the City such working drawings, data on materials, calculations, and equipment and samples as are required for the proper control of the work, including, but not limited to the following:

- A. Pavement and concrete mix design.
- B. Pipe and fittings.
- C. Bolts, nuts and gaskets.
- D. Precast concrete vaults and drain boxes.
- E. Trench and slot drains.
- F. Trench shoring design and details per General Provisions.

All working drawings, data, and samples, shall be subject to review by the Engineer for conformity with the drawings and specifications.

#### 1.07 RECORD DRAWINGS SUBMITTALS

- A. The Contractor shall keep and maintain, at the job site, one record set of Drawings. On these, it shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Contract Drawings. Said record drawings shall be supplemented by any detailed sketches as necessary or directed to indicate, fully, the Work as actually constructed. These master record drawings of the Contractor's representation of as-built conditions, including all revisions made necessary by addenda and change orders shall be maintained up to date during the progress of the Work.
  
- B. In the case of those drawings which depict the detail requirement for equipment to be assembled and wired in the factory, such as motor control centers and the like, the record drawings shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings, and by including appropriate reference information describing the change orders by number and the shop drawings by manufacturer, drawing, and revision numbers.
  
- C. Record drawings shall be accessible to the Engineer at all times during the construction period and shall be delivered to the Engineer upon completion of the Work.
  
- D. Upon substantial completion of the Work and prior to final acceptance, the Contractor shall complete and deliver a complete set of record drawings to the Engineer for transmittal to the City, conforming to the construction records of the Contractor. This set of drawings shall consist of corrected drawings showing the reported location of the Work.

The information submitted by the Contractor and incorporated by the Engineer into the Record Drawings will be assumed to be reliable, and the Engineer will not be responsible for the accuracy of such information, nor for any errors or omissions which may appear on the Record Drawings as a result.

END OF SECTION 013000

## SECTION 014000 – PRE-CONSTRUCTION CONFERENCES

### 1.01 PRECONSTRUCTION CONFERENCE

- A. Upon issuance of Notice to Proceed, or earlier when mutually agreeable, CITY will arrange a preconstruction conference in a convenient place for most persons invited.
- B. CONTRACTOR'S superintendent, CITY, Engineer/Architect representatives of utilities, major subcontractors and others involved in performance of the Work, and others necessary to agenda shall attend Preconstruction Conference.
- C. CITY will preside at conference.
- D. Purpose of Conference: To establish working understanding between parties and to discuss Construction Schedule, shop drawing and other submittals, cost breakdown of major lump sum items, processing of submittals and applications for payment, and other subjects pertinent to execution of the Work.
- E. Agenda Will Include:
  - 1. Adequacy of distribution of Contract Documents.
  - 2. Distribution and discussion of list of major subcontractors and suppliers.
  - 3. Proposed progress schedules and critical construction sequencing.
  - 3. Major equipment deliveries and priorities.
  - 4. Project coordination.
  - 5. Permits and Permit Conditions
  - 6. ~~Environmental (CEQA/NEPA) Mitigation Requirements~~
  - 7. Designation of responsible personnel.
  - 8. Procedures and Processing of:
    - a. Field decisions
    - b. Proposal requests
    - c. Submittals
    - d. Change Orders
    - e. Applications for Payment
    - f. Record Documents
  - 9. Use of Premises:
    - a. Office, construction, and storage areas
    - b. CITY'S requirements
  - 10. Construction facilities, controls, and construction aids
  - 11. Coordination of construction with CITY operations and others

12. Temporary utilities
  13. Safety and first aid procedures
    - a. Contractor to submit safety plan to included Cal OSHA Requirements
    - b. Contractor Emergency Contacts List
  14. Housekeeping procedures
  15. Security procedures
- F. CITY will record minutes of meeting and distribute copies of minutes within seven (7) days of meeting to participants and interested parties.

END OF SECTION 014000

## SECTION 014100 - CONSTRUCTION SAFETY PROCEDURES

### 1.01 GENERAL

- A. CONTRACTOR shall assure that each employee is trained in the work practices necessary to safely perform his/her job.
- B. CONTRACTOR shall assure that each employee is instructed in the known potential hazards related to his/her job and the process, and the applicable provisions of the emergency action plan for the plant or facility as covered during CONTRACTOR safety orientation.
- C. CONTRACTOR shall document that each employee has received and understood the training required. The documentation shall contain the identity of the employee, the date of training, and the means used to verify that the employee understood the training. Documentation shall be submitted to CITY upon request.
- D. CONTRACTOR shall advise CITY of any unique hazards presented by the CONTRACTOR'S work.
- E. CONTRACTOR shall immediately notify CITY of any hazards found or discovered during the course of the work.
- F. CONTRACTOR shall comply with the Cal OSHA Construction Safety Orders.

### 1.02 CONSTRUCTION SAFETY

- A. CONTRACTOR shall submit a Construction Safety Plan detailing the methods and procedures for complying with California Labor Code Section 6401.7, Federal, and local health and safety laws, rules and requirements for the duration of the contract time. The plan shall include the following:
  - 1. Identification of the Safety Officer (or Consultant), who will prepare, initiate, maintain and supervise safety programs, and procedures.
  - 2. Procedures for providing workers with an awareness of safety and health hazards expected to be encountered in the course of construction.
  - 3. Safety equipment appropriate to the safety and health hazards expected to be encountered during construction.

4. Methods for minimizing employees' exposure to safety and health hazards expected during construction.
  5. Procedures for reporting safety or health hazards.
  6. Procedures to follow to correct a recognized safety and health hazard.
  7. Procedures for investigation of accidents, injuries, illnesses and unusual events that have occurred at the construction site.
  8. Periodic and scheduled inspections of general work areas and specific workstations.
  9. Training for employees and workers at the jobsite.
  10. Methods of communication of safe working conditions, work practices and required personal protection equipment.
- B. CONTRACTOR shall assume responsibility for every aspect of Health and Safety on the jobsite, including the health and safety of Subcontractors, suppliers, and other persons on the jobsite.
- C. CONTRACTOR'S Safety Officer shall periodically review job safety information and reports and make recommendations concerning worker health and safety at the jobsite.
- D. CONTRACTOR shall employ health and safety measures specified by the Safety Officer, as necessary, for workers in accordance with OSHA guidelines.
- E. CONTRACTOR shall transmit to CITY copies of reports and other documents related to accidents or injuries encountered during construction.

### **1.03 SAFETY PROCEDURES**

- A. Accident Prevention:
1. Exercise precautions throughout construction for protection of persons and property.
  2. Observe safety provisions of applicable Laws and Regulations.
  3. Guard machinery and equipment, and eliminate other hazards.

4. Make reports required by authorities having jurisdiction, and permit safety inspections of the Work.
  5. Before commencing construction Work, take necessary action to comply with provisions for safety and accident prevention.
- B. Barricades:
1. Place barriers at ends of excavations and along excavations to warn pedestrian and vehicular traffic of excavations.
  2. Provide barriers with flashing lights after dark.
  3. Keep barriers in place until excavations are entirely backfilled and compacted.
  4. Barricade excavations to prevent persons from entering excavated areas in streets, roadways, parking lots, treatment plants, or other public or private areas.
- C. Warning Devices and Barricades: Adequately identify and guard hazardous areas and conditions by visual warning devices and, where necessary, physical barriers.
1. Devices shall conform to minimum requirements of OSHA and State agency which administers OSHA regulations where Project is located.
- D. Hazards in Public Right-of-Way:
1. Mark at reasonable intervals, trenches and other continuous excavations in public right-of-way, running parallel to general flow of traffic, with traffic cones, barricades, or other suitable visual markers during daylight hours.
    - a. During hours of darkness, provide markers with torches, flashers, or other adequate lights.
  2. At intersections or for pits and similar excavations, where traffic may reasonably be expected to approach head on, protect excavations by continuous barricades.
    - a. During hours of darkness, provide warning lights at close intervals.
- E. Hazards in Protected Areas: Mark or guard excavations in areas from which public is excluded, in manner appropriate for hazard.

- F. Above Grade Protection: On multi-level structures, provide safety protection that meets requirements of OSHA and State agency which administers OSHA regulations where Project is located.
- G. Protect existing structures, trees, shrubs, and other items to be preserved on Project site from injury, damage or destruction by vehicles, equipment, worker or other agents with substantial barricades or other devices commensurate with hazards.
- H. Fences: Enclose site of the Work with fence adequate to protect the Work against acts of theft, violence and vandalism.

END OF SECTION 014100

**SECTION 014400 - TEMPORARY FACILITIES AND CONTROLS**

1.01 CONSTRUCTION WATER

- A. Construction water shall available through the water purveyor for the Work.
- B. Construction water will be available at a fire hydrant located at the corner of 14<sup>th</sup> Street and Palm Drive. Contractor must complete a construction hydrant meter application, application fee, and submit a meter deposit with the water purveyor. ~~The City will pay for the cost of construction water.~~

1.02 CONSTRUCTION POWER

Temporary power is not available. Contractor shall provide for the purchase of power or provide portable power for the Work.

1.03 DUST CONTROL

- A. Contractor shall provide the means and methods for controlling dust generated by work on the site at or below ambient dust levels for the City's acceptance.

1.04 NOISE ABATEMENT

The Contractor shall comply with the following:

- A. State and local requirements as to allowable noise levels during construction.
- B. Equip all internal combustion engines in vehicles and construction equipment with effective mufflers.
- C. Prevent noise disturbance to adjoining property owners and the public.
- ~~D. Project Mitigated Negative Declaration.~~
- E. Permits.

END OF SECTION 014400

## SECTION 015200 - CLOSEOUT PROCEDURES

### 1.01 FINAL CLEANING

- A. Perform final cleaning prior to inspections for Final Acceptance.
- B. Use cleaning materials which are recommended by manufacturers of surfaces to be cleaned.
- C. Prevent scratching, discoloring, and otherwise damaging surfaces being cleaned.
- D. Broom clean exterior paved surfaces and rake clean other surfaces of site work. Inspect yards and grounds to keep clean.
- E. Remove dust, cobwebs, and traces of insects and dirt.
- F. Clean grease, mastic, adhesives, dust, dirt, stains, fingerprints, paint, blemishes, sealants, plaster, concrete, and other foreign materials from sight-exposed surfaces, and fixtures and equipment.
- G. Remove non-permanent protection and labels.
- H. Polish glossy surfaces to clear shine.

### 1.02 WASTE DISPOSAL

- A. Surplus materials, waste products, and other debris shall be properly disposed off-site.

### 1.03 TOUCH-UP AND REPAIR

- A. Touch-up, repair, or replace finished surfaces on structures, equipment and installation that have been damaged prior to inspection for final acceptance.

1.04 CLOSEOUT DOCUMENTS

- A. Submit following closeout documents upon completion of the Work, and at least 7 days prior to application for Final Payment:
  - 1. Project Record Documents, including:
    - Record drawings
    - Testing reports
    - Survey data
  - 2. Warranties and Bonds
  - 3. Spare Parts

END OF SECTION 015200

## **SECTION 018400 - BASIS OF MEASUREMENT FOR PAYMENT**

### **1.01 BID SCHEDULE ITEMS**

The price paid for the work items listed in the Bid Schedule shall include full compensation for furnishing the labor, material, tools and equipment and doing all of the related and incidental work involved to complete the work per the plans, specifications and contract documents. Contractor will include the cost of work not listed but necessary to complete the project designated in the Contract Documents in the various listed work items on the Bid Form.

The General Provisions and specifications which are not listed in the schedule of work items of the bid form are, in general, applicable to more than one listed work item, and no separate work item is provided therefore. Include the cost of work not listed, but necessary to complete the project designated in the contract documents, in the various listed work items of the bid form. This shall include, but not be limited to, keeping a neat and orderly work site, free of trash, and based on the City's site inspections, the City shall back-charge the Contractor for any remedial trash pickup determined to be required by the City.

The bids for the work are intended to establish a total cost for the work in its entirety. Should the Contractor feel that the cost for the work has not been established by specific items in the bid form, he shall include the cost for that work in some related bid item so that his proposal for the project does reflect his total cost for completing the work in its entirety.

Work for bid schedule items shall be constructed per the plans, specifications and contract documents, complete-in-place.

END OF SECTION 018400

# **PART III**

## **CIVIL SPECIFICATIONS**

## SECTION 017420 - STORMWATER POLLUTION CONTROL

### PART 1 - GENERAL

#### 1.1 PERFORMANCE

##### A. Minimum Water Quality Protection Requirements

1. The Contractor is required to meet the following minimum standards of good housekeeping:
  - a. Eroded sediments and other pollutants must be retained on site and may not be transported from the site via sheet flow, swales, area drains, natural drainage, or wind.
  - b. Stockpiles of earth and other construction-related materials must be protected from being transported from the site by wind or water.
  - c. Fuels, oils, solvents, and other toxic materials must be stored in accordance with their listing and are not to contaminate the soil nor the surface waters. All approved toxic storage containers are to be protected from the weather. Spills must be cleaned up immediately and disposed of in a proper manner. Spills may not be washed into the drainage system.
  - d. Excess or waste concrete may not be washed into the public way or any drainage system. Provisions shall be made to retain concrete wastes on-site until they can be appropriately disposed of or recycled.
  - e. Trash and construction-related solid wastes must be deposited into a covered receptacle to prevent contamination of rainwater and dispersal by wind.
  - f. Sediments and other materials may not be tracked from the site by vehicle traffic. The construction entrance roadways must be stabilized so as to inhibit sediments from being deposited into the public ways. Accidental depositions must be swept up immediately and may not be washed down by rain or by any other means.

##### B. Wet Weather Erosion Control Plan (WWECP)

1. The Contractor shall prepare a Wet Weather Erosion Control Plan (WWECP) and implement Best Management Practices (BMPs) necessary.

##### C. Stormwater Pollution Prevention Plan

1. The Contractor shall prepare applicable sections and comply with The Stormwater Pollution Prevention Plan (SWPPP). The Contractor shall complete and submit the Notice of Intent to construct under the California Construction General Permit (NPDES). The Contractor shall implement Best Management Practices (BMPs) necessary to control

- stormwater pollution from sediments, erosion, and construction materials leaving the construction site.
2. The BMPs contained in the Development Best Management Practices Handbook – Part A, Construction Activities cover the following categories of construction activities:
    - a. Site preparation/earth removal
    - b. Underground structures
    - c. Aboveground structures
    - d. Roadways, walkways and parking lots
    - e. Planting and landscaping
  3. The SWPPP document shall include the following information:
    - a. The name, location, period of construction, and a brief description of the Project.
    - b. Contact information for the Contractor, including name, address, and telephone number.
    - c. Name, location, and description of any environmentally sensitive areas located on or adjoining the Project.
    - d. A list of major construction materials, waste, and activities.
    - e. A list of BMPs to be used to control pollutant discharges from major construction materials, wastes, and activities.
    - f. A site plan (a construction plan may be used) indicating the location of BMPs where appropriate.
    - g. A developer's certification statement that all required and selected BMPs will be effectively implemented.
  4. Whenever the Contractor is required to get any type of permit from the Department of Building and Safety (DBAS), the Contractor shall submit the SWPPP document to the DBAS for review and approval before obtaining the permit. If the Contractor does not need any type of permit from the DBAS, the Contractor shall submit the SWPPP document to the Project Manager for review and approval. At least one copy of the approved SWPPP shall be kept at the construction site and accessible to City inspectors.

END OF SECTION 017420

## SECTION 024116 - DEMOLITION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes demolition and removal of the following:
  - 1. Site improvements including site utilities.
  - 2. Protecting existing trees, shrubs, groundcovers, plants, and grass to remain.
  - 3. Removing existing trees, shrubs, groundcovers, plants, and grass.
  - 4. Clearing and grubbing.
  - 5. Stripping and stockpiling topsoil.
  - 6. Removing above- and below-grade site improvements.
  - 7. Disconnecting and capping or sealing site utilities.
  - 8. Temporary erosion and sedimentation control measures.
- B. See Division 26 Sections for demolishing or relocating site electrical items.

#### 1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or recycled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- C. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or recycled.

#### 1.3 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

#### 1.4 SUBMITTALS (Not Applicable)

#### 1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

- B. Standards: Comply with ANSI A10.6 and NFPA 241.
- C. Predemolition Conference: Conduct conference at Project site.

#### 1.6 PROJECT CONDITIONS

- A. Owner assumes no responsibility for buildings and structures to be demolished.
  - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- B. Hazardous Materials: Hazardous materials are present in buildings and structures to be demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
  - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
  - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
  - 3. Owner will provide material safety data sheets for materials that are known to be present in buildings and structures to be demolished because of building operations or processes performed there.
- C. Storage or sale of removed items or materials on-site is not permitted.
- D. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- E. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- F. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- I. Do not commence site-clearing operations until temporary erosion and sedimentation control measures are in place.

#### 1.7 COORDINATION

- A. Arrange demolition schedule so as not to interfere with Owner's, building manager's, and other tenants' on-site operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Survey existing conditions and correlate with requirements indicated to determine extent of building and site demolition required.
- B. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Inventory and record the condition of items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element. Promptly submit a written report to Architect.

3.2 PREPARATION

- A. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
  - 1. Arrange to shut off indicated utilities with utility companies.
  - 2. If utility services are required to be removed, relocated, or abandoned, before proceeding with building demolition provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
  - 3. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
- B. Existing Utilities: Refer to Division 22 (Plumbing) and 26 (Electrical) Sections for shutting off, disconnecting, removing, and sealing or capping mechanical or electrical utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.
- C. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
- D. Removed and Salvaged Items: Comply with the following:
  - 1. Clean salvaged items of dirt and demolition debris.
  - 2. Pack or crate items after cleaning. Identify contents of containers.
  - 3. Store items in secure area until delivery to Owner.
  - 4. Transport items to Owner's storage area designated by Owner.
  - 5. Protect items from damage during transport and storage.

- E. Protect and maintain benchmarks and survey control points from disturbance during construction.
- F. Locate and clearly flag trees and vegetation to remain or to be relocated.
- G. Protect existing site improvements to remain from damage during construction.  
Restore damaged improvements to their original condition, as acceptable to Owner.

### 3.3 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control Drawings.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### 3.4 TREE PROTECTION

- A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

### 3.5 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations.
- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during demolition and cleaned and reinstalled in their original locations after demolition operations are complete.
- C. Existing Utilities: Maintain utility services indicated to remain and protect them against damage during demolition operations.
  - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
  - 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.

- a. Provide at least 72 hours notice to Owner if shutdown of service is required during changeover.
- D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Division 1 Section "Temporary Facilities and Controls."
- 1. Protect existing site improvements, appurtenances, and landscaping to remain.
  - 2. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  - 3. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
  - 4. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.

### 3.6 DEMOLITION, GENERAL

- A. General: Demolish indicated existing buildings, structures, and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
- 1. Do not use cutting torches until work area is cleared of flammable materials. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
  - 2. Maintain adequate ventilation when using cutting torches.
  - 3. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Engineering Surveys: Perform surveys as the Work progresses to detect hazards that may result from building demolition activities.
- C. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
  - 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

### 3.7 MECHANICAL DEMOLITION

- A. Concrete: Cut concrete full depth at junctures with construction indicated to remain.
- B. Masonry: Cut masonry cleanly at junctures with construction indicated to remain.

- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished at junctures with construction indicated to remain, then break up and remove.
- D. Below-Grade Construction: Demolish foundation walls and other below-grade construction as indicated on Contract Documents.
  - 1. Remove below-grade construction, including basements, foundation walls, and footings, as indicated on Contract Documents.
- E. Existing Utilities: Demolish existing utilities and below-grade utility structures as indicated on Contract Documents.
  - 1. Fill abandoned utility structures with satisfactory soil materials according to backfill requirements in Division 31 Section "Earth Moving." Verify structures in field with Owner before proceeding.

### 3.8 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
  - 1. Arrange with utility companies to shut off indicated utilities.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Owner's written permission.

### 3.9 CLEARING AND GRUBBING

- A. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
- B. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

### 3.10 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3.11 EXPLOSIVE DEMOLITION

- A. Explosives: Use of explosives is not permitted.

3.12 SITE RESTORATION

- A. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Division 31 Section "Earth Moving."
- B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.13 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

3.14 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property. Coordinate disposal with LEED Requirements.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

3.15 REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by building demolition operations.
- B. Where repairs to existing surfaces are required, patch to restore surface to original or better condition.
- C. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.16 RECYCLING DEMOLISHED MATERIALS

- A. General: Separate recyclable demolished materials from other demolished materials to the maximum extent possible. Separate recyclable materials by type. Coordinate recycling of demolition materials with LEED Requirements.

1. Provide containers or other storage method approved by Architect for controlling recyclable materials until they are removed from Project site.
  2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  3. Stockpile materials away from demolition area. Do not store within drip line of remaining trees.
  4. Store components off the ground and protect from the weather.
  5. Transport recyclable materials off Owner's property and legally dispose of them.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling building demolition materials shall accrue to Owner

### 3.17 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill. Coordinate recycling of demolition materials with LEED Requirements.
1. Do not allow demolished materials to accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### 3.18 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION 024116

## SECTION 057316 - CABLE RAILINGS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES:

- A. Aluminum railings with cable infill.

#### 1.2 RELATED SECTIONS

- A. Section 03 62 13 - Non-Shrink Grouting.
- B. Section 05 15 13 - Aluminum Wire Rope Assemblies.

#### 1.3 REFERENCES

- A. American National Standards Institute (ANSI):
  1. ANSI A21.1 - Safety Requirements for Floor and Wall Openings, Railings and Toe Boards.
  2. ANSI A58.1 - Minimum Design Loads in Buildings and Other Structures.
  3. ICC/ANSI A117.1 - Accessible and Usable Buildings and Facilities.
- B. American Welding Society (AWS):
  1. AWS Specifications for Welding Rods and Bare Electrodes.
- C. Americans with Disabilities Act Accessibility Guidelines (ADAAG).
- D. ASTM International (ASTM):
  1. ASTM A 47 - Specification for Ferritic Malleable Iron Castings.
  2. ASTM A 269 - Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  3. ASTM A 276 - Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
  4. ASTM A 312 - Specification for Seamless and Welded Austenitic Stainless Steel Pipe.
  5. ASTM A 554 - Welded Stainless Steel Mechanical Tubing
  6. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  7. ASTM A1264-1 - Safety Requirements for Workplace Floor and Wall Openings, Stairs and Railing Systems
  8. ASTM B 221 Specification for Aluminum-Alloy Bars, Rods, Wires, Shapes and Tubes.
  9. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials.
  10. ASTM E 894 - Standard Test Methods for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
  11. ASTM E 935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
  12. ASTM E 985 - Specification for Permanent Metal Railing Systems and Rails for Buildings.

- E. General Service Administration (GSA) Federal Specifications (FS):
  - 1. QQ-S-766 - Stainless Steel, Class 302 or 304.
  
- F. International Code Council (ICC):
  - 1. International Building Code (IBC).
  - 2. International Residential Code (IRC).
  
- G. Military Specifications (MIL):
  - 1. MIL-C-5688 - Pre-Stretching and Proof-Testing of Wire Rope Assemblies.
  - 2. MIL-P-1144 - Pipe, Corrosion Resistant, Stainless Steel, Seamless or Welded.
  - 3. MIL-P-25995 - Pipe, Aluminum Alloy, Drawn or Extruded.
  - 4. MIL-R-36516 - Rail, Restraint.
  - 5. MIL-W-87161 - Wire Strand, Non-Flexible, for Aircraft Control. Oil Free Condition.
  
- H. National Association of Architectural Metal Manufacturers (NAAMM) and National Ornamental and Miscellaneous Metals Association (NOMMA):
  - 1. NAAMM Metal Finishes Manual.
  
- I. National Association of Architectural Metal Manufacturers (NAAMM):
  - 1. NAAMM Pipe Railing Manual.
  - 2. NAAMM Metal Stair Manual.
  
- J. National Association of Home Builders (NAHB):
  - 1. Model Green Home Building Guidelines.
  
- K. National Association of Home Builders' Research Center (NAHBRC):
  - 1. Review of Fall Safety of Children between the Ages of 18 Months and 4 Years in Relations to Guards and Climbing in the Built Environment.
  
- L. National Fire Protection Association (NFPA):
  - 1. 101 - Life Safety Code.
  
- M. Institute of Building Sciences (IBS):
  - 1. IBS Metric Guide for Federal Construction.
  
- N. U.S. Green Building Council:
  - 1. The Leadership in Energy and Environmental Design (LEED) Green Building Rating System.

#### 1.4 DEFINITIONS

- A. Refer to definitions in ASTM E985 for railing-related terms that apply to this Section.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. General: Handrails and railings shall withstand structural loading as determined by allowable design working stresses of materials.

- B. Structural Performance: Provide handrails and railings capable of withstanding the following structural loads without exceeding allowable design working stress of materials for handrails, railings, anchors, and connections.
  - 1. Components and installation shall be in accordance with state and local code authorities.
  - 2. Components and installation shall follow current ADA and ICC/ANSI A117.1 guidelines.
  - 3. Top Rail: Shall withstand the following loads.
    - a. Concentrated load of 200 lb applied at any point and in any direction.
    - b. Uniform load of 50 lb/ft. applied horizontally and concurrently with uniform load of 100 lb/ft. applied vertically downward.
    - c. Concentrated and uniform loads above need not be assumed to act concurrently.
  - 4. Handrails Not Serving as Top Rails: Shall withstanding the following loads.
    - a. Concentrated load of 200 lb applied at any point and in any direction.
    - b. Uniform load of 50 lb/ft. applied in any direction.
    - c. Concentrated and uniform loads above need not be assumed to act concurrently.
  - 5. Guard Infill Area: Shall withstand the following loads.
    - a. Concentrated horizontal load of 200 lb applied to 1 square foot at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area. Loads need not be assumed to act concurrently with loads on top rails in determining stress on guard.
- C. Thermal Movements: Handrails and railings shall allow for movements resulting from 120 deg F (49 deg C) changes in ambient and 180 deg F (82 deg C) surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- D. Corrosion Resistance: Separate incompatible materials to prevent galvanic corrosion.

## 1.6 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including, but not limited to, the following:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
  - 4. Grout, anchoring cements and paint products.
- C. Shop Drawings: Submit shop drawings showing fabrication and installation of handrails and railings. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Provide setting diagrams for installation of anchors, location of pockets, weld plates for attachment of rails to structure, and blocking for attachment of wall rail.
  - 2. Indicate all required field measurements to be held.

3. Indicate materials, sizes, styles, fabrication, anchorage and installation details for railing system and infill.
  4. Signed and Sealed Shop Drawings to be provided by a Registered Professional Engineer registered in the jurisdiction of the project.
- D. Certifications:
1. Furnish certification that all components and fittings are furnished by the same manufacturer or approved by the primary component manufacturer.
  2. Furnish certification that components were installed in accordance to the manufacturer's engineering data to meet the specified design loads.
- E. Samples:
1. Post and rail sections, minimum 4 inch (100 mm) long piece of each type.
  2. Infill Cable: Minimum 8 inch (200 mm) long piece with end fittings.
  3. Verification Samples: For each type of exposed finish required, prepared on components indicated below and of same thickness and metal indicated for the work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
    - a. 6 inches (152 mm) long sections of each different linear railing member, including handrails and top rails.
- F. Quality Control Submittals:
1. Certificates: Submit certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOC's).

## 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of aluminum handrails and railings of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of 5 years.
- B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.
- C. Installer Qualifications: Minimum 2 years' experience installing similar systems.
- D. Pre-Installation Meeting:
1. Prior to the beginning of work, conduct a pre-job conference at the job site.
  2. Provide seven calendar days advance written notice ensuring the attendance by competent authorized representatives of the fabricator, building owner's representative, architect and subcontractors whose work interfaces with the work of this section.
  3. Review the specifications to determine any potential problems, changes, scheduling, unique job site conditions, installation requirements and procedures and any other information pertinent to the installation.
  4. Record the results of the conference and furnish copies to all participants.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

#### 1.9 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

#### 1.10 WARRANTY

- A. Special Warranty: Provide manufacturer's standard form outlining the terms and conditions of their standard Limited Warranty:
  - 1. Cable and Connectors: 10 year limited warranty against defects in materials and workmanship.
  - 2. Paint Finish on Aluminum Extrusions and Components: 10 year limited warranty against cracking, flaking, blister, and peeling.
- B. Additional Owner Rights: The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Stainless Cable & Railing Inc., which is located at: 3315 N.E. 112th Ave. Suite 73; Vancouver, WA 98682; Toll Free Tel: 888-686-7245 (RAIL); Tel: 360-314-4288; Fax: 888-686-7245; Email: request info (sales@stainlesscablerailing.com); Web: <http://stainlesscablerailing.com>
- B. Substitutions: Not permitted.

#### 2.2 ALUMINUM RAILINGS WITH CABLE INFILL

- A. Aluminum Railings with Cable Infill.
  - 1. Mounting: Core Mounted Posts.
  - 2. Rail Height: 36 inches (914 mm).
  - 3. Top Rail Type: Aluminum Shaped.
  - 4. Foot Rail / Handrail Type: Aluminum Post-To-Post (stand-alone).
  - 5. Color: Natural.
- B. Square Extruded Aluminum Components: Provide manufacturer's standard extruded aluminum components as follows:
  - 1. Intermediate Post (Standard): 2.362 inches (60 mm) by 2.362 inches (60 mm) with radiused corner, 0.079 inch (2 mm) wall thickness.
  - 2. Cable Assemblies: 3/16 inch (4.8 mm) 1x19 fittings to be sized according to cable diameter. Fittings to be 316 measure grade stainless.

3. Top Rail: Cable View Shaped Top Rail, rectangular cross section 3-1/2 inch by 1-3/4 inch (90 by 48 mm) by .079 inch (2 mm) thick extruded aluminum.
  4. Foot Rail / Handrail: Post-To-Post profile 1-7/8 inch by 1-3/16 inch (50 by 30 mm) by .07874 inch (2.0 mm) thick extruded aluminum.
  5. End Caps: Aluminum end caps for exposed open ends of rails, tubes, and profiles.
- C. Aluminum Material:
1. Extruded Pipe: Alloy 6005-T52, ASTM B 221.
  2. Extruded Bars, Shapes and Mouldings: Alloy 6063-T6, ASTM B 221.
- D. Aluminum Finish: NAAMM/NOMMA Metal Finishes Manual. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
1. Powder Coat Finish: AA-C12-C42-R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply manufacturer's standard baked powder coat finish. Comply with coating manufacturer's written instructions for cleaning, surface preparation, pretreatment, and application.
    - a. Color: Natural.

## 2.4 CABLE RAILING COMPONENTS

- A. Cables:
1. Material: 1 x 19, Type 316 stainless steel strand, left-hand lay, per dimensional properties contained in MIL-DTL-87161.
  2. Finish: Mill.
  3. Diameter: 3/16 inch (5 mm), minimum breaking strength of 4000 pounds.
  4. Spacing: Maximum 3 inches (76 mm) on center.
  5. Cable Hardware Components, as applicable:
    - a. Material: Stainless steel, ASTM A276 and A479, SAE/AMS QQ-S-763, Type 316.
    - b. Include washers, nuts, end caps and any accessory items as recommended by manufacturer for installation conditions or as shown on Drawings.
    - c. Type: Use swageless hardware wherever practical.
    - d. Type: Use hardware substantially concealed inside end posts wherever practical.
    - e. Factory Assembly: Factory Threaded Tensioner/Factory. Threaded Terminal/Acorn Nut, Hex Nut, & Stainless Washer or Cable Quick Nut & Cover.
    - f. Field Assembly: Field Threaded Tensioner/Field. Threaded Terminal/Acorn Nut, Hex Nut, & Stainless Washer or Cable Quick Nut & Cover.
    - g. Cable Quick Lock Swageless Assembly Type 1: Field Threaded Tensioner/Cable Quick Lock Swageless Receiver/Cable Quick Nut Connector/Cable Quick Nut & Cover.
    - h. Cable Quick Lock Swageless Assembly Type 2: Cable Quick Lock Swageless Receiver/Terminal Hex Bolt/Cable Quick Receiver & Stud.

- i. Low Profile Assembly: Cable Quick Terminal/Terminal Hex Bolt/Cable Quick Receiver & Stud.
  - j. Fine-Line Ball Assembly: Fine-Line Ball Turnbuckle/Swage Ball End.
  - k. Fine-Line Button Assembly: Fine-Line Button Turnbuckle/Swage Ball End.
  - l. Fine-Line Lag Assembly: Fine-Line Lag Turnbuckle/Swage Lag End.
  - m. Fine-Line Jaw-Wood Assembly: Fine-Line Jaw Turnbuckle/Fixed Jaw Clevis.
  - n. Fine-Line Jaw-Metal Assembly: Fine-Line Jaw Turnbuckle/Fixed Jaw Clevis/Threaded Eye.
  - o. Fine-Line Jaw-Eye Assembly: Fine-Line Jaw Turnbuckle/Fixed Jaw Clevis/Surface Mount Eye.
  - p. Fine-Line Drill & Tap Assembly: Fine-Line Jaw Turnbuckle/Swage Stud.
  - q. Classic Ball Assembly: Classic Ball Turnbuckle/Swage Ball End.
  - r. Classic Button Assembly: Classic Button Turnbuckle/Swage Button End.
  - s. Classic Jaw Assembly: Classic Jaw Turnbuckle/Swage Jaw End.
  - t. Surface Mount Toggle Assembly: Surface Mount Toggle Turnbuckle/Surface Mount Toggle End
  - u. European Jaw Assembly: European Jaw Turnbuckle/European Jaw End
- B. Handrail Brackets
- 1. Stainless Steel; cast: SC&R No. \_\_\_\_\_.
- C. Fasteners:
- 1. Handrail Anchors: Select fasteners of type, grade and class required to produce connections suitable for anchoring handrails and railings to other types of construction indicated and capable of withstanding design loads.
  - 2. Handrail and Railing Component Anchors: Use fasteners fabricated from same basic metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
    - a. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are standard fastening method for handrail and railing indicated.
    - b. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.
- D. Grout and Anchoring Cement:
- 1. Non-Shrink, Non-Metallic Grout: Provide premixed, factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
  - 2. Interior Anchoring Cement: Provide factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with water at project site to create pourable anchoring, patching and grouting compound. Use for interior applications only.

## 2.5 FABRICATION

- A. Fabricate handrails and railings by connecting members with railing manufacturer's standard concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- B. Provide manufacturer's standard wall brackets, flanges, miscellaneous fittings, and anchors to connect handrail and railing members to other construction.
- C. Provide inserts and other anchorage devices to connect handrails and railings to concrete or masonry. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.
- D. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.
- E. Cut, reinforce, drill, and tap components as indicated on the Drawings to receive finish hardware, screws, and similar items.
- F. Close exposed ends of railing members with prefabricated end fittings.
- G. Provide mounted handrail wall returns at wall ends unless otherwise indicated. Close ends of returns, unless clearance between end of railing and wall is 1/4 inch (6 mm) or less.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Architect, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
  - 1. Examine substrates to receive anchors verifying that locations of concealed reinforcements have been clearly marked for the Installer. Locate reinforcements and mark locations if not already done.
  - 2. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

### 3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installing anchors, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the Project site.

### 3.3 INSTALLATION

- A. General: Install components in accordance with manufacturer's instructions and in proper relationship with adjacent construction.
  - 1. Fitting: Fit exposed connections together to form tight, hairline joints.
  - 2. Cutting and Placement: Set handrails and railings accurately in location, alignment, and elevation measured from established lines and levels and free from rack.

- a. Do not weld, cut, or abrade coated or finished surfaces of railing components that are intended for field connection by mechanical or other means without further cutting or fitting.
  - b. Align rails so variations from level or parallel alignment do not exceed 1/4 inch in 12 feet (1.6 mm per m).
  - c. Provide manufacturer's proprietary system to evacuate entrapped water in hollow sections of railing members that are exposed to exterior or to moisture from condensation or other sources, in order to prevent water from entering the concrete slab. In lieu of the manufacturer's proprietary system, if acceptable to the Architect, provide another means to evacuate the entrapped water, i.e., a weep hole and epoxy fill system ("drill-and-fill").
  - d. Anchor posts in concrete with pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, solidly fill annular space between post and sleeve with non-metallic, non-shrink grout, mixed and placed to comply with anchoring material manufacturer's directions.
  - e. Anchor posts in concrete by forming or core drilling holes not less than 5 inches (127 mm) deep and 3/4 inch (19 mm) greater than outside diameter of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-metallic, non-shrink grout, mixed and placed to comply with anchoring material manufacturer's directions.
  - f. Leave anchorage joint exposed, wipe off surplus anchoring material, and leave 1/8 inch (3 mm) buildup, sloped away from post.
  - g. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
  - h. Adjusting: Adjust handrails and railings before anchoring to ensure alignment at abutting joint's space posts at interval indicated, but not less than required to achieve structural loads.
  - i. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing handrails and railings and for properly transferring loads to in-place construction.
- B. Non-Welded Railings Connections: Use mechanical joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings.
- C. Metal Interaction:
1. When aluminum components come into contact with dissimilar metals, surfaces shall be kept from interacting through painting the dissimilar metal with a heavy coat of a proper primer. The use of plastic grommets and/or PVC sleeves is encouraged to prevent contact between stainless steel cables and aluminum hole edges.
  2. When aluminum components come into contact with cement or lime mortar, exposed aluminum surfaces shall be painted with water-white methacrylate lacquer.

### 3.4 ADJUSTING AND CLEANING

- A. Touch-Up Painting: Immediately after erection, and abraded areas of shop paint, and appoint exposed areas with same material.
- B. Passivation: Immediately after erection, spray passivation solution on stainless steel frame pieces and cables to restore protective layer. Use Boeshield T9 in marine environments for additional protection.
- C. Cleaning: Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in field to shop; make required alterations and refinish entire unit, or provide new units.

### 3.5 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to the Installer that shall ensure that the aluminum handrails and railings shall be without damage at time of Substantial Completion.
- B. Protect finishes of handrails and railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Substantial Completion.
- C. Protect stainless steel from corrosion and staining by applying passivation solution following installation and periodically thereafter. Use Boeshield T9 in addition to passivator in marine environments.
- D. Protect wood products from fading, checking, splitting, etc. with proper end grain sealant and oil treatment.

END OF SECTION 057316

## SECTION 312000 - EARTH MOVING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses, and exterior plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Base course for concrete walks and pavements.
5. Base course for asphalt paving.
6. Excavating and backfilling for utility trenches.

#### 1.2 QUALITY ASSURANCE

Standard Specifications: Comply with the Standard Specifications for Public Works Construction (SSPWC), latest edition and supplements for rock materials. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the Work. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

#### 1.3 REFERENCES

This specification section has been prepared using the Geotechnical Investigation, Parking Lot "D" Improvement Project, dated January 22, 2018, prepared by CTE, Inc. as a reference.

#### 1.4 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subgrade and hot-mix asphalt or concrete paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Classified Excavation: Removal and disposal of materials not defined as rock.

F. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

- G. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
  - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions changes in the Work.
  - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- H. Fill: Soil materials used to raise existing grades.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base, drainage fill, or topsoil materials.
- K. Unclassified Excavation: Removal and disposal of materials encountered regardless of nature of materials, including rock.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

## 1.5 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by City or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Sand, gravel, friable earth, or non-expansive clays, subject to Testing Laboratory's approval. Fill and backfill material shall be free of organic material, slag, cinders, expansive soils, trash or rubble and stones having maximum dimension greater than 6 inches.
- C. Unsatisfactory Soils: Expansive and other soils as defined in the project's geotechnical investigation report.
  - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

- D. Base Course: Material conforming to SSPWC section 200-2.2, Crushed Aggregate Base or SSPWC section 200-2.4 Crushed Miscellaneous Base.
- E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- F. Bedding Course: Naturally or artificially graded clean, crushed sand; ASTM D 2940; except with 100 percent passing a 3/8-inch sieve and not more than 8 percent passing a No. 200 sieve.
- G. Drainage Course: Narrowly graded mixture of washed, crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

## 2.2 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility. Color coding shall be according to the American Public Works Association (APWA) standards:
  - 1. Blue – Potable water and fire suppression lines.
  - 2. Green – Sanitary sewer and storm drain lines
  - 3. Orange – Communication, alarm or signal lines
  - 4. Purple – Reclaimed water, irrigation, and slurry lines
  - 5. Red – Electrical power lines, cables, conduit and lighting lines
  - 6. Yellow – Gas, oil, steam, petroleum, or gaseous material lines.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 2 Section "Site Clearing" or "Demolition".
- C. Protect and maintain erosion and sedimentation controls, which are specified in Division 2 Section "Site Clearing" or "Demolition," during earthwork operations.

### 3.2 EXCAVATION

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil

materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

### 3.3 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

### 3.4 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

### 3.5 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide 6 inch clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
  1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material, 4 inches deeper elsewhere, to allow for bedding course.

### 3.6 SUBGRADE INSPECTION

- A. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by City, without additional compensation.

### 3.7 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean

concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

### 3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### 3.9 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 3 Section Cast-in-Place Concrete.

D. Provide blanket protection for all utility pipes and conduits under driveways, roadways, parking lots, and other vehicular path of travel per APWA Standard Plan 225-1 where the minimum cover over the pipes and conduits is less than 36".

E. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Place and compact final backfill of satisfactory soil to final subgrade elevation.

G. Install warning tape directly above utilities, minimum 6 inches above top of pipe, minimum 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### 3.10 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use engineered fill.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

### 3.11 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
  1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
  2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

### 3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
  1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material to 95 percent.
  2. Under walkways, scarify and recompact top 12 inches below subgrade and compact each layer of backfill or fill soil material to 90 percent.
  3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material to 85 percent.
  4. For utility trenches, compact each layer of initial and final backfill soil material to 85 percent.

### 3.13 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
  1. Lawn or Unpaved Areas: Plus or minus 1 inch.

2. Walks: Plus or minus 1 inch.
  3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

### 3.14 BASE COURSES

- A. Place base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place base course under pavements and walks as follows:
  1. Shape base course to required crown elevations and cross-slope grades.
  2. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

### 3.15 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
  1. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
  2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

### 3.16 FIELD QUALITY CONTROL

- A. Testing Agency: City will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
  - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off City's property.

END OF SECTION 312000

## SECTION 321216 - HOT-MIX ASPHALT PAVING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes hot-mix asphalt paving.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
- B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
- C. Material certificates.
- D. Log of placement of asphalt, including dates, times, temperature readings and other pertinent information.

#### 1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be registered with and approved by authorities having jurisdiction or the DOT of the state in which Project is located.
- B. Standard Specifications: Comply with the Standard Specifications for Public Works Construction (SSPWC) and the California Department of Transportation (Caltrans), latest editions and supplements for asphalt paving work. These Specifications apply only to performance and materials and how they are to be incorporated into the Work. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.
- C. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

#### 1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:
  - 1. Tack Coat: Minimum surface temperature of 60 deg F.
  - 2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
  - 3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.

## PART 2 - PRODUCTS

### 2.1 AGGREGATES

- A. Coarse Aggregate: Crushed rock conforming to SSPWC 400-4.2.3.
- B. Fine Aggregate: Sand, rock dust, mineral filler, or a blend of these materials conforming to SSPWC 400-4.2.4. Mineral filler, if required, shall conform to SSPWC section 203-6.2.3.

### 2.2 ASPHALT MATERIALS

- A. Asphalt Binder: Paving asphalt, viscosity grade PG 64-10 conforming to Section 92 of the Caltrans Standard Specifications.
- B. Tack Coat: PG 64-10 conforming to Section 92 of the Caltrans Standard Specifications.
- C. Mixes: Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mix III-C3 PG 64-10 designed in conformance with SSPWC Section 400-4.

### 2.3 AUXILIARY MATERIALS

- A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.
- B. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with Caltrans Standard Specifications - Section 84 (Federal Specification No. TT-P-1952 for Blue, Red and Green paint; and State of California Standard Specification No. PTWB-01 for White, Yellow and Black paint) with drying time of less than 45 minutes.
  - 1. Color: White
- C. Wheel Stops: Precast, air-entrained concrete
  - 1. Dowels: Galvanized steel, 3/4-inch diameter, 24-inch minimum length.

### PART 3 - EXECUTION

#### 3.1 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
  - 1. Mill to a depth of 3 inches

#### 3.2 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompress existing unbound-aggregate base course to form new subgrade.
- B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.
- C. Patching: Fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.

#### 3.3 SURFACE PREPARATION

- A. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.
- B. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
  - 1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.
- C. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
- D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

### 3.4 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
  - 1. Spread mix at minimum temperature of 250 deg F.
  - 2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### 3.5 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
  - 1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
  - 1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- F. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.6 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch (no minus).

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch
2. Surface Course: 1/8 inch
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

### 3.7 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Owner.
- B. Allow paving to age for 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

### 3.8 WHEEL STOPS

- A. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel 1 inch beneath top of wheel stop.

### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

### 3.10 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

END OF SECTION 321216

## SECTION 321313 - CONCRETE PAVING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
  - 1. Driveways and roadways.
  - 2. Parking lots.
  - 3. Curbs and gutters.
  - 4. Walkways.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, including admixtures.
- B. Design Mixtures: For each concrete pavement mixture.
- C. Product Data for Credit MRc4: For products and materials having recycled content, documentation indicating percentages by weight of postconsumer recycled content. Include statement indicating cost for each product having recycled content.
- D. Product Data for Credit MRc5: For products and materials qualified as regional materials, documentation indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material and fraction by weight is considered regional.

#### 1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
- C. All work to be performed and materials to be used shall be in accordance with the Standard Specifications for Public Works Construction, latest edition and supplements.
- D. The Contractor shall have one copy of the Standard Specifications at the job site.
- E. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the Work. The legal/contractual relationship sections and the measurement and pavement sections do not apply to this document.

## PART 2 - PRODUCTS

### 2.1 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice."

### 2.2 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:
  - 1. Portland Cement: ASTM C 150, Type II, low alkali. Supplement with the following:
    - a. Pozzolan: ASTM C618, Class F or N Fly Ash, 100 pounds maximum per cubic yard, containing one percent or less carbon. Fly ash shall not be used in excess of 15 percent by weight of total cement quantity.
- B. Combined Aggregates: Gradation "C" conforming to SSPWC Section 201-1.3.2.
- C. Water: ASTM C 94/C 94M.

### 2.3 CURING MATERIALS

- A. Liquid Curing Compound: ASTM C309, fugitive dye dissipating type, complying with Rule II 13 of the South Coast Air Quality Management District and Federal Air Quality Regulation 40 CFR 52.254.
- B. Moisture-Retaining Cover (Curing Sheet): ASTM C 171, non-staining polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

### 2.4 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

- C. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- D. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with Caltrans Standard Specifications - Section 84 (Federal Specification No. TT-P-1952 for Blue, Red and Green paint; and State of California Standard Specification No. PTWB-01 for White, Yellow and Black paint) with drying time of less than 45 minutes.

## 2.5 WHEEL STOPS

- A. Wheel Stops: Precast, air-entrained concrete
  - 1. Dowels: Galvanized steel, 3/4-inch diameter, 24-inch minimum length.

## 2.6 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:
  - 1. Compressive Strength (28 Days): 2,500 psi
  - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45
  - 3. Slump Limit: 4 inches, plus or minus 1 inch.
- B. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions.

## 2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates to Architect for each batch discharged and used in the Work.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

### 3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

### 3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

### 3.4 JOINTS

- A. General: Form construction, isolation, and control joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
- D. Control Joints: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of the concrete thickness to match jointing of existing adjacent concrete pavement.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

### 3.5 CONCRETE PLACEMENT

- A. Moisten subbase to provide a uniform dampened condition at time concrete is placed.
- B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- D. Screed pavement surfaces with a straightedge and strike off.
- E. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

### 3.6 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.

- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
  - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
- C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on pavement surface according to manufacturer's written instructions.
  - 1. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
  - 2. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.

### 3.7 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturers written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these methods.

### 3.8 PAVEMENT TOLERANCES

- A. Comply with tolerances as follows
  - 1. Elevation: 1/4 inch
  - 2. Thickness: Plus 3/8 inch minus 1/4 inch
  - 3. Surface: Gap below 10-foot-long, unlevelled straightedge not to exceed 1/4 inch.
  - 4. Joint Spacing: 3 inches.
  - 5. Contraction Joint Depth: Plus 1/4 inch no minus.
  - 6. Joint Width: Plus 1/8 inch, no minus.

3.9 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.10 WHEEL STOPS

- A. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded in holes drilled or cast into wheel stops at one-quarter to one-third points. Firmly bond each dowel to wheel stop and to pavement. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel 1 inch beneath top of wheel stop.

3.11 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.
- B. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement.
- C. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

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## SECTION 321413.19 – PERMEABLE INTERLOCKING CONCRETE PAVEMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Work consists of furnishing and installing a Permeable Interlocking Concrete Pavement (PICP) System in accordance with these specifications and in general conformance with the lines, grades, design, and dimensions shown on the plans.
2. Installation work includes:
  - a. Verifying subgrade elevations and slope generally conform to the lines, grades, infiltration rate, density, and site conditions depicted in the construction documents;
  - b. Furnishing and installing geotextile and/or geomembrane liner (where required), horizontal drainage piping (where required), subbase course, base course, bedding course, edge restraint, concrete pavers and permeable joint material in general conformance to the lines and grades shown on the construction documents.

##### B. Related Requirements:

1. Section 31 20 00 Earth Moving
2. Section 31 05 19.13 Geotextiles for Earthwork
3. Section 31 05 19.16 Geomembranes for Earthwork
4. Section 32 11 23 Aggregate Base Courses
5. Section 32 16 13 Curbs and Gutters
6. Section 32 17 00 Paving Specialties (Parking Bumpers, Pavement Markings, Snow Melt Systems, Tactile Warnings)
7. Section 33 41 16.19 Pipe Underdrains

#### 1.2 REFERENCES

##### A. American Society for Testing and Materials (ASTM):

1. ASTM C33 Standard Specification for Concrete Aggregates
2. ASTM C94 Standard Specification for Ready-Mixed Concrete
3. ASTM C131 Standard Test Method for Resistance to Degradation of Small-Sized Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
4. ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse-Grained Aggregates
5. ASTM C140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
6. ASTM C936 Standard Specification for Solid Concrete Interlocking Paving Units
7. ASTM C979 Standard Specification for Pigments for Integrally Colored Concrete
8. ASTM C1645 Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Interlocking Paving Units

9. ASTM C1781 Standard Test Method for Surface Infiltration Rate of Permeable Unit Pavement Systems
  10. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
  11. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
  12. ASTM D3034 Standard Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
  13. ASTM D3350 Standard Specification for Polyethylene Plastic Pipe and Fittings Materials
  14. ASTM D4873 Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
  15. ASTM E2835 Standard Test Method for Measuring Deflections using a Portable Impulse Plate Load Test Device
- B. Interlocking Concrete Pavement Institute (ICPI)
1. Permeable Interlocking Concrete Pavement manual (latest edition)
  2. Permeable Design Pro software for hydrologic and structural design
  3. Tech Specs and Technical Bulletins

### 1.3 SUBMITTALS

- A. Contractor shall submit to the owner for approval a minimum of four full-size samples of each concrete paver type/size/thickness/color/finish specified. The samples shall represent the range of shape, texture, and color permitted for the respective type. Color(s) will be selected by Architect/Engineer/Landscape Architect/Owner from Manufacturer's standard colors.
- B. Prior to delivery of the associated material to the site, the Contractor shall submit the following product-specific documentation for approval:
1. Aggregates
    - a. Sieve analysis per ASTM C136 for subbase, base, bedding and joint aggregate materials
    - b. Minimum 3 lb. sample of each material for independent testing.
  2. Concrete Pavers:
    - a. Test results from an independent testing laboratory for compliance to ASTM C936.
    - b. For machine installation projects, stitching details to be used during product placement.
    - c. Safety Data Sheets (SDS).
  3. Geosynthetics
    - a. One 18-inch x 18-inch panel of each type of geosynthetic (geotextile or geomembrane Liner) to be used for inspection and testing. The sample panels shall be uniformly rolled and shall be wrapped in plastic to protect the material from moisture and damage during shipment. Samples shall be externally tagged for easy identification. External identification shall include the name of the manufacturer; product type; product grade; lot number; and physical dimensions.
    - b. Current National Transportation Product Evaluation Program (NTPEP) evaluation report.
    - c. Safety Data Sheets (SDS).]

1.4 QUALITY ASSURANCE

A. Contractor Qualifications:

1. Contractor shall submit a list of five (5) previously constructed projects of similar size and magnitude prior to the bid date to be qualified. Contact names, telephone numbers, and date of completion shall be listed for each project.
2. The Contractor's site foreman shall hold a PICP Specialist Designation from the Interlocking Concrete Pavement Institute (ICPI). The site foreman shall be onsite for the entire installation.
3. Contractor shall conform to all local, state/provincial licensing and bonding requirements.

B. Mockups: Build mockups to verify selections made under submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Install a 10 ft x 10 ft paver area following the installation practices described in Article 3.2 to 3.4. This area shall be used to verify joint sizes; lines; laying pattern(s); stitching details (for mechanical installation); color(s); and, texture of the job.
2. To provide a proper representation of color blend, blending during installation of sample mock-up will be pulled from a minimum of 3 cubes.
3. This area shall be the standard from which the work will be judged.
4. Subject to approval by the Owner, the mock-up may be retained as part of the finished work. If mock-up is not retained, remove and dispose of mock-up at the completion of the project.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Contractor shall coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.
- B. Contractor shall check all materials upon delivery to assure that the proper materials have been received and are in good condition before signing off on the manufacturer's packing slip.
- C. Contractor shall protect all materials from damage or contamination due to job site conditions and in accordance with manufacturer's recommendations. Damaged or contaminated materials shall not be incorporated into the work.
- D. Concrete pavers shall be delivered to the site in steel banded, plastic banded, or plastic wrapped cubes capable of transfer by forklift or clamp lift. Unload and store concrete pavers at the job site in such a manner that no damage occurs to the product.
- E. Contractor shall handle and transport aggregates to avoid segregation, contamination, and degradation and keep different materials sufficiently separated as to prevent mixing. The material shall not be dumped or stored one material on top of another unless it is part of the installation process. Materials shall be covered to prevent removal by wind.
- F. Geosynthetics shall be delivered, stored and handled in accordance with ASTM D4873.

1.6 ENVIRONMENTAL CONDITIONS

- A. Pavers shall not be installed during heavy rain, freezing conditions or snowfall.

- B. Pavers shall not be installed on frozen soil subgrade or aggregates.

#### 1.7 MAINTENANCE MATERIALS

- ~~A. Provide [specify quantity] square feet additional paver material for use by Owner for maintenance and repair.~~
- ~~B. Store extra paver materials in Owner designated location.~~

### PART 2 - PRODUCTS

#### 2.1 PERMEABLE INTERLOCKING CONCRETE PAVERS

- A. Interlocking Concrete Pavers Basis-of-Design:
1. Vehicular - Permeable (On-Site)  
Belgard - Aqualine 4.5 x 9 x 80mm Permeable - Toscana (formerly Aqua Roc)  
Pattern: Herringbone  
Substitutions: No substitutions permitted.
  2. Pedestrian - Interlocking (On-Site)  
Belgard - Holland 4 x 8 x 60mm - Toscana  
Polymeric Sand: Techniseal- HP NexGel – Tan  
Substitutions: No substitutions permitted.
  3. Pedestrian – Interlocking (Manhattan Avenue Parkway)  
Belgard – Avalon Slate 3-pc small and large pattern, Color: Bella  
Substitutions: Substitutions for an approved equal product that closely matches the existing pavers along the Manhattan Avenue is permitted. Contractor to submit samples of proposed alternatives for approval.
- B. Supplier/Local Sales Representative:  
Yvonna Garcia  
Belgard Architectural Consultant – Southern California  
10714 Poplar Ave., Fontana, CA 92337  
Cell: 949 281-9692
- C. Pavers shall meet the minimum material and physical properties set forth in ASTM C 936, Standard Specification for Interlocking Concrete Paving Units.
1. Measured length or width of test specimens shall not differ by more than +/- 0.063 in, while measured thickness shall not differ by more than +/- 0.125 in.
  2. Average compressive strength of 8,000 psi (55 MPa) with no individual unit under 7,200 psi (50 MPa) when tested in accordance with ASTM C140.
  3. Average absorption of 5% or less with no unit greater than 7% when tested in accordance with ASTM C140.
  4. Freeze-thaw durable as tested in accordance with ASTM C1645. The average mass loss of all specimens tested shall not be greater than (A) 225 g/m<sup>2</sup> when subject to 28 freeze-thaw cycles, or (b) 500 g/m<sup>2</sup> when subject to 49 freeze-thaw cycles. Testing shall be conducted using a 3% saline solution.
  5. Efflorescence shall not be a cause for rejection.

6. Pigment in Concrete Pavers shall conform to ASTM C979.

## 2.2 AGGREGATE MATERIALS

### A. General Requirements:

1. Clean, non-plastic aggregate, free from deleterious or foreign matter, manufactured from crushed rock. Recycled aggregates shall not be used.
2. Percent of angular and sub-angular particles greater than 90%. Rounded river gravel shall not be used.
3. LA Abrasion of the aggregate used shall be less than 40 as per ASTM C131.
4. All aggregates shall be washed and have less than 2% passing the No. 200 (0.075 mm) sieve.
5. All aggregate material gradations shall be tested in accordance with ASTM C136.

### B. Bedding Course/Joint Fill Material – open-graded aggregate conforming to the following gradation:

*Note: No. 89 or No. 9 stone may be used as joint fill material. If No. 8 stone material is not available locally, No. 89 can be used as a bedding course if choke criteria is met with underlying base aggregate.*

#### ASTM C33 size No. 8

<u>Sieve Size</u>	<u>Percent Passing</u>
1/2 in. (12.5 mm)	100
3/8 in. (9.5 mm)	85 to 100
No. 4 (4.75 mm)	10 to 30
No. 8 (2.36 mm)	0 to 10
No. 16 (1.18 mm)	0 to 5
No. 200 (0.075 mm)	0 – 2

### C. Base Course Material - open graded aggregate conforming to the following gradation:

#### ASTM C33 size No. 57

<u>Sieve Size</u>	<u>Percent Passing</u>
1-½ in. (37.5 mm)	100
1 in. (25 mm)	95 to 100
1/2 in. (12.5 mm)	25 to 60
3/8 in. (9.5 mm)	0 to 10
No. 4 (4.75 mm)	0 to 5
No. 200 (0.075 mm)	0 - 2

### D. Subbase Course Material – open-graded aggregate conforming to the following gradation:

*Note: ASTM No. 3 or No. 4 may be used as subbase material if No. 2 stone is unavailable locally.*

ASTM C33 size No. 2

<u>Sieve Size</u>	<u>Percent Passing</u>
3 in. (75 mm)	100
2- ½ in. (63 mm)	90 to 100
2 in. (50 mm)	35 to 70
1-½ in. (37.5 mm)	0 to 15
¾ in. (19 mm)	0 to 5
No. 200 (0.075 mm)	0 – 2

2.3 EDGE RESTRAINTS

- A. Edge restraints shall be cast in place concrete curbs in general conformance with the specifications and dimensions in the construction documents

2.4 GEOSYNTHETICS

- A. Geotextile and/or geomembrane liner materials shall be selected by the Design Engineer based on the intended use.
- B. Only geosynthetics with a current NTPEP evaluation will be accepted.

2.5 PIPE UNDERDRAINS

- A. Where shown on the plans, pipe underdrains shall be perforated or slotted PVC pipe manufactured in accordance with ASTM D3034 or corrugated HDPE pipe manufactured in accordance with ASTM D3350 and comply with the requirements of Section 33 46 14.19 - Pipe Underdrains.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to commencement of any work, the Contractor shall conduct a pre-construction meeting with the Owner, Designer, and affected sub-trades. The pre-construction meeting should establish contractor responsibilities and at a minimum verify:
  1. The location of the mock-up, and whether it will be part of the final construction or need to be removed.
  2. The site layout is in general conformance to the construction documents. In particular, the location and elevation of discharge points (if any) of the pipe underdrains.
  3. The subgrade lines and elevations are in general conformance with the construction documents. The subgrade elevations shall be within +/- 0.1 ft of the specified grades.
  4. The minimum slope of subgrade shall be at least 0.5% or as specified in the design.
  5. Subgrade soil conditions and grades meet the requirements in the construction documents.
  6. The details of the site's erosion and sediment control plan.

7. Panel Installation drawings for the geomembrane, including the location of any protrusions through a membrane liner where boots are required.
- B. Proof-roll prepared subgrade according to requirements in Section 31 20 00 Earth Moving to identify soft pockets and areas of excess yielding. Proceed with subbase installation only after deficient subgrades have been corrected. Scarify subgrade surface following any stabilization efforts before installing subbase course.
- C. If compaction is required in the construction documents, Contractor shall verify compaction of the subgrade is in general conformance with the construction documents prior to placing subbase materials.
- D. Once the Contractor has confirmed the subgrade conditions are in general conformance with the requirements in the construction documents, the Contractor shall begin installing the subbase material. By initiating installation of the subbase material, the Contractor acknowledges acceptance of the subgrade.

### 3.2 INSTALLATION OF SUBBASE AND BASE COURSES

- A. Keep the area where the pavement is to be constructed free from sediment during the entire job. Any materials contaminated with sediment shall be removed and replaced with clean material.
- B. Install membrane liner and any associated cushion geotextile in accordance with the manufacturer's recommendations. The membrane liner is applied to the bottom and sides of the excavation for non-infiltration purposes and must include a drainage pipe. Allow for enough membrane liner to exceed the final elevation of the surface. After completion of the surface, the excess liner should be cut flush with the finished grade. Membrane lines shall be welded together and boots installed around all protrusions.
- C. Install geotextiles as required in accordance with the specifications and drawings. The geotextile is applied to the bottom and sides of the excavation with overlapping joints a minimum of ~~{12 inches}~~ [24 inches]. Overlaps to be constructed to "shingle" moisture from upstream panel to downstream panel. Allow for enough geotextile to exceed the final elevation of the surface. After completion of the surface, the excess geotextile should be cut flush with the finished grade.
- D. Install the subbase course and base course at the thicknesses, compaction rates, surface tolerances, and elevations outlined below.
  1. Place and spread the first layer of subbase without displacing or damaging the geosynthetics (if used). To prevent damage, tracked vehicles shall not be allowed directly on the geotextiles or geomembranes during the initial spreading process of the subbase layer.
  2. The aggregate should be spread and compacted in uniform layers not exceeding 6-inch loose thickness. Compaction is performed using either a 10 T (10 ton) vibratory roller or a minimum 13,500 lb-f centrifugal force reversible vibratory plate compactor. For each lift, make at least two passes in the vibratory mode and at least two passes in the static mode and continue compaction until there is no visible movement in the materials.
  3. At the specified elevation(s), install the pipe underdrains in accordance with the manufacturer's recommendations. Ensure the pipes are sloped to provide proper drainage to the outlets. Pipes shall be surrounded by a minimum of 4 inches of base course

- material to prevent damage during compaction. Care must be taken not to damage pipe underdrains during subsequent aggregate installation.
4. Final subbase surface tolerance shall be plus or minus 0.1 ft over a 10-foot straight edge laid in any direction.
  5. Final base surface tolerance shall be plus or minus 3/4 inch over a 10-foot straight edge laid in any direction.
  6. Provide proper compaction near curbs, grade beams, concrete collars around utility structures, lights standards, tree wells, building edges and other protrusions as applicable to the project.
- E. Before starting to place the bedding course, the base shall be inspected and approved by the Engineer.
- F. Light Weight Deflectometer (LWD) for Compacted Base Aggregate Deflection Testing:
1. After three preloading drops, the maximum average deflection from three additional drops shall be no greater than 0.5 mm.
  2. Conduct LWD tests on every (800 tons) of remaining area of compacted base aggregates.]
- G. LWD Test Report shall include the following:
1. Project description.
  2. Sketch of the test area and numbered test locations.
  3. Aggregate type and layer thicknesses.
  4. Aggregate characteristic properties: gradation, porosity, bulk density.
  5. Compaction equipment type and weight.
  6. Static and/or vibratory compaction.
  7. Number of passes of the compaction equipment.
  8. Average of three deflections for each location.

### 3.3 INSTALLATION OF EDGE RESTRAINTS

- A. All concrete edge restraints shall be constructed to dimensions and grades in general conformance with the construction documents and shall be supported on a compacted base not less than 6-inch thick and meet local requirements or the requirements of Section 32 16 13 Curbs and Gutters whichever are more restrictive. All concrete shall be in accordance with ASTM C94 requirements.

### 3.4 INSTALLATION OF BEDDING COURSE, PAVERS, AND JOINT MATERIAL

- A. Spread the bedding course evenly over the base course and screed to a nominal 2 in. thickness utilizing an approved mechanical spreader or by screed rails and boards. Do not use the bedding material to fill depressions in the base course surface. Surface tolerances shall be +/- 3/8 inch over a 10-foot straight edge.
- B. Ensure that concrete pavers are free of foreign material before installation. Concrete pavers shall be inspected for color distribution and all chipped, damaged, or discolored concrete pavers shall be replaced. Initiation of concrete paver placement shall be deemed to represent acceptance of the pavers.

- C. Lay the concrete pavers in the pattern(s) shown on the drawings. Maintain straight pattern lines. For mechanical installations, follow the stitching details as submitted and verified during the mock-up.
- D. Paving units shall be installed simultaneously from a minimum of 3 bundles for hand installations, and 6 bundles for mechanical installations to provide proper color blending.
- E. Joints between the individual concrete pavers shall be uniformly maintained and installed in accordance with the in-place dimensions
- F. Fill gaps at the edges of the paved area with cut pavers or edge units. Do not install cut pavers smaller than one-third of a whole paver along edges subject to vehicular traffic – trim two pavers to fit.
- G. Cut pavers using a masonry saw or splitting device. Upon completion of cutting, the area must be swept clean of all debris.
- H. Using a low amplitude plate compactor capable of at least 5,000 lbs. (22 kN) compaction at a frequency of 75 Hz –100 Hz, compact and seat the concrete pavers into the bedding course.
- I. The pavers shall be compacted to achieve consolidation of the bedding course and brought to level and profile by not less than three passes. Initial compaction should proceed as closely as possible following the installation of the paving units and prior to the acceptance of any traffic.
- J. Any units that are structurally damaged during compaction shall be immediately removed and replaced.
- K. Apply the joint material to the surface and sweep into the joints and voids. Fill joints and voids then sweep off excess material before vibrating the material down into the joints using a plate compactor. This will typically require two to three passes with the plate compactor.
- L. Do not compact within 6 feet of unrestrained edges of the paving units.
- M. All work to within 6 feet (1 m) of the laying face must be left fully compacted at the end of each day.
- N. Sweep off excess aggregate when the job is complete.

### 3.5 AS-BUILT CONSTRUCTION TOLERANCES

- A. Final inspection shall be conducted to verify conformance to the drawings after removal of excess aggregate. All pavements shall be finished to lines and levels to ensure positive drainage at all drainage outlets and channels.
- B. The final surface elevations shall not deviate more than +/- 3/8 inch under a 10 ft long straight edge.
- C. Lippage shall be no greater than 1/8-inch difference in height between adjacent pavers.
- D. Bond lines for the pavers shall be +/- 1/2-inch over a 50-foot string ling.

- E. Verify the in-situ surface infiltration rate of the permeable pavement is a minimum of 100 in/hour using ASTM C1781.

### 3.6 MAINTENANCE AND PROTECTION

- A. At the completion of the work, the Contractor shall provide the Owner with the manufacturer's PICP System Operation and Maintenance Guidelines.
- B. Once the work is complete, the Owner shall be responsible for protecting the work from sediment deposition and damage due to subsequent construction activity on the site.
- C. The Contractor shall return to the site after 6 months from the completion of the work and conduct an inspection of the PICP System with the Owner, Designer, and Contractor in accordance with the PICP System Operation and Maintenance Guidelines.

END OF SECTION 321413.19

## SECTION 331100 - WATER UTILITY DISTRIBUTION PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Requirements: Provide water distribution system, complete, as indicated on the Drawings or inferable therefrom and/or as specified in accordance with the Contract Documents.

#### 1.2 SUBMITTALS

- A. Product Data: Submit copies of manufacturer's specifications and installation instructions for each material. Include certification or other data verifying compliance with required characteristics. Indicate by transmittal form that copy of each has been distributed to the Installer.
- B. Shop Drawings: Submit layout and shop drawings as required under Section Submittals. Include details of reinforced concrete structures.
- C. Test Reports: Submit certified Test Reports showing compliance of the following items in accordance with Section General Conditions.
  - 1. Laboratory test for bedding and trench stabilization materials.
  - 2. Concrete design mix.
  - 3. Compression tests.
  - 4. Water Test Reports: Submit results of water sample tests by State or local health authorities

#### 1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
  - 2. All work to be performed and materials to be used shall be in accordance with the Standard Specifications for Public Works Construction, latest edition and supplements.
  - 3. The Contractor shall have one copy of the Standard Specifications at the job site.
  - 4. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the Work. The legal/contractual relationship sections and the measurement and pavement sections do not apply to this document.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with FM's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

- D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- E. NSF Compliance:
  - 1. Comply with NSF 14 for plastic potable-water-service piping.
  - 2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.
- F. California Health and Safety Code:
  - 1. Per Section 116875 subparagraphs a through d, effective January 1, 2010 as specified in SB 1334, Stat. 2008, c.580 – all domestic water systems have to use lead-free pipes, fixtures, solder or flux.

#### 1.4 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify OWNER'S REPRESENTATIVE not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without OWNER'S REPRESENTATIVE written permission.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prevent damage to materials during loading, transportation, and unloading. Store equipment with moving parts off ground on platforms or skids.
- B. COORDINATION
- C. Coordinate connection to water main with utility company.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## 2.2 PIPE AND FITTINGS

- A. Ductile-Iron Pipe (NPS 4 to NPS 6): AWWA C151, Class 200 with cement mortar lining complying with AWWA C104 and one mil thick bituminous coating.
  - 1. Fittings: Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts. Use corrosion resistant, high strength, low alloy steel, bolts and nuts where in contact with corrosive soil ASTM A 325.
  - 2. Fittings: Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern. Use corrosion resistant, high strength, low alloy steel, bolts and nuts where in contact with corrosive soil ASTM A 325.
    - a. Gaskets: AWWA C111, rubber.
- B. PVC, Schedule 40 (NPS 1/8 to NPS 3 1/2): ASTM D 1785. Suitable for potable water distribution and manufactured in compliance with NSF Standards.
  - 1. Fittings: PVC, Schedule 40 Socket Fittings: ASTM D 2466.
- C. PVC, AWWA Pipe (NPS 4 to NPS 12): AWWA C900, Class 200 DR 14, with bell-and-spigot or double-bell ends.
  - 1. PVC to PVC Fittings: Push-on-Joint, PVC Fittings, ASTM 3139, with elastomeric gasket bell ends, conforming to ASTM D2122 for bell measurements.
  - 2. PVC to Metal Fittings, Valves, and Accessories: Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts. Use corrosion resistant, high strength, low alloy steel, bolts and nuts where in contact with corrosive soil ASTM A 325.

## 2.3 VALVES

- A. AWWA, UL/FM Cast-Iron, Gate Valves:
  - 1. Nonrising-Stem, Resilient-Seated Gate Valves: AWWA C509 and UL/F.M. approved, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
    - a. Minimum Working Pressure: 200 psig.
    - b. End Connections: Flanged, push-on rubber gasketed, or mechanical joint, as required.
    - c. Interior Coating: Complying with AWWA C550.

## 2.4 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," bottom section with base of size to fit over valve, and approximately five-inch diameter barrel. Fabricate valve box cover to fit snugly to prevent displacement by traffic.
  - 1. Operating Wrenches: Steel tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- B. Vertical-Type Indicator Posts: UL 789, FM-approved, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve with tamperproof electrical supervisory switch for connection to the fire alarm control panel system.

## 2.5 VALVE APPLICATION

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FM, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.
  - 1. Where specific valve types are not indicated, the following requirements apply:
    - a. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated, gate valves with valve box.
    - b. Underground Valves, NPS 4 and Larger, for Vertical-Type Indicator Posts: UL/FM, Cast-iron, nonrising-stem gate valves with indicator post.

## 2.6 CORROSION-PROTECTION ENCASUREMENT FOR PIPING

- A. Polyethylene Encasement for Underground Ductile-Iron Pipe and Fittings: Polyethylene encasement of eight mils thickness shall conform to AWWA C105. Joint tape shall be self sticking PVC or polyethylene, eight mils thick.
- B. Fusion-Bonded Epoxy Coatings for Ductile-Iron and Gray-Iron Fittings: Epoxy coating shall conform to AWWA C116.

## 2.7 WATER METERS

- A. Water meter(s) indicated on drawings shall be installed by the local water purveyor for the area, unless noted otherwise.

## 2.8 BACKFLOW-PREVENTION DEVICES

- A. General: FM Approved, AWWA, UL Classified, Approved by the Foundation for Cross Connection Control and Hydraulic Research at the University of Southern California.
  - 1. Working Pressure: 175 psi minimum, unless otherwise indicated.

2. Interior Components: Corrosion-resistant materials.
  3. Exterior Components: Assembly shall be provided with flanged connections, galvanized cast-iron or epoxy coated construction.
- B. Reduced-Pressure-Detector Assembly Backflow Preventers: Suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet. Include test cocks; pressure-differential relief valve with ASME A112.1.2, air-gap fitting located between two positive-seating check valves; and bypass with displacement-type water meter, valves, and reduced-pressure backflow preventer. Include tamperproof electrical supervisory switch for connection to tie the fire alarm control panel system.

## 2.9 FIRE HYDRANTS

- A. Before procurement, verify approval has been issued by the Fire Department having jurisdiction.
- B. Wet-Barrel Fire Hydrants: AWWA C503 or UL 312, one NPS 4 and two NPS 2-1/2 outlets, NPS 6 threaded or flanged inlet, and base section with NPS 6 mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have 150-psig minimum working-pressure design.
1. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
  2. Operating and Cap Nuts: Pentagon, one and one-half inches point to flat.
  3. Direction of Opening: Open hydrant valves by turning operating nut to left or counterclockwise.
- C. Combined length of bury and extension shall be as indicated. Where not indicated, install top of hydrant flange three inches above finished surface.
- D. Exterior Finish: "O.S.H.A. safety yellow" Ameritone 719 or approved equal after receiving a prime coat.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Examination: Examine substrates, adjoining construction and conditions under which Work is to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected

### 3.2 PREPARATION

- A. Field Measurements: Verify dimensions before proceeding with Work. Obtain field measurements for work required to be accurately fitted to other construction. Be responsible for accuracy of such measurements and precise fitting and assembly of finished work.

### 3.3 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
  - 1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
  - 2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
  - 3. Copper Tubing Soldered Joints: ASTM B 828. Use flushable flux and lead-free solder.
  - 4. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
  - 5. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

### 3.4 PIPING INSTALLATION

- A. Project site water lines shall terminate approximately five feet from buildings, unless otherwise indicated on Drawings. Install temporary cap or plug terminals for future connection to building.
- B. Bury piping with depth of cover over top at least 36 inches, unless otherwise indicated.
- C. Comply with NFPA 24 for fire-service-main piping materials and installation.
- D. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
- E. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- F. Install PVC, AWWA pipe according to AWWA M23 and ASTM F 645.
- G. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports for all lines NPS 3 or greater.
- H. Water Main Connection: Arrange and pay for tap in the water main, water meter, and all associated fees from the water purveyor.

### 3.5 CLEARANCE OF WATER LINE

- A. Building or Structure: Two feet minimum horizontal separation.
- B. Sewer crossing:
  - 1. Typical Conditions: Lay water mains over sanitary sewers to provide vertical separation minimum three feet.
  - 2. Unusual Conditions: If above separation cannot be met, for sewers less than three feet below the water pipe, use the following:
    - a. Install water line with all joints located at least four feet from each side of the sewer pipe.
    - b. Sewer pipe encased in six inches concrete around pipe, and extend four feet either side of water main.

- C. Parallel to Sewer Line: Water line shall not be installed in a common trench with the building sanitary sewer unless both of the following requirements are met:
  - 1. The bottom of the water pipe, at all points, shall be at least 12 inches above the top of the sewer.
  - 2. The water pipe shall be placed on a solid shelf excavated at one side of the common trench with a minimum clear horizontal distance of at least 12 inches from the sewer.

### 3.6 ANCHORAGE INSTALLATION

- A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches for all lines NPS 3 or greater. Include anchorages for the following piping systems:
  - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
  - 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
  - 3. Fire-Service-Main Piping: According to NFPA 24.
  - 4. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

### 3.7 VALVE INSTALLATION

- A. Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. Vertical-Type Indicator Post Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post. Include tamperproof electrical supervisory switch for connection to tie the fire alarm control panel system.

### 3.8 BACKFLOW-PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers with relief drain in vault or other space subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support three-inch and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.
- E. Access and clearance shall be provided for the required testing, maintenance and repair. Access and clearance shall require a minimum of one foot between the lowest portion of the assembly and grade or platform.
- F. Include tamperproof electrical supervisory switch for connection to tie the fire alarm control panel system.

3.9 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. UL/FM-Type Fire Hydrants: Comply with NFPA 24.

3.10 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-service piping. Locate below finished grade, directly over piping. Refer to Division 31 Section "Earth Moving" for tape specifications.

3.11 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: The piping shall be subjected for a minimum of two hours to a pressure of one and one-half times the working pressure, but in no case less than 150 psi. Examine all exposed pipe, joints, fittings and accessories during the test period. Replace or repair defective portions of the system, and repeat tests until results are satisfactory.
  - 1. Allowable leakage shall be as specified in AWWA C-600, Table 3.
- C. Prepare reports of testing activities.

3.12 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
  - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
  - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or as described below:
    - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours, or
    - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for three hours.
    - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 331100

## SECTION 334100 - STORM UTILITY DRAINAGE PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes gravity-flow, nonpressure storm drainage pipe and drainage structures outside the building.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product installed.
- B. Field quality-control test reports.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

#### 2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

#### 2.3 PVC PIPE AND FITTINGS

- A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

- B. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T-2 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

#### 2.4 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

- B. Sleeve Materials:

- 1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
- 2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
- 3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

- C. Unshielded Flexible Couplings: Elastomeric sleeve with corrosion-resistant-metal tension band and tightening mechanism on each end.

- 1. Manufacturers:

- a. Dallas Specialty & Mfg. Co.
- b. Fernco Inc.
- c. Logan Clay Products Company (The).
- d. Mission Rubber Company; a division of MCP Industries, Inc.
- e. NDS Inc.
- f. Plastic Oddities, Inc.

- D. Shielded Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

- 1. Manufacturers:

- a. Cascade Waterworks Mfg.
- b. Dallas Specialty & Mfg. Co.
- c. Mission Rubber Company; a division of MCP Industries, Inc.
- d. Any equivalent manufacturer.

- E. Ring-Type Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

- 1. Manufacturers:

- a. Fernco Inc.
- b. Logan Clay Products Company (The).
- c. Mission Rubber Company; a division of MCP Industries, Inc.
- d. Any equivalent manufacturer.

## 2.5 MANHOLES

- A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
1. Diameter: 48 inches minimum, unless otherwise indicated.
  2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
  3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
  4. Riser Sections: 4-inch minimum thickness, and of length to provide depth indicated.
  5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
  6. Joint Sealant: ASTM C 990 bitumen or butyl rubber.
  7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
  8. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
  9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
  10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
  11. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording "STORM DRAIN."
    - a. Material: ASTM A 536, Grade 60-40-18 ductile iron or ASTM A 48, Class 35 gray iron, unless otherwise indicated.

## 2.6 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
1. Cement: ASTM C 150, Type II.
  2. Fine Aggregate: ASTM C 33, sand.
  3. Coarse Aggregate: ASTM C 33, crushed gravel.
  4. Water: Potable.
- B. Ballast and Pipe Supports: Portland cement design mix, 3250-psi minimum, with 0.45 maximum water-cementitious materials ratio.
1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
  2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

## 2.7 CATCH BASINS

- A. Standard Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
  - 1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
  - 2. Top Section: Eccentric-cone type unless flat-slab-top type is indicated.
  - 3. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
  
- B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16 (heavy traffic) structural loading unless otherwise indicated. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch- diameter flat grate with small square or short-slotted drainage openings.
  - 1. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Pipe couplings and fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
  - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
    - a. Shielded flexible couplings for same or minor difference OD pipes.
    - b. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

### 3.2 PIPING INSTALLATION

- A. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
  
- B. Install manholes for changes in direction if shown on plan, otherwise use fittings. Use fittings for branch connections unless direct tap into existing sewer is indicated.
  
- C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
  
- D. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
  2. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
  3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
- E. Clear interior of piping and manholes of dirt and superfluous material as work progresses.

### 3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure drainage piping according to the following:
1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
  2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
  3. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-gasket joints.
  4. Join dissimilar pipe materials with nonpressure-type flexible couplings.

### 3.4 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

### 3.5 CATCH BASIN INSTALLATION

- A. Set frames and grates to elevations indicated.

### 3.6 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's storm building drains specified in Division 15 Section "Storm Drainage Piping."
- B. Make connections to existing piping and underground manholes.
1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3250 psi.

3.7 FIELD QUALITY CONTROL

- A. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
  - 1. Do not enclose, cover, or put into service before inspection and approval.
  - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
  - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
  - 4. Submit separate report for each test.
  - 5. Hydrostatic Tests: Test sewers according to requirements of authorities having jurisdiction and the following:
    - a. Allowable leakage is maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
    - b. Close openings in system and fill with water.
    - c. Purge air and refill with water.
    - d. Disconnect water supply.
    - e. Test and inspect joints for leaks.
  - 6. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 psig.
  - 7. Air Tests: Test storm drainage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
    - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
- B. Leaks and loss in test pressure constitute defects that must be repaired.
- C. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 334100

**PART IV**

**LANDSCAPE AND IRRIGATION  
SPECIFICATIONS**

## SECTION 328400 - PLANTING IRRIGATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Piping.
2. Manual valves.
3. Automatic control valves.
4. Automatic drain valves.
5. Sprinklers.
6. Quick couplers.
7. Controllers.
8. Boxes for automatic control valves.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.
- C. Delegated Design: Design 100 percent coverage irrigation system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
  - a.
- D. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
  1. Irrigation Main Piping: 200 psig.
  2. Circuit Piping: 150 psig.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.

- C. Delegated-Design Submittal: For irrigation systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Zoning Chart: Show each irrigation zone and its control valve.
- B. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
- C. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### PART 2 - PRODUCTS

#### 2.1 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. Galvanized-Steel Pipe: ASTM A53/A53M, Standard Weight, Type E, Grade B.
  - 1. Galvanized-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M or ASTM A106/A106M, Standard Weight, seamless-steel pipe with threaded ends.
  - 2. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
  - 3. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface, and female threaded ends.
  - 4. Cast-Iron Flanges: ASME B16.1, Class 125.
- C. Ductile-Iron Pipe with Push-on Joint: AWWA C151, with push-on-joint bell and spigot ends.
  - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    - a. Gaskets: AWWA C111, rubber.
- D. Hard Copper Tube: ASTM B88, Type L, and ASTM B88, Type M, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
  2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
  3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- E. PE Pipe with Controlled ID: ASTM F771, PE 3408 compound; SIDR 11.5 and SIDR 15.
1. Insert Fittings for PE Pipe: ASTM D2609, nylon or propylene plastic with barbed ends. Include bands or other fasteners.
- F. PVC Pipe: ASTM D1785, PVC 1120 compound, Schedules 40 and 80.
1. PVC Socket Fittings: ASTM D2466, Schedules 40 and 80.
  2. PVC Threaded Fittings: ASTM D2464, Schedule 80.
  3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.
- G. PVC Pipe, Pressure Rated: ASTM D2241, PVC 1120 compound, SDR 21 and SDR 26.
1. PVC Socket Fittings: ASTM D2467, Schedule 80.
  2. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.

## 2.2 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.
- E. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer according to ASTM F656.
- F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

## 2.3 MANUAL VALVES

- A. Curb Valves:
  1. Description:

- a. Standard: AWWA C800.
- b. NPS 1 and Smaller Pressure Rating: 150 psig.
- c. NPS 1-1/4 to NPS 2 Pressure Rating: 150 psig.
- d. Body Material: Brass or bronze with ball or ground-key plug.
- e. End Connections: Matching piping.
- f. Stem: With wide-tee head.

B. Curb-Valve Casing:

1. Standard: Similar to AWWA M44 for cast-iron valve casings.
2. Top Section: Telescoping, of length required for depth of burial of curb valve.
3. Barrel: Approximately 3-inch diameter.
4. Plug: With lettering "WATER."
5. Bottom Section: With base of size to fit over valve.
6. Base Support: Concrete collar.

C. Shutoff Rods for Curb-Valve Casings: Furnish one steel, tee-handle shutoff rod(s) with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve for Project.

D. Brass Ball Valves:

1. MATCO-NORCA Model 759 LF
2. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Two piece.
  - e. Body Material: Forged brass.
  - f. Ends: Threaded or solder joint if indicated.
  - g. Seats: PTFE or TFE.
  - h. Stem: Brass.
  - i. Ball: Chrome-plated brass.
  - j. Port: Full.

E. Plastic Ball Valves:

1. Kbi, Speurs, Lasco
2. Description:
  - a. Standard: MSS SP-122.
  - b. Pressure Rating: 125 psig minimum.
  - c. Body Material: PVC.
  - d. Type: Union.
  - e. End Connections: Socket or threaded.
  - f. Port: Full.

2.4 AUTOMATIC CONTROL VALVES

A. Bronze, Automatic Control Valves:

1. GRISWOLD DWS-PRV
2. Description: Cast-bronze body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

2.5 SPRINKLERS

A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.

B. Plastic, Pop-up, Gear-Drive Rotary Sprinklers:

1. RAINBIRD 1800-SAM-PRS 6" POPOUP with HUNTER MP ROTATOR NOZZLE
2. Description:
  - a. Body Material: ABS.
  - b. Nozzle: ABS.
  - c. Retraction Spring: Stainless steel.
  - d. Internal Parts: Corrosion resistant.
3. Capacities and Characteristics:
  - a. Flow: 40 gpm.
  - b. Pop-up Height: 6 inches aboveground to nozzle.
  - c. Arc: varies
  - d. Radius: varies
  - e. Inlet: NPS 1/2.

C. Plastic, Surface Spray Sprinklers:

1. RAINBIRD 1800-SAM-PRS 6" POPUPS
2. Description:
  - a. Body Material and Flange: ABS.
  - b. Pattern: Fixed, with flow adjustment.
3. Capacities and Characteristics:
  - a. Nozzle: Varies
  - b. Flow: Varies
  - c. Arc: Varies
  - d. Radius: Varies
  - e. Inlet: NPS 1/2.

D. Plastic, Pop-up Spray Sprinklers:

1. RAINBIRD 1800-SAM-PRS 6" POPUP W 5Q-5 NOZZLE

2. Description:
  - a. Body Material: ABS.
  - b. Nozzle: ABS.
  - c. Retraction Spring: Stainless steel.
  - d. Internal Parts: Corrosion resistant.
  - e. Pattern: Fixed, with flow adjustment.
  - f. Nozzle: ABS.
  - g. Flow: 40 gpm.
  - h. Inlet: NPS 1/2.

## 2.6 QUICK COUPLERS

- A. Description: Factory-fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key.
  1. Locking-Top Option: Vandal-resistant locking feature. Include two matching key(s).

## 2.7 CONTROLLERS

- A. Calsense CS 3000

- B. Description:

1. Controller Stations for Automatic Control Valves: Each station is variable from approximately 5 to 60 minutes. Include switch for manual or automatic operation of each station.
2. Exterior Control Enclosures: NEMA 250, Type 4, weatherproof, with locking cover and two matching keys; include provision for grounding.
  - a. Body Material: Stainless-steel sheet metal.
  - b. Mounting: Freestanding type for concrete base.
3. Control Transformer: 24-V secondary, with primary fuse.
4. Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily.
  - a. Manual or Semiautomatic Operation: Allows this mode without disturbing preset automatic operation.
  - b. Nickel-Cadmium Battery and Trickle Charger: Automatically powers timing device during power outages.
  - c. Surge Protection: Metal-oxide-varistor type on each station and primary power.
5. Wiring: UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial.
  - a. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers.

- b. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple-cable installation in same trench.
  - c. Splicing Materials: Manufacturer's packaged kit consisting of insulating, spring-type connector or crimped joint and epoxy resin moisture seal; suitable for direct burial.
6. Concrete Base: Reinforced precast concrete not less than 36 by 24 by 4 inches thick, and 6 inches greater in each direction than overall dimensions of controller. Include opening for wiring.

## 2.8 BOXES FOR AUTOMATIC CONTROL VALVES

### A. Plastic Boxes:

1. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
  - a. Size: As required for valves and service.
  - b. Shape: Round Rectangular.
  - c. Sidewall Material: PE, ABS, or FRP.
  - d. Cover Material: PE, ABS, or FRP.
    - 1) Lettering: "VALVE BOX." And QC, PB, SB, FS, MV ,V#.

- B. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch minimum to 3 inches maximum.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."
- B. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.
- C. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from 3/4 to 3 inches, to 12 inches below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.
- D. Provide minimum cover over top of underground piping according to the following:
  1. Irrigation Main Piping: Minimum depth of 36 inches below finished grade, or not less than 18 inches below average local frost depth, whichever is deeper.
  2. Circuit Piping: 12 inches.
  3. Drain Piping: 12 inches.

4. Sleeves: 24 inches.

### 3.2 PIPING INSTALLATION

- A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
- B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- C. Install piping free of sags and bends.
- D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Install unions adjacent to valves and to final connections to other components with NPS 2 or smaller pipe connection.
- G. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 or larger pipe connection.
- H. Install underground thermoplastic piping according to ASTM D2774 and ASTM F690.
- I. Install expansion loops in control-valve boxes for plastic piping.
- J. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- K. Install ductile-iron piping according to AWWA C600.
- L. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.

### 3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- D. Copper-Tubing Brazed Joints: Construct joints according to CDA's "Copper Tube Handbook," using copper-phosphorus brazing filler metal.
- E. Copper-Tubing Soldered Joints: Apply ASTM B813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B32.
- F. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Pressure Piping: Join schedule number, ASTM D1785, PVC pipe and PVC socket fittings according to ASTM D2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D2855.
  - 3. PVC Nonpressure Piping: Join according to ASTM D2855.

### 3.4 VALVE INSTALLATION

- A. Underground Curb Valves: Install in curb-valve casings with tops flush with grade.
- B. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.
  - 1. Install valves and PVC pipe with restrained, gasketed joints.

### 3.5 SPRINKLER INSTALLATION

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Locate part-circle sprinklers to maintain a minimum distance of 6 inches from walls and 6 inches from other boundaries unless otherwise indicated.

### 3.6 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

- A. Equipment Mounting: Install interior controllers on concrete bases.
  - 1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Equipment Mounting: Install exterior freestanding controllers on precast concrete bases.
  - 1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Install control cable in same trench as irrigation piping and at least 2 inches below or beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

### 3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.

1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Section 312000 "Earth Moving" for warning tapes.

### 3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Any irrigation product will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

### 3.9 ADJUSTING

A. Adjust settings of controllers.

B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.

C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch above, finish grade.

3.10 PIPING SCHEDULE

- A. Install components having pressure rating equal to or greater than system operating pressure.
- B. Aboveground irrigation main piping, 1-2", shall be the following:
  - 1. Class 315, PVC pipe; socket-type PVC fittings; and solvent-cemented joints.
- C. Underground irrigation main piping, 1-2", shall be the following:
  - 1. Class 315, PVC pipe and socket fittings, and solvent-cemented joints.
- D. Circuit piping, ¾-1.25", shall be the following:
  - 1. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
- E. Underground Branches and Offsets at Sprinklers and Devices: Schedule 80, PVC pipe; threaded PVC fittings; and threaded joints.
  - 1. Option: Plastic swing-joint assemblies, with offsets for flexible joints, manufactured for this application.
- F. Risers to Aboveground Sprinklers and Specialties: Schedule 80, PVC pipe and socket fittings; and solvent-cemented joints.

3.11 VALVE SCHEDULE

- A. Underground, Shutoff-Duty Valves: Use the following:
  - 1. NPS 2 and Smaller: Curb valve, curb-valve casing, and shutoff rod.
  - 2. NPS 3 and Larger: Iron gate valve, resilient seated; iron gate valve casing; and operating wrench(es).

END OF SECTION 328400

## SECTION 32 91 13 - SOIL PREPARATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes planting soils specified by composition of the mixes.
- B. Related Requirements:
  - 1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.

#### 1.2 DEFINITIONS

- A. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- B. Imported Soil: Soil that is transported to Project site for use.
- C. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- E. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- F. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- G. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- H. USCC: U.S. Composting Council.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at City Hall.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Samples: For each bulk-supplied material in sealed containers labeled with content, source, and date obtained; providing an accurate representation of composition, color, and texture.
- C. Samples of fertilizers, organic amendment, soil conditioners, shall be submitted to the Engineer for inspection seventy-two (72) hours prior to incorporation in the work.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.
- B. Soil Analysis: If the contract documents do not include an agricultural suitability report, Contractor may, at the request of the Agency and/or construction manager (CM), after rough grading, provide for agricultural suitability testing and a written report by a qualified soil-testing laboratory. Recommendations of agricultural suitability and fertility analysis soils report, after review by Agency and/or construction manager (CM), may take precedence over these specifications.
  - 1. The soil-testing laboratory shall oversee soil sampling. Quantity of test sites shall be determined by Agency and/or project construction manager (CM).
  - 2. Report suitability of tested soil for plant growth.
    - a. Recommendations for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
    - b. Report presence of problem salts, minerals, or heavy metals; if present, provide additional recommendations for corrective action.

### PART 2 - PRODUCTS

#### 2.1 PLANTING SOILS SPECIFIED BY COMPOSITION

- A. Topsoil: Topsoil shall consist of fertile, friable soil of loamy character, and shall contain an amount of organic matter normal to the area. It shall be reasonably free from weeds, refuse, roots, heavy or stiff clay, stones larger than one inch (1") in diameter, sticks, brush, litter and other deleterious substances. Topsoil may be obtained from the site if approved by the Agency.
  - 1. For bidding purposes, or in the event a Soils Analysis as described in Article 1.6 Paragraph B is not performed, the following amendments shall be uniformly cultivated

into the upper six inches (6"), per 1000 square feet, of soil by suitable equipment operated at approximate right angles in at least two (2) directions.

- a. Nitrogen stabilized organic amendment: 4 CY
- b. 16-20-0 Ammonium phosphate: 10 LBS
- c. Agricultural Gypsum: 100 LBS
- d. Soil Sulfur: 20 LBS

B. Backfill for Plant Pits: Backfill shall be machine-mixed and approved by the Engineer prior to incorporation in planting pits. For bidding purposes, or in the event a Soils Analysis as described in Article 1.6 Paragraph B is not performed, the following amendments shall be provided

- 1. On-site Soil: 6 parts by volume
- 2. Nitrogen stabilized organic amendment 4 parts by volume
- 3. 16-20-0 1 pound per CY of mix
- 4. Iron Sulfate 2 pounds per CY of mix
- 5. Agricultural Gypsum 10 pounds per CY of mix

## 2.2 INORGANIC SOIL AMENDMENTS

A. For bidding purposes, or in the event a Soils Analysis as described in Article 1.6 Paragraph B is not performed, the following inorganic amendments shall be provided.

- 1. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
  - a. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
  - b. Class: O, with a minimum of 95 percent passing through a No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
- 2. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.
- 3. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- 4. Perlite: Horticultural perlite, soil amendment grade.

5. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.
6. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

### 2.3 ORGANIC SOIL AMENDMENTS

- A. Nitrogen stabilized organic amendment shall be a ground or processed wood product derived from wood of redwood, fir or cedar, treated with a non-toxic agent to absorb water quickly. Nitrogen content, based on dry weight, shall be 0.5% for redwood and 0.7% for fir and cedar. Iron content, based on dry weight, shall be 0.1%.
- B. Wood derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil or toxic materials.
- C. Pine sawdust is not acceptable.

### 2.4 FERTILIZERS

- A. Fertilizers shall comply with applicable requirements of the State Agricultural Codes and shall be packaged, first grade, commercial quality products identified as to source, type of material, weight and manufacturer's guaranteed analysis. Fertilizers shall not contain toxic ingredients in quantities harmful to human, animal, or plant life.
- B. Commercial fertilizer shall be pelleted or granular product having the chemical analysis specified herein and shall be free-flowing material delivered in original unopened containers. Use of material which becomes caked or otherwise damaged shall not be permitted.
- C. Organic base fertilizer shall be a highly concentrated humate material derived from decomposed animal, fish, and vegetable matter with humic acids and trace minerals.
- D. Iron sulfate shall be ferrous sulfate containing not less than twenty-one and one-half percent (21.5%) iron expressed as metallic iron.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

- A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.
- B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
- C. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.
- D. Screening: remove stones larger than 1 inch in diameter.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Agency's property.
- C. Mixing: Spread unamended soil to total depth 6 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is muddy, or excessively wet.
  - 1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.
    - a. Mix lime and sulfur, if required, with dry soil before mixing fertilizer.
    - b. Mix fertilizer with planting soil no more than seven days before planting.
  - 2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place except where a different compaction value is indicated on Drawings.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is muddy, or excessively wet.

- B. Subgrade Preparation: Till subgrade to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Agency's property.
- C. Application: Spread planting soil to total depth of 6 inches, but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
  - 1. Lifts: Apply planting soil in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- D. Compaction: Compact each lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 except where a different compaction value is indicated on Drawings.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

### 3.5 BLENDING PLANTING SOIL IN PLACE

- A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is muddy, or excessively wet.
- B. Preparation: Till unamended, existing soil in planting areas to a minimum depth 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Agency's property.
- C. Mixing: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them into full depth of unamended, in-place soil to produce planting soil.
  - 1. Mix lime and sulfur, if required, with dry soil before mixing fertilizer.
  - 2. Mix fertilizer with planting soil no more than seven days before planting.
- D. Compaction: Compact blended planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 except where a different compaction value is indicated on Drawings.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: The Agency will engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D 698. Space tests at no less than one for each 1000 sq. ft. of in-place soil or part thereof.
- C. Soil will be considered defective if it does not pass tests.
- D. Prepare test reports.
- E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

### 3.7 PROTECTION AND CLEANING

- A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."
- B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
  1. Storage of construction materials, debris, or excavated material.
  2. Parking vehicles or equipment.
  3. Vehicle traffic.
  4. Foot traffic.
  5. Erection of sheds or structures.
  6. Impoundment of water.
  7. Excavation or other digging unless otherwise indicated.
- C. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
  1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 329113

## SECTION 329200 - TURF AND GRASSES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Seeding.
2. Sodding.

#### 1.2 DEFINITIONS

- A. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- B. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation and drawing designations for planting soils.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at City Hall.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Certification of grass seed.
1. Certification of each seed mixture for turfgrass sod.
  2. Certification of each seed mixture for hydroseed.
- B. Product certificates.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.
1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  2. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

- a. Landscape Industry Certified Technician - Exterior.
  - b. Landscape Industry Certified Lawncare Manager.
  - c. Landscape Industry Certified Lawncare Technician.
3. Pesticide Applicator: State licensed, commercial.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

## PART 2 - PRODUCTS

### 2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species:
  1. Quality: State-certified seed of grass species as listed below for solar exposure.
  2. Quality: Seed of grass species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed.
- C. Grass-Seed Mix: Proprietary seed mix as follows:
  1. Products: Basis of Design, provide mix as indicated on the Drawings.

### 2.2 TURFGRASS SOD

- A. Turfgrass Sod: Certified Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.
- B. Turfgrass Species: Basis of Design, provide sod as indicated on the Drawings.

## 2.3 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
  - 1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
  - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

## 2.4 PESTICIDES

- A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

## PART 3 - EXECUTION

### 3.1 TURF AREA PREPARATION

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."
- B. Reduce elevation of planting soil to allow for soil thickness of sod.
- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

### 3.2 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
  - 1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
  - 2. Do not use wet seed or seed that is moldy or otherwise damaged.
  - 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

- B. Sow seed at a total rate of 5 to 8 lb/1000 sq. ft.
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas.
  - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
- E. Protect seeded areas from hot, dry weather or drying winds by applying planting soil within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.

### 3.3 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
  - 1. Lay sod across slopes exceeding 1:3.
  - 2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

### 3.4 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
- B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings.

### 3.5 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
  2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

END OF SECTION 329200

## SECTION 329300 - PLANTS

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. Contractor shall provide all labor, materials, and equipment for the installation of plant material as indicated on the drawings and as specified herein.

#### 1.2 COORDINATION

- A. Contractor shall coordinate planting with other site improvements. Unless otherwise specified, structural improvements shall be constructed prior to planting operations.
- B. Contractor shall be responsible for locating and staking existing sewer, water and utility lines above or below grade that might be damaged as a result of planting operation. Contractor shall assume sole responsibility for any cost incurred due to damage and for replacement of aforementioned utilities.
- C. All work on the irrigation system, including hydrostatic and coverage tests, operational tests, and the backfilling and compaction of trenches shall be performed prior to planting operations.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at City Hall.

#### 1.4 SUBMITTALS

- A. When requested, Contractor shall furnish the Engineer with a delivery receipt and Certificate of Compliance stating that the material substantially meets the specifications.
- B. Contractor shall provide a representative color photo of each type of plant material to be installed on the project to the Engineer for review at least four (4) weeks prior to incorporation into the work.

#### 1.5 REPAIR and REPLACEMENT

- A. Costs incurred due to repair or replacement of defective or damaged work, rejected materials, workmanship and damage to utilities or sparse turf areas shall be the responsibility of the Contractor.
- B. Replacement plant material shall be of the same species, variety, size and condition as shown on the drawings and specified herein, and shall be guaranteed for one (1) full year from the date of planting

1.6 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  - 1. Pesticide Applicator: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- B. Handle planting stock by root ball.
- C. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1.8 POST INSTALLATION MAINTENANCE PERIOD

- A. Provide post installation maintenance as prescribed herein.
  - 1. Contractor shall provide all labor, materials, equipment and incidentals to perform work during the Post-Installation Maintenance Period, as specified herein, including but not limited to; litter removal, drain cleaning, hardscape sweeping, adequate watering of plant materials, mowing, fertilizing, replacing unsuitable plant material and controlling weeds, rodents and other pests.
  - 2. Shall commence on the first day after the completion of planting.
  - 3. Maintenance during Plant Establishment shall include eradicating weeds, eradicating insects and diseases, and protecting areas from traffic, watering, and erosion.
  - 4. Contractor shall maintain the project on a continuous basis for ninety (90) calendar days. Areas shall be so cared for as to present a neat and clean condition at all times.
  - 5. Working days when the Contractor fails to adequately perform maintenance operations as specified herein will not be credited as time of Post-Installation Maintenance Period.
  - 6. Post-Installation Maintenance Period may be extended by the Engineer if the Project is improperly maintained, appreciable replacement is required, or other corrective work becomes necessary.

7. Contractor shall schedule a monthly walkthrough inspection five (5) calendar days prior to the first thirty (30) calendar days. This notification and inspection time should continue for the duration of the maintenance period until acceptance of the work. Contractor shall correct deficiencies before the next monthly walkthrough or maintenance period shall be extended accordingly.
8. At the end of the Post-Installation Maintenance Period, all areas shall be in a weed-free condition.

B. Specialty Type Operations

1. Notification shall be given to the Agency seventy-two (72) hours prior to the Contractor performing "specialty-type" operations, including but not limited to; fertilization, chemical weed abatement and turf aerification, de-thatching and fungicide applications.
2. Contractor shall apply spray chemicals when air currents are still; preventing drifting onto adjoining property and preventing toxic exposure to persons whether or not they are in, or near, the project.

C. Protection

1. Contractor shall be responsible for fencing and maintaining adequate protection of the site. Costs incurred due to damage or replacement shall be the responsibility of the Contractor.

D. Public Interface

1. Contractor shall be responsible for fencing and maintaining adequate protection of the site. Costs incurred due to damage or replacement shall be the responsibility of the Contractor.

E. Repair and Replacement

1. Dead or dying container plant material shall be immediately replaced with material of the same species and size and guaranteed as described in these specifications.
2. Costs incurred due to repair or replacement of irrigation equipment shall be the responsibility of the Contractor. Replacement parts shall be identical to the material specified herein and on the drawings.

## PART 2 - PRODUCTS

### 2.1 CONTAINER GROWN PLANT MATERIAL QUALITY

- A. Plant material shall be in accordance with the California State Department of Agriculture's regulations for nursery inspections, rules and grading. All plants shall be of No. 1 Grade and have a normal habit of growth, and shall be sound, healthy, vigorous and free of insect infestations, plant diseases, sun scalds, fresh bark abrasions or other objectionable

disfigurements. All plants shall have a normal, well-developed branch system and vigorous and fibrous root system which are not pot bound and are free of kinked or girdling roots.

## 2.2 CONTAINER GROWN PLANT MATERIAL

- A. Nursery grown stock shall be selected from high quality, well-shaped stock, grown under climatic conditions similar to those in the project locale. Minimum acceptable size of plants specified shall correspond with that normally expected for the species and variety of commercially available nursery stock.
- B. Caliper shall be the diameter of the trunk one foot (1') above the ground surface and shall be the determining measurement for trees when specified.
- C. Oversize plants may be used if not root bound, but shall not increase the Contract price. Up to ten percent (10%) of undersize plants in any one (1) variety and grade may be used; provided they are larger than the average size of the next smaller grade.
- D. Scientific and common names conform to customary nursery usage, Hortus Third, or the Checklist of Woody Ornamental Plants of California, Oregon, and Washington.
- E. Types, sizes and quantities of plant materials shall be as indicated on the drawings. The plant list shown on the drawings shall be used as a guide only; Contractor shall verify quantities by Contractor's own plan check.
- F. The Engineer reserve the right to refuse or reject any unsuitable plant material. Unsuitable plants shall be removed from the project site and replaced at the Contractor's expense. New plants shall be the same species, variety, size and condition as specified.
- G. Pruning of plant materials shall not be done prior to delivery. After planting, as directed by the Engineer, pruning shall be limited that which is necessary to remove injured twigs and branches, deadwood, and suckers.
- H. Plant material specified is subject to substitution based upon availability. Substituted materials shall be approved in advance by the Engineer and shall conform to the requirements of those originally specified and be supplied by the Contractor.

## 2.3 WOOD MULCH

- A. Wood mulch shall be a ground or processed wood product derived from fir or cedar, or from the bark of fir or pine, free of stones, sticks, and toxic substances harmful to plants and stabilized with nitrogen.

## 2.4 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric, if required: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

2.5 PESTICIDES

- A. General: Pesticide registered and approved by the Environmental Protection Agency (EPA), acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

2.6 POST INSTALLATION MAINTENANCE

- A. Fertilizer: Provide fertilizer as specified in Fertilizer Article.

PART 3 - EXECUTION

3.1 MATERIAL DELIVERY AND INSPECTION

- A. Plant material shall be delivered with legible identification labels, handled and stored adequately to maintain a healthy condition. They shall be protected from drying out, windburn or any other injury. Container plant material shall not be picked up by stems or trunks.
- B. Inspection of plant materials required by State or Federal authorities shall be the responsibility of the Contractor. Secure any permits or certificates, if required by the jurisdiction having authority, prior to delivery of plants to project site.
- C. Plants shall be inspected and approved by the Engineer, at the Contractor's source prior to delivery to the project site and until acceptance of the work, for size, variety, condition, latent defects and injuries. Engineer to provide acceptance letter to the Agency after delivery of the plant material to the project site.

3.2 FINISH GRADING

- A. Finish grading shall be completed prior to weed abatement operations. The Agency, at its own expense, may conduct a soils test at the completion of grading operations. See Section 31 20 00 for additional grading requirements.

3.3 WEED ABATEMENT OPERATIONS

- A. The irrigation system, soil preparation operations, and finish grade shall be approved by the Engineer prior to weed abatement operations.
- B. Contractor shall operate the irrigation system to keep planting areas uniformly moist for a period of two (2) weeks (14 calendar days). At the end of the two (2) week period, Contractor shall spray all visible weeds with an approved non-selective, post emergent herbicide. Application rate and method shall be recommended by the manufacturer. After spraying, planting areas shall remain unwatered for a minimum of forty-eight (48) hours.

- C. After seven (7) calendar days from the chemical application, weeds and debris shall be disposed of off-site.
- D. Contractor shall apply spray chemicals when air currents are still; preventing drifting onto adjoining property and preventing any toxic exposure to persons whether or not they are in or near the project.
- E. After weed abatement operations, and as determined by the Engineer, planting areas shall be scarified to a depth not to exceed one inch (1"). The Engineer shall approve weed abatement operations prior to sodding, if applicable.
- F. Weeds and debris shall be disposed of off-site.

#### 3.4 INSTALLATION OF CONTAINER GROWN PLANT MATERIAL

- A. Plant trees, shrubs, and ground cover as indicated on the drawings and specified herein as soon as the site and weather conditions are suitable.
- B. Planting operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work shall be suspended. When special conditions warrant a variance to the planting operations proposed planting times shall be submitted to and approved by the Engineer.
- C. Install trees before turf is installed, if applicable.
- D. Stake plant locations and secure approval from the Engineer before excavating pits, making necessary adjustments as requested by the Engineer.
- E. Excavated pits shall have vertical, roughened sides, and uncompacted bottoms. Glazed surfaces created by using an auger shall be scarified. Dust sides of pits with gypsum before backfilling.
- F. Plants shall be set plumb and held into position until sufficient soil/backfill has been firmly placed around roots or ball. Container-grown material shall be installed such that the collars of the plants are slightly higher than immediate adjacent grades.
- G. Containers shall be opened and removed in such a manner that the plant root ball is not injured. Non-biodegradable containers or platforms shall be removed without damage to the plant or root system. Biodegradable containers shall be split.
- H. Test for percolation shall be done to determine positive drainage of plant pits. The Engineer shall be notified of all soil and drainage conditions detrimental to growth of plant material. Contractor shall submit proposal for correcting the condition.
- I. Trees shall be staked at time of planting as indicated on the drawings.
- J. Unsuitable soil encountered in excavation shall be disposed of off-site and acceptable soil shall be provided.
- K. Water all planting areas thoroughly after installation of plant materials. Additional backfill shall be added to fill voids caused by water settlement.

- L. Inspection of all planting shall be made at the end of the construction to establish the time for the beginning of the Post-Installation Maintenance Period.
- M. Except in turf areas, plants shall be set in a temporary watering basin as indicated on the drawings.
- N. Areas around the plants shall be regarded to indicated finish grade.

### 3.5 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
  - 1. Mulch in Planting Areas: Apply thickness as indicated on drawings of mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 6 inches of trunks or stems.

### 3.6 POST INSTALLATION MAINTENANCE PERIOD

- A. Weed Control.
  - 1. Before weeds exceed two inches (2") in height, they shall be removed and disposed of off-site. Serious weed pests (i.e. blackberry, nut sedge or bind weed) shall be sprayed with an approved non-selective, post-emergent herbicide and left in place for seven (7) calendar days. Application rate and method shall be as recommended by the manufacturer. As determined by the Engineer, a second application shall be made seven (7) days after the first application. With both applications, areas sprayed shall remain unwatered for a minimum of forty-eight (48) hours. Dead weeds shall be removed seven (7) calendar days after second application and disposed of off-site.
  - 2. If the Engineer notifies the Contractor of failure to control weeds as specified herein, the Contractor shall kill all weeds within ten (10) calendar days of such notification. The Post-Installation Maintenance Period will be extended for every day after ten (10) calendar days until such weeds have been killed.
- B. Irrigation System.
  - 1. Contractor shall operate the irrigation system automatically and shall properly and completely maintain all parts of the irrigation system during both the Post-Installation Maintenance Period.
  - 2. Contractor shall adjust irrigation system to deliver water in sufficient quantities to maintain plant material in a healthy condition and adjust water application to compensate for seasonal conditions.
  - 3. Irrigation system is designed for watering five (5) days a week, 11 p.m. to 4 a.m. with even distribution.
- C. Trees and Shrubs.

1. Installed plants shall be maintained in a healthy growing condition. Maintenance operations shall begin immediately after each plant is installed and shall continue until the post-installation maintenance period commences. This maintenance shall include, but not be limited to: watering, pruning, wound dressing, straightening, and other industry-related, customary and necessary procedure for healthy and vigorous growth. Plant beds and earth saucers shall be kept free of weeds, grass, and other undesirable vegetation. Plants shall be checked for settlement and shall be reset at proper grade as necessary. Run-off, puddling, and wilting shall be prevented.
2. Fifteen (15) calendar days after the beginning of the Post-Installation Maintenance Period, container plant material as part of the Contract shall be fed with a commercial fertilizer at rates recommended by the manufacturer. No fertilizer shall be applied directly at the crown and/or during the months of September through February.
3. Dead or dying plant material shall be immediately replaced with material of the same species and size and guaranteed as described in these specifications.
4. Trees planted as part of the Contract shall be pruned or headed back, as requested by the Engineer, to eliminate diseased or damaged growth, reduce the risk of toppling or wind damage, maintain growth within space limitations, maintain natural appearance, and to balance the crown with the root structure.
5. Staking of trees shall be checked frequently for damage, and to prevent chafing and girdling. Costs incurred due to damage or replacement of staking materials shall be the responsibility of the Contractor.
6. Contractor shall provide a clearance of not less than seven feet (7') in height over walks, slabs and active play areas, and not less than fourteen feet (14') in height over roadways.
7. As approved by the Engineer, all wounds over one and one-half inch (1 ½") in diameter may be sealed with a tree seal.

### 3.7 GUARANTEE

- A. Contractor shall guarantee new trees through one (1) full year after the date of acceptance of the work.

END OF SECTION 329300

## SECTION 329310 – NON-VEGETATIVE SITE MATERIALS

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. Contractor shall provide all labor, materials, tools, equipment, and incidentals for establishing subgrade, ensuring flow lines are maintained, performing weed abatement operations and furnishing, loading, hauling, and placing non-vegetative surface or subbase materials as indicated on the drawings and specified herein.

#### 1.2 MATERIAL SAMPLES

- A. Contractor shall submit samples of materials to the Engineer for review and approval prior to purchase and installation.

#### 1.3 QUALITY MEASUREMENT

- A. Quantities of non-vegetative surface materials will be as measured in place and compensated for at the Contract unit prices bid.
- B. Quantities of non-vegetative subsurface materials shall be as indicated in the unit price bid for the various item of work.

#### 1.4 PROTECTION

- A. Contractor shall provide all necessary protection to prevent injury to humans, animals, or adjacent plant life and property occasioned by application of weed abatement materials or soil sterilant for decomposed granite.
- B. Contractor will be held responsible for all personal injury or property damage caused by application or storage of such materials.

### PART 2 - PRODUCTS

#### 2.1 DECOMPOSED GRANITE

- A. Decomposed granite shall be the product of crushing rock or gravel; clean, hard, sound durable, uniform in quality, and free of any detrimental quantity of soft, friable, thick elongated or laminated pieces, disintegrated material, organic matter, oil or other deleterious material.
- B. Color shall be as indicated on the drawings. Contractor shall submit a sample to Engineer prior to purchase of material.

- C. Soil sterilant for decomposed granite areas shall be Lacco-Bor by Los Angeles Chemical Company, Spike 8OW by Elanco Products, Poly-Bor-Chlorate by United States Borox and Chemical Corporation, or an approved equal.
- D. Soil stabilizer, if applicable, for decomposed granite areas shall be Polypavement by Polypavement (323-954-2240), Soil Secure by Southwest Boulder & Stone (800-540-1147), or approved equal.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Contractor shall furnish and place decomposed granite on compacted and sterilized subgrade in areas as indicated on the drawings and according to the details.
- B. If applicable, thoroughly blend the stabilizer into the decomposed granite by mechanical means per manufacturer's recommendations.
- C. Prior to placing the decomposed granite surfacing, the subgrade shall be cleaned of all foreign substances. Ruts or soft, yielding spots that may appear in subgrade, areas having inadequate compaction, and deviations of the surface from requirements set forth therein shall be corrected by loosening, removing, and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements and as approved by the Engineer.
- D. Soil sterilant shall be applied per manufacturer's recommendation and applied by or under the direct supervision of someone holding a State of California Qualified Application Certificate.
- E. Material shall be level to a uniform thickness so that the layer, after compaction, will not be less than the indicated thickness.
- F. Decomposed granite shall be compacted to at least eighty-five (85%) of maximum density obtainable and shall be hydroseeded as turf.
- G. Finish surface shall not vary more than two one-hundredths foot (0.02') from required grades adjacent to both paved and unpaved areas.
- H. Adjustments shall be made in placing, spreading, or finishing procedures as may be directed by the Engineer to obtain a uniform layer thickness and true grades, to minimize segregation and degradation where pertinent, to reduce or increase water content, and to insure a satisfactory course.
- I. Materials found unsatisfactory shall be replaced or reworked at the Contractor's expense to produce satisfactory material.

#### 3.2 GUARANTEE

- A. Contractor shall guarantee new trees through one (1) full year after the date of acceptance of the work.

END OF SECTION 329310

## SECTION 329320 – SITE FURNITURE AND AMENITIES

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. Contractor shall provide all labor, materials, tools, equipment, and incidentals to furnish, assemble and install Site Furniture and Amenities as indicated on the drawings and specified herein, including but not limited to excavation and backfilling, fine grading, footings, painting, and related appurtenances.

#### 1.2 SUBMITTALS

- A. Within fifteen (15) calendar days after award of Contract and at least thirty (30) days prior to installation, Contractor shall submit shop drawings or manufacturer's cut sheets to the Agency in triplicate. One (1) set will be returned to the Contractor.

#### 1.3 SUBSTITUTIONS

- A. No substitution for Site Furniture and Amenities will be considered which is based on material delivery schedules, fabrication by Contractor, manufacturer carrying less than \$1,000,000 product liability insurance or wood members of a different species, quality, or dimension.

#### 1.4 REPAIR AND REPLACEMENT

- A. A.Method of repair to damaged finished surfaces shall be as approved by the Agency and shall match the original finish.
- B. B.Costs incurred for repair or replacement of defective or damaged work, rejected materials or workmanship shall be the responsibility of the Contractor.

### PART 2 - PRODUCTS

#### 2.1 Basis of design products shall be provided per drawings:

- A. Waste Receptacle
- B. Pebble Seat
- C. Bike Rack
- D. Tree Grate
- E. Water Scupper

- F. Skatestopper

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Contractor shall install all Site Furniture and Amenities in accordance with the manufacturer's recommendations for each item of work and as indicated on the drawings and specified herein.
- B. Staked locations for Site Furniture and Amenities shall be approved by the Agency prior to digging for footings or installation.
- C. Metal components, connections and fastenings shall be free of any burrs or sharp points and edges.

END OF SECTION 329320

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**SECTION 329600 - TRANSPLANTING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes transplanting non-nursery-grown trees by tree spade.

1.2 DEFINITIONS

- A. General: See definitions in ANSI A300 (Part 6) and in ANSI Z60.1 pertaining to field-grown trees, except as otherwise defined in this Section.
- B. Caliper: Diameter of a trunk as noted in Section 015639 Temporary Tree and Plant Protection.
- C. Root-Ball Depth: Measured from bottom of trunk flare to the bottom of root ball.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at City Hall.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Pruning Schedule: Written schedule prepared by arborist detailing scope and extent of pruning each tree in preparation for and subsequent to transplanting.

1.5 INFORMATIONAL SUBMITTALS

- A. Certification: From arborist, certifying that transplanted trees have been protected during construction and that trees were promptly and properly treated and repaired when damaged.
- B. Maintenance Recommendations: From arborist, recommended procedures to be established by Owner for care and protection of trees after completing the Work.
- C. Existing Conditions: Documentation of existing trees indicated to be transplanted, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
- D. Tree-maintenance reports.

1.6 QUALITY ASSURANCE

- A. Tree-Service Firm Qualifications: An experienced landscaping contractor or tree-moving firm that has successfully completed transplanting work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.
  - 1. Arborist Qualifications: Certified Arborist as certified by ISA, licensed arborist in jurisdiction where Project is located, current member of ASCA, or registered Consulting Arborist as designated by ASCA.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees in such a manner as to destroy their natural shape.
- B. Completely cover foliage when transporting trees while they are in foliage.
- C. Handle trees by root ball. Do not drop trees.
- D. Contractor, prior to any work within the park, shall meet with the Owner's representatives to flag and number all the trees within the park. Each tree shall be assigned a unique number and Owner's Representative to confirm disposition (removal, relocation, or protect in place) of tree prior to any Contractor activity related to the trees. The trees marked for relocation shall be included on a plan sheet showing the existing and proposed locations for each tree. Trees marked for relocation shall be boxed, as noted herein, and moved on-site to area designated by the engineer and arborist.
- E. Move trees after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after moving, set trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify final grade elevations and final locations of trees and construction contiguous with trees by field measurements before proceeding with transplanting work. Perform transplanting only after finish grades are established.
- B. Seasonal Restrictions: To be determined at time of award of contract.

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Provide tree maintenance by skilled employees of tree-service firm and as required in Part 3. Begin maintenance immediately after preparatory pruning and continue until plantings are healthy and well established but for not less than maintenance period below.
  - 1. Maintenance Period: 12 months from date determined at award of contract.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Transplanted trees shall be healthy and resume vigorous growth within one year of transplanting without dieback due to defective extracting, handling, planting, maintenance, or other defects in the Work.

### 2.2 PLANTING MATERIALS

- A. Backfill Soil: Excavated soil mixed with planting soil, as noted in Section 329113 "Soil Preparation", of suitable moisture content and granular texture for placing and compacting in planting pit around tree, and free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.
  - 1. Mixture: Well-blended mix of planting soil as noted in Section 329113 "Soil Preparation".
  - 2. Planting Soil: Planting soil as specified in Section 329113 "Soil Preparation."

### 2.3 WATERING DEVICES

- A. Watering Pipe: Refer to Irrigation Plans for irrigation system for trees.
- B. Slow-Release Watering Device: Refer to Irrigation Plans for irrigation system for trees.

### 2.4 MISCELLANEOUS PRODUCTS

- A. Retain "Organic Mulch" or "Mineral Mulch" Paragraph below if required and mulch type is not indicated on Drawings; revise to suit Project.
- B. Organic Mulch: Ground or shredded bark as specified in Section 329300 "Plants."
- C. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- D. Burlap: Non-synthetic, biodegradable.
- E. Pesticides: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended in writing by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- F. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: As noted in Section 329113 "Soil Preparation" and Appendix: Landscape Soil Sampling and Testing.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

G. Weed-Control Barriers:

1. Nonwoven Geotextile As noted in Section 329300 "Plants"
2. Composite Fabric: As noted in Section 329300 "Plants"

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning excavation.
- B. Lay out individual transplant locations and areas for multiple plantings, and obtain Architect's acceptance of layout before transplanting.
- C. Apply antidesiccant to trees uniformly, using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during extracting, handling, and transportation.
  1. If deciduous trees are moved in full leaf, spray with antidesiccant before extracting and again two weeks after transplanting.
- D. Wrap trees with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during extracting, handling, and transporting.

### 3.2 PREPARATORY PRUNING

- A. Root Pruning: Perform preparatory root pruning under direction of arborist as far in advance of extracting each tree as the Project Schedule allows.
- B. Crown Pruning (Tip Pruning):
  1. Do not perform preparatory crown pruning (tip pruning).
  2. Perform preparatory crown pruning as directed by arborist. Follow procedures as specified in "Crown Pruning" Article.

### 3.3 EXCAVATING PLANTING PITS

- A. General: Excavate under supervision of the arborist. Keep excavations covered or otherwise protected until replanting trees.
- B. Subsoil and topsoil removed from excavations may be used as planting soil.

- C. Obstructions: Notify Engineer if unexpected rock or obstructions detrimental to trees are encountered in excavations.
- D. Seepage: Notify Engineer if subsoil conditions evidence unexpected water seepage into tree-planting pits.

### 3.4 EXTRACTING TREES

- A. General: Extract trees under supervision of the arborist.
- B. Orientation Marking: Mark the north side of each tree with non-permanent paint before extracting.
- C. Root-Ball Width: Minimum 10 inches of root-ball diameter, or least dimension for non-round root balls, for each inch of tree caliper being transplanted, or as directed by the arborist.
  - 1. Out-of-Season Planting: If planting before or after the in-season period for tree, provide a minimum root-ball diameter of 12 inches for each inch of tree caliper being transplanted, or as directed by the arborist.
- D. Root-Ball Depth: As determined by the arborist for each species and size of tree and for site conditions at original and planting locations.
- E. Digging:
  - 1. Dig and clear a pit with tree spade to the depth of the root system.
  - 2. Cut exposed roots manually with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not paint or apply sealants on cut root ends.
  - 3. Cover roots with burlap and keep them moist until planted.
- F. Extracting with Tree Spade: Use the same tree spade to extract the tree as will be used to transport and plant the tree.

### 3.5 PLANTING

- A. Planting Standard: Perform planting according to ANSI A300 (Part 6) unless otherwise indicated.
- B. Before planting, verify that root flare is visible at top of root ball. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- C. Ensure that root flare is visible after planting.
- D. Remove injured roots by cutting cleanly; do not break. Do not paint or apply sealants on cut root ends.

- E. Orientation: Position the tree so that its north side, marked before extracting, is facing north in its new location.
- F. Set tree plumb and in center of planting pit as designated by Arborist.
  - 1. Use specified backfill soil for backfill.
  - 2. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  - 3. Redirect exposed root ends downward in backfill areas where possible. Hand-expose roots as required to bend and redirect them without breaking.
  - 4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended by arborist. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
  - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- G. Watering Pipe: During backfilling, install watering pipe as indicated on drawings and as designated by Arborist.
- H. Planting with Tree Spade: Use the same tree spade for planting as was used to extract and transport the tree.
- I. Slopes: When planting on slopes, set the tree so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

### 3.6 CROWN PRUNING

- A. Prune branches as directed by the arborist.
  - 1. Prune to remove only injured, broken, dying, or dead branches. Do not prune for shape.
  - 2. Do not remove or reduce living branches to compensate for root loss caused by cutting root system or to improve natural tree form.
  - 3. Pruning Standards: Perform pruning according to ANSI A300 (Part 1).

### 3.7 TREE STABILIZATION

- A. Stabilize tree as indicated on drawings and as directed by the arborist.

### 3.8 MULCHING

- A. Install weed-control barriers before mulching as noted in Section 329300 "Plants".
- B. Organic Mulch: Apply as noted in Section 329300 "Plants".

3.9 INSTALLING SLOW-RELEASE WATERING DEVICE

- A. Provide device for each tree as indicated on drawings..
- B. Place device at base of tree as indicated on drawings.

3.10 TREE MAINTENANCE

- A. Perform tree maintenance as recommended by arborist. Maintain arborist observation of transplanting work.
- B. Maintain trees by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings and as directed by Arborist. Treat as required to keep trees free of insects and disease.
- C. From time of preparatory root pruning measure soil moisture adjacent to edge of each root ball weekly. Record findings and weather conditions.
- D. Fill areas of soil subsidence with backfill soil. Replenish mulch materials damaged or lost in areas of subsidence.
- E. Apply treatments as required to keep tree materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.
- F. Pesticide Application: Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written instructions. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- G. Reports: Have arborist prepare weekly inspection reports.

3.11 REPAIR AND REPLACEMENT

- A. General: Repair or replace transplanted trees and other plants indicated to remain or be relocated that are damaged by construction operations, in a manner recommended and approved by the arborist.
  - 1. Submit details of proposed pruning and repairs.
  - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
  - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by the arborist.
- B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that arborist determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size and species as those being replaced at no additional cost to City/Owner.

3.12 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Except for materials indicated to be recycled, remove surplus soil, excess excavated material, waste materials, displaced plants, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 329600

**PART V**

**ELECTRICAL SPECIFICATIONS**

**SECTION 111200 – PARKING CONTROL EQUIPMENT**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Multi-Space Pay Stations.

1.3 DEFINITIONS

- A. NFC: Near-Field Communication.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Detail fabrication and assembly of mounting assemblies for pay station equipment.
  - 4. Include diagrams for power, signal, and control wiring.
  - 5. Include verification of wireless communications service at each location of Equipment.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Data: Certificates, accessories, and components, from manufacturer.
- C. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

- D. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- E. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- F. Field quality-control reports.
- G. Sample Warranty: For manufacturer's warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For Equipment to include in operation and maintenance manuals.
- B. Software and Firmware Operational Documentation:
  - 1. Software operating manuals.
  - 2. Program Software Backup: On USB, CD, Cloud, or approved media, complete with configuration files.
  - 3. Device address and password list.
  - 4. Printout of software application and graphic screens.

#### 1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain each product through one source from a single manufacturer.
- B. Comply with UL 1703 and UL 1741. Furnish products listed and classified by Underwriter's Laboratories Inc. as suitable for purpose specified and shown.
- C. Manufacturer shall have a minimum of ten (10) years of experience in the production of Equipment specified and shall have ISO 9001 certification.

#### 1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace Equipment components that fail(s) in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five year(s) from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PARKING CONTROL EQUIPMENT

- A. Basis of Design Product: Subject to compliance with requirements, provide product indicated on the drawings or comparable by one of the following manufacturers:
  - 1. IPS Group Inc.
  - 2. TAPCO – Traffic and Parking Control Company, Inc.
  - 3. T2 Systems

## 2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: EVSE shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Component Importance Factor: 1.0.
- B. Ambient Temperature: 41 to 110 deg F.
- C. Relative Humidity: Zero to 95 percent.
- D. Altitude: Sea level to 1000 feet.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

## 2.3 MULTI-SPACE PAY STATIONS

- A. Description:
- B. Comply with ADA-ABA Accessibility Guidelines.
- C. Metering: Revenue grade meter.
- D. Control Power: 20 A, 110/120-V ac, 60 Hz, single phase with solar back-up.
- E. Mounting: Floor mounted.
- F. Enclosures:
  - 1. Rated for environmental conditions at installed location.
    - a. Outdoor Locations: NEMA 250, Type 3R.
    - b. Lockable.
    - c. Tamper resistant.
- G. Status Indicators:
  - 1. LEDs to indicate power, system status, faults, and service.
- H. Display Screen:
  - 1. Daylight viewable, UV-protected display with human-machine interface capability.
  - 2. Displays power, system status, faults, and service.
- I. Networking:
  - 1. WAN Communications: Cellular GSM/GPRS or CDMA.
  - 2. Capable of remote configuration and reporting.
- J. Payment System:

1. Credit card capable.
2. NFC reader.
3. PCI compliant.
4. Capable of remote control and authorization.

#### 2.4 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by utilizing cushioning materials or foam or by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical conduit to verify actual locations of conduit connections before equipment installation.
- C. Examine pavement for suitable conditions where Equipment will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 413.
- B. Concrete Base Mounting:
  1. Install Equipment on 6-inch (150-mm) nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
    - a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
    - b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
    - c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    - d. Install anchor bolts to elevations required for proper attachment to supported equipment.
    - e. Secure Equipment to concrete base according to manufacturer's written instructions.
- C. Wiring Method: Conceal conductors and cables below grade where possible.

- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking from enclosures and components.
- F. Secure covers to enclosure.
- G. Cybersecurity:
  - 1. Software:
    - a. Coordinate security requirements with Owner's IT department.
    - b. Ensure that latest stable software release is installed and properly operating.
    - c. Disable or change default passwords to password of at least eight characters in length, using a combination of uppercase and lower letters, numbers, and symbols. Record passwords and turn over to party responsible for system operation and administration.
  - 2. Hardware:
    - a. Coordinate location and access requirements with IT department.
    - b. Enable highest level of wireless encryption that is compatible with Owner's ICT network.
    - c. Disable dual network connections.

### 3.3 CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Comply with grounding requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Comply with requirements for installation of conduit in Section 260533 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- E. Verify that all electrical connections have been made according to the manufacturer's instructions. Remove all burrs, shavings, and detritus from inside the enclosure.
- F. After confirming all connections, install covers and tighten fasteners to according to manufacturer's instructions.

### 3.4 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."

- B. Identify Equipment with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with white-filled lettering, and durable wire markers or tags inside wiring enclosure.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Visual Inspection: Prior to startup, examine installation for the following:
    - a. All equipment shall be mechanically secured and provided with adequate ventilation.
    - b. All electrical terminations and connections shall be made using approved products and installation methods.
    - c. All electrical equipment shall be marked with the manufacturer's identification and applicable specifications and ratings.
    - d. Sufficient working spaces shall be provided about any electrical equipment that is likely to be serviced or maintained while energized.
  - 2. For each piece of Equipment, perform the following tests and inspections:
    - a. Unit self-test.
    - b. Unit operation.
    - c. Network communications test.
- B. Equipment will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports. Submit reports within two (2) weeks of completion of tests.

### 3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions.

### 3.7 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for four years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within four years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
- C. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain Equipment.

END OF SECTION 111200

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**SECTION 260000 – GENERAL ELECTRICAL REQUIREMENTS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SCOPE

- A. Basic electrical requirements specifically applicable to Division 26 Sections.
- B. Work includes but is not necessarily limited to the following:
  - 1. Labor, materials, services, equipment, and appliances required for completion of tasks as indicated on drawing or in specification or as inherently necessary to provide complete and operational electrical systems including:
    - a. All temporary construction power including test power, temporary heat and lighting;
    - b. Incidental items not indicated on the drawings nor mentioned in the Specifications that belong to the work described, or are required to provide complete and operable systems, as though called out here in every detail;
    - c. Cleaning, cutting, patching, repairing and painting;
    - d. Testing and commissioning;
    - e. The Contractor shall coordinate this Section with all other Sections of the Specification.

1.3 DRAWINGS AND SPECIFICATIONS

- A. Drawings accompanying these Specifications show intent of Work to be done. Specifications shall identify quality and grade of installation and where equipment and hardware is not particularly specified, Contractor shall provide submittals for all products and install them per manufacturers' recommendations, and in a workmanlike manner.
- B. Examine Drawings and Specifications for elements in connection with this Work; determine existing and new general construction conditions and be familiar with all limitations caused by such conditions.
- C. In the event of a conflict or inconsistency between items indicated on the plans and/or specifications or with code requirements, the note, specification or code which prescribes and establishes the more complete job or the higher standard prevail.
- D. Plans are intended to show general arrangement and extent of Work contemplated. Exact location and arrangement of parts shall be determined after the Owner has reviewed equipment, as Work progresses, to conform in best possible manner with surroundings, and as directed by the Owner's Representative.
- E. For purposes of clearness and legibility, the electrical drawings are essentially diagrammatic. The size and location of equipment is shown to scale where possible. The contractor shall verify all

conditions, data information as indicated on the drawings and in the specification sections where electrical work interfaces with other trades.

- F. Contract Documents are intended to show the scope and general arrangement of the Work under this Contract. Drawings are not intended to be scaled for roughing in measurements or to serve as shop drawings. Where job conditions require minor changes or adjustments in the indicated locations or arrangement of the Work, such changes shall be made without change in the Contract amount.
- G. The contractor shall maintain as built drawings to reflect all changes made during construction and any deviations from the electrical drawings. This includes deviations from circuit numbers and any addition, deletion or relocation of fixtures/outlets shown on working drawings.

#### 1.4 UTILITIES

- A. Location and sizes of electrical, mechanical and plumbing service facilities are shown in accordance with data secured from existing record drawings and site observations. Data shown are offered as an estimating guide without guarantee of accuracy. Check and verify all data given, and verify exact location of all utility services pertaining to Work prior to excavation or performing Work.

#### 1.5 APPLICABLE REFERENCE STANDARDS, CODES AND REGULATIONS

- A. Meet requirements of all state codes having jurisdiction.
- B. State of California Code of Regulations:
  - 1. Title 8, Chapter 4. Division of Industrial Safety, Subchapter 5. Electrical Safety Orders (Cal/OSHA):
    - a. Low-Voltage Electrical Safety Orders (Sections 2299 - 2599)
    - b. High-Voltage Electrical Safety Orders (Sections 2700 - 2989)
  - 2. Title 19, State Fire Marshal Regulations
  - 3. Current California Building Code (CBC), Title 24, Part 2
  - 4. Current California Electrical Code, Title 24, Part 3
  - 5. Current California Mechanical Code, Title 24, Part 4
  - 6. Current California Plumbing Code, Title 24, Part 5
  - 7. Current California Energy Code, Title 24, Part 6
  - 8. Current California Fire Code, Title 24, Part 9
  - 9. Current California Standards Code, Title 24, Part 12
- C. Additional Referenced Standards:
  - 1. ANSI American National Standards Institute
  - 2. IEEE Institute of Electrical and Electronic Engineers
  - 3. NEMA National Electrical Manufacturer's Association
  - 4. NFPA National Fire Protection Association Standards
  - 5. UL Underwriters Laboratories
- D. Codes and ordinances having jurisdiction over Work are minimum requirements; but, if Contract Documents indicate requirements, which are in excess of those minimum requirements, then requirements of the Contract Documents shall be followed. Nothing in these drawings and

specifications shall be construed to permit work not conforming to governing codes or regulations. Should there be any conflicts between Contract Documents or codes or any ordinances having jurisdiction, report these to the Owner's Representative.

- E. Obtain permits, and request inspections from authority having jurisdiction.

#### 1.6 PROJECT AND SITE CONDITIONS

- A. The arrangement of and connection to equipment shown on the Drawings is based upon information available and is not intended to show exact dimensions peculiar to a specific manufacturer. The Drawings are, in part, diagrammatic and some features of the illustrated equipment installations may require revision to meet actual equipment installation requirements. Structural supports, housekeeping pads, piping connections and adjacent equipment may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions or alterations.
- B. Examine all Drawings and Specifications to be fully cognizant of all work required under this Division.
- C. Examine site related work and surfaces before starting work of any Section.
- D. Install Work in locations shown on approved Drawings, unless prevented by Project conditions.
- E. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission from the Owner's Representative before proceeding.

#### 1.7 COOPERATION WITH WORK UNDER OTHER DIVISIONS

- A. Cooperate with other trades to facilitate general progress of Work. Allow all other trades every reasonable opportunity for installation of their work.
- B. Work under this Division shall follow general building construction closely. Set pipe sleeves and inserts and verify that openings for chases and pipes are provided.
- C. Work with other trades in determining exact location of outlets, conduits, pipes, and pieces of equipment to avoid interference with lines required to maintain proper installation of Work.
- D. Make such progress in the Work to not delay work of other trades.

#### 1.8 DISCREPANCIES

- A. The contractor shall check all drawings furnished to him immediately upon their receipt and shall promptly notify the owner of any discrepancies. Figures marked on drawings shall in general be followed in preference to scale measurements. Large scale drawings in general govern small scale drawings. The contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors which might have been avoided thereby. Where no figures or notations are given, the plans shall be followed.
- B. Omissions from the Drawings or Specifications or the erroneous description of details of work which are manifestly necessary to carry out the intent of the Drawings and Specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or

erroneously described details of the work but they shall be performed as if fully and correctly set forth and described in the drawings and specifications.

- C. If any part of the Specifications or Drawings appears unclear or contradictory, apply to Owner's Representative for interpretation and decision as early as possible, including during bidding period. Do not proceed with such work without Owner Representatives decision. Beginning work of any Section constitutes acceptance of conditions.

#### 1.9 CHANGES

- A. The Contractor shall be responsible to make and obtain approval from the Owner's Representative for all necessary adjustments in piping and equipment layouts as required to accommodate the relocations of equipment and/or devices, which are affected by any approved authorized changes or Product substitutions. All changes shall be clearly indicated on the "Record" drawings.

#### 1.10 SUBMITTALS

- A. Refer to Division 01 for additional requirements.
- B. The manufacturer, contractor or supplier shall include a written statement that the submitted equipment, hardware or accessory complies with the requirement of that particular specification section.
- C. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section.
- D. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- E. Note that prior to acceptance of submittals for review, a submittal schedule shall be submitted to the Owner's Representative.
- F. Submit all Division 26 shop drawings and product data grouped and referenced by the specification technical section number in one complete submittal package.
- G. Shop Drawings:
  - 1. Include installation details of equipment indicating proposed location, layout and arrangement, accessories, piping, and other items that must be shown to assure a coordinated installation.
  - 2. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
  - 3. If equipment is rejected, revise drawings to show acceptable equipment and resubmit.
  - 4. Whenever more than one (1) manufacturer's product is specified, the first named product is the basis of design used in the Drawings and the use of alternate-named manufacturer's products or substitutes may require modifications to the design.
  - 5. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the Owner's Representative bearing the Owner's Representative stamp of "Reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site at the request of the Owner's Representative without additional compensation.

6. **Manufacturer's Data:** For each manufactured item, provide current manufacturer's descriptive literature of cataloged products, certified equipment drawings, diagrams, performance and characteristic curves if applicable, and catalog cuts.
7. **Standard Compliance:** When materials or equipment provided by the Contractor must conform to the standards of organizations such as American National Standards Institute (ANSI) or UL, submit proof of such conformance to the Owner Representative for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified. In lieu of the label or listing, submit a certificate from an independent testing organization, which is competent to perform acceptance testing and is approved by the Owner Representative. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.
8. **Certified Test Reports:** Before delivery of materials and equipment, certified copies of all test reports specified in individual sections shall be submitted for approval.
9. **Certificates of Compliance or Conformance:** Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this Contract. Pre-printed certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; or "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance or conformance.

- H. The Contractor shall submit all passcodes and passwords for any hardware and software required for the operations and troubleshooting in all systems and components no less than fourteen (14) calendar days prior to Final Completion.

#### 1.11 PROJECT RECORD DOCUMENTS

- A. Refer to Division 01 for additional requirements.
1. All changes, deviations and information recorded on the "Project Record Drawings" set during Construction shall be redrafted using the latest version of AutoCAD or Revit, where applicable.
  2. Submit completed shop drawings to the Owner prior to completion in digital format.
  3. Contractor hand-marked or drafted redlined "Project Record Drawings" will not be accepted.

#### 1.12 PRODUCT ALTERNATIVES OR SUBSTITUTIONS

- A. Refer to General Conditions and Division 01 for additional requirements.

#### 1.13 OPERATING INSTRUCTIONS

- A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel.

1.14 MANUFACTURER'S RECOMMENDATIONS

- A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

1.15 DELIVERY AND STORAGE

- A. Refer to Division 01 for additional requirements.
- B. Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of NFPA 70B P, Appendix I, titled "Equipment Storage and Maintenance During Construction." Replace damaged or defective items with new items.

1.16 GUARANTEE

- A. Except as may be specified under other sections in the Specifications, guarantee all equipment furnished under the Specifications for a period of one year from date of project acceptance against defective workmanship and material and improper installation. Upon notification of failure, correct deficiency immediately and without cost to the Owner.
- B. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Owner for their service agency as directed.

PART 2 - PRODUCTS

2.1 COMPETITIVE PRODUCTS

- A. Unless otherwise noted, any reference in the Specification to any article, device, product, material, fixture, form, or type of construction by name, make, or catalog number shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. The Contractor may at his option propose substitutions for such material in accordance with the substitution procedure outlined in the Contract Documents.

2.2 MATERIALS

- A. Provide all new materials and equipment, free from any defects, in first-class condition, and suitable for the space provided. Provide materials and equipment approved by UL authority having jurisdiction approved testing agency, wherever standards have been established by that agency.
- B. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of units or equipment need not be products of the same manufacturer.

- C. Unless otherwise indicated, provide materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturers' latest standard design that conforms to these Specifications.
- D. Provide materials and equipment with manufacturers' standard finish system, except where otherwise specified. Provide manufacturers' standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment with ANSI Number 61, light gray color.
- E. Environmental and Seismic Conditions: Material and Equipment shall be designed to insure satisfactory operation and operational life in the environmental and seismic conditions which will prevail where they are being installed. Electrical equipment and enclosures shall be designed, constructed and certified to withstand external loading conditions as prescribed by the California Building Code for the locations of the equipment. Supplied equipment shall either be shake table tested and certified or comprehensive seismic calculations shall be provided. All seismic calculations and structural drawings shall bear the seal of a Structural Professional Engineer currently licensed in the State of California.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. Obtain and pay for all permits and inspections, including any independent testing required to verify standard compliance, and deliver certificates for same to the Owner's Representative.

#### 3.2 WORK RESPONSIBILITIES

- A. The drawings indicate diagrammatically the desired locations or arrangement of piping, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions.
- B. The Contractor is responsible for the correct placing of Work and the proper location and connection of Work in relation to the work of other trades. Advise appropriate trade as to locations of access panels.
- C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the construction or rearrangement of furnishings or equipment, such changes shall be made without extra cost, providing the change is ordered before the conduit runs, etc. and work directly connected to same is installed and no extra materials are required.
- D. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.
- E. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the drawings to see that the equipment will fit into the spaces provided without violation of applicable codes.
- F. Should any changes to the Work indicated on the Drawings or described in the Specifications be necessary in order to comply with the above requirements, notify the Owner immediately and

cease work on all parts of the contract, which are affected until approval for any required modifications to the construction has been obtained from the Owner.

- G. Be responsible for any cooperative work, which must be altered due to lack of proper supervision or failure to make proper provisions in time. Such changes shall be under direction of the Owner and shall be made to his satisfaction. Perform all Work with competent and skilled personnel.
- H. The electrical drawings do not indicate all fittings, hardware, or appurtenances required for a complete operating installation.
- I. Wiring diagrams are not intended to indicate the exact course of raceways.
- J. One-line and riser diagrams are only schematics and do not show physical arrangements of equipment.
- K. All workmanship, including aesthetic as well as electrical aspects of the Work, shall be of the highest quality consistent with the best practices of the trade.
- L. Replace or repair, without additional compensation, any Work, which, in the opinion of the Owner, does not comply with these requirements.

### 3.3 CLEANING & PAINTING OF EQUIPMENT

- A. Refer to Division 09 for additional requirements.
- B. Factory Applied:
  - 1. Electrical equipment shall have factory-applied painting systems, which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test, except equipment specified to meet requirements of ANSI C37.20 shall have a finish as specified in ANSI C37.20.
  - 2. Refer to individual sections of this Division for more stringent requirements.
- C. Field Applied: Paint electrical equipment as required to touch up, to match finish on other equipment in adjacent spaces, or to meet safety criteria.
- D. After installation, all metal finishes shall be polished and cleaned of all dirt, rust, cement, plaster, grease, and paint.

END OF SECTION 260000

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
  - 3. Photovoltaic cable, Type PV, rated 2000 V or less.
- B. Related Requirements:
  - 1. Section 260533 "Raceways and Boxes for Electrical Systems"
  - 2. Section 260553 "Identification for Electrical Systems."

#### 1.3 DEFINITIONS

- A. ASTM: American Society of Testing Materials.
- B. ICEA: Insulated Cable Engineers Association.
- C. IEEE: Institute of Electrical & Electronics Engineers.
- D. NEMA: National Electrical Manufacturers Association.
- E. NETA ATS: InterNational Electrical Testing Association - Acceptance Testing Specification.
- F. PV: Photovoltaic.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each type of product, indicating conductor/cable construction, insulation material, thickness of insulation, jacket, cable stranding, and voltage rating of each type of conductor/cable specified, splices and terminations. Indicate date and place of manufacture for each conductor/cable, cable, splice and termination.
- B. Manufacturer's ISO certification.
- C. Product Cable Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Independent Testing Agency.
- B. Field quality-control reports. Perform field testing of cables per para 3.8. Submit six (6) copies of field test reports to owner's representative within two (2) weeks of completion of test.

1.6 QUALITY ASSURANCE

- A. General Requirements: The low voltage power conductors and cable shall be copper, minimum 600V rated unless otherwise indicated. Aluminum conductors and cables shall not be accepted unless otherwise indicated.
- B. Materials and installation shall meet or exceed requirements in the following referenced standards and shall be listed and labelled by UL.
  - 1. ICEA S-95-658/ NEMA WC 70.
  - 2. UL 1072.
  - 3. IEEE.
  - 4. ASTM.
  - 5. NEMA.
- C. Conductors and cables shall be of the same manufacturer and shipped to the job site in original unbroken reels.
- D. Conductors and cables shall be manufactured with in twelve (12) months of installation. Date of manufacture shall be clearly marked on conductors or conductor reels.
- E. Manufacturer shall have minimum ten (10) years experience in the manufacturer of conductors and cables similar to those specified on this project.
- F. Manufacturer shall have ISO 9001 and ISO 9002 certification.
- G. All conductors and cables shall be new and supplied by a local distributor.
- H. If alternate manufacturer of products other than what are specified in this section are submitted, all necessary documents not limited to cut sheets, technical information, test reports from recognized testing labs and factory test reports shall be submitted to the satisfaction of the owner/engineer to ensure quality and conformance to the specifications. Additional testing shall be undertaken if it is concluded by the owner/engineer that the submitted test reports are either insufficient or do not include all tests necessary for product acceptance. The tests shall be conducted by a recognized lab acceptable to the owner/engineer and all tests shall be witnessed by owner's/engineer's personnel. All testing procedures and test results shall be satisfactory to the owner/engineer. Contractor shall be responsible for arranging the tests, for transportation, food and lodging for minimum of one owner's/engineer's representative to witness the test at the testing lab. Include all costs for the above in the bid.
- I. Testing: Provide the services of an independent qualified testing laboratory to perform the specified field tests. Notify the University's Representative fourteen (14) days in advance of performance of work requiring testing.
- J. Conductors, cables, splices and terminations shall be manufactured within twelve (12) months of installation. Each item shall have a permanent marking on the product or the original manufacturers' package indicating the date of manufacture unless otherwise noted.

K. Testing Agency Qualifications:

1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of last ten (10) years and has permanent in-house testing engineers and technicians involved with testing of low voltage electrical power conductors and cables similar to those specified on this project.
2. Testing company shall be located with 50 miles radius of the project.
3. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
4. Field Testing technician and supervisor shall have minimum ten (10) years' experience in field testing of low voltage power conductors and cables of the type and rating similar to the conductors and cables to be tested on this project.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

1. General Cable Technologies Corporation.
2. Southwire Incorporated
3. Alpha Wire.
4. Belden Inc.
5. Encore Wire Corporation..

B. Conductor Material: Electrical grade, soft drawn annealed copper, 98 percent conductivity, and fabricated in accordance with ASTM and ICEA standards. Minimum size is number 12 for branch circuits, number 14 stranded for control wiring. Aluminum conductors are not permitted. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type XHHW-2.

D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for Type SO with ground wire.

2.2 PHOTOVOLTAIC CABLE, TYPE PV

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 2000 V.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

D. Conductor Insulation: Comply with UL 44 and UL 4703.

## 2.3 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
1. Ideal Industries, Inc.
  2. IlSCO
  3. NSi Industries LLC.
  4. O-Z/Gedney; a brand of Emerson Industrial Automation.
  5. 3M; Electrical Markets Division.
  6. TE Connectivity - Raychem.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- C. Copper conductors shall be terminated in copper or bronze mechanical connectors or lugs or tool applied compression connections made of copper for all connections except those on wiring devices.
- D. Splices in wires No. 10 and smaller shall be made with twist-on splicing connector in accordance with UL486-C. Connections in wires No. 8 and larger shall be made with compression type connectors in accordance with UL486-A and wrapped with insulated tape in accordance with UL501. Insulating tape shall be applied in a minimum of two layers of half wrap or built to match the overall insulation of the wire.
- E. Splices in underground pull boxes shall be made submersible type and made using "3M" Scotch-cast epoxy kits.
- F. PV Circuits: Use MC4 connectors.
- G. Pressure type connectors are not permitted.

## 2.4 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway
- B. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway
- C. PV Circuits: Type PV for PV source circuits rated at 1000 V.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. All conductors and cables shall be installed in a raceway.
- B. Before installing conductors and cables in existing conduits, verify the continuity of each conduit; each surface conduit is properly supported per code and clear of any debris.
- C. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- D. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors].
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 IDENTIFICATION

- A. Each conductor shall be factory color coded by conductor manufacturer. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance conductors, and feeder conductors for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical tests stated in latest NETA Acceptance Testing Specification section 7.3.2 (Inspection and Test Procedures-Cables, Low Voltage-600V Maximum). Certify compliance with test parameters per NETA tables.
- B. Test and Inspection Reports: Prepare a written report to record the following:
  - 1. Procedures used.
  - 2. Results that comply with requirements. Include color scan images.
  - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

## **SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Grounding systems and equipment.
- B. Section includes grounding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding.

#### **1.3 Definitions:**

- A. NETA ATS: InterNational Electrical Testing Association - Acceptance Testing Specification.
- B. NETA MTS: InterNational Electrical Testing Association - Maintenance Testing Specification.
- C. NFPA : National Fire Protection Association.
- D. IEEE: Institute of Electrical and Electronics Engineers

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: Submit manufacturer's technical catalog cuts for each type of product indicated.
- B. Shop Drawings: Site drawings to scale including details showing location and size of each field connection of grounding system.
  - 1. Wiring Diagrams: Differentiate between manufacturer installed and field installed wiring.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Informational Submittals: Plans drawn to scale (1/4"=1'-0") showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
  - 1. Test wells.
  - 2. Ground rods.
  - 3. Ground rings.
  - 4. Grounding conductors, connectors.
  - 5. Grounding arrangements and connections for separately derived systems.
  - 6. Grounding for sensitive electronic equipment.

- B. Field quality-control reports. Submit written test reports including the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include operation, and maintenance manuals.
  - 1. Instructions for periodic testing and inspection of grounding features at test wells based on NFPA 70B.
    - a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
    - b. Include recommended testing intervals.

#### 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
  - 1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of last ten (10) years and has permanent in-house testing engineers and technicians involved with testing of grounding systems similar to those specified on this project.
  - 2. Testing company shall be located within 50 miles radius of the project.
  - 3. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
  - 4. Field Testing technician and supervisor shall have minimum ten (10) years' experience in field testing of grounding systems of the type and rating similar to the systems to be tested on this project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

### PART 2 - PRODUCTS

#### 2.1 GROUNDING ELECTRODES, CONDUCTORS, CONNECTOR, BUS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal:
  - 1. Grounding Connectors, Bars and Rods:
    - a. Erico - Pentair Electrical Fastening Solutions
    - b. Burndy – A Hubbell Company.
    - c. Ideal Industries, Inc.
    - d. O-Z/Gedney Co. - A brand of Emerson Industrial Automation.

- e. Thomas & Betts - A Member of the ABB Group.
2. Grounding Conductors and cables:
- a. Southwire
  - b. American Insulated Wire
  - c. Okonite

## 2.2 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

## 2.3 CONNECTORS

- A. Listed and labeled by UL for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors, Rods and Pipes: Copper or copper alloy, pressure type with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits in the same conduit containing phase and neutral conductors. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
1. Feeders and branch circuits.
  2. Lighting circuits.
  3. Receptacle circuits.
  4. Flexible raceway runs.
- C. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode next to the pole and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors. Provide a handhole for the grounding electrode at each pole.
- D. Metallic Fences or Other Metal Structures: Comply with requirements of IEEE C2. Bond metallic fences and other metal structures located within 8 feet (2.5 m) vertically or 16 feet (5 m) horizontally of exposed conductors or equipment.
1. Grounding Conductor: Bare, tinned-copper, not less than No. 8 AWG.
  2. Gates: Shall be bonded to the gate support post with a flexible bonding jumper. Bond each gate support post to the grounding electrode system in the area.
  3. Provide bond across fence openings with 2 AWG bonding jumper buried 18 inches (460 mm) minimum below finished grade. Extend local grounding electrode system to cover swing of gates.
  4. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.

- C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade using exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. For grounding electrode system, install ground rods at least two rods (unless otherwise indicated on the drawings), spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
  
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.
  - 1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
  - 2. Test Wells near light poles: Coordinate location with landscape drawings and install one at each pole. Test well shall be open bottom and installed on a 12"H bed of gravel or crushed stone (1" size).
  
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

### 3.4 LABELING

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells and at individual ground rods. Make tests at ground rods before any conductors are connected.

- a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
  - b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

**SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Metal conduits, tubing, and fittings.
  - 2. Nonmetal conduits, tubing, and fittings.
  - 3. Metal wireways and auxiliary gutters.
  - 4. Nonmetal wireways and auxiliary gutters.
  - 5. Surface raceways.
  - 6. Boxes, enclosures, and cabinets.
  - 7. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

- A. EMT: Electrical metal tubing
- B. GRC: Galvanized rigid steel conduit.
- C. LFMC: Liquidtite flexible metal conduit.
- D. RNC: Rigid nonmetallic conduit.

1.4 QUALITY ASSURANCE:

- A. Each conduit shall bear manufacturer's trademark and UL label.
- B. Each type of conduit and fittings shall be of a single manufacturer. Multiple manufacturers of the same material are not acceptable.
- C. Comply with California Electric Code (CEC)

1.5 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved.
- B. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 2. Electri-Flex Company.
  - 3. O-Z/Gedney; a brand of EGS Electrical Group.
  - 4. Republic Conduit.
  - 5. Robroy Industries.
  - 6. Thomas & Betts Corporation.
  - 7. Western Tube and Conduit Corporation.
  - 8. Wheatland Tube Company; a division of John Maneely Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be UL listed and labeled as defined in NFPA 70, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit]
  - 1. Comply with NEMA RN 1.
  - 2. Coating Thickness: 0.040 inch, minimum.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
  - 2. Fittings for EMT:

- a. Material: Steel
  - b. Type: Setscrew.
- 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
  - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- H. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. CANTEX Inc.
  - 2. Condux International, Inc.
  - 3. Electri-Flex Company.
  - 4. Lamson & Sessions; Carlon Electrical Products.
  - 5. RACO; a Hubbell company.
  - 6. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

## 2.3 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers:
- 1. Cooper Technologies Company; Cooper Crouse-Hinds.
  - 2. EGS/Appleton Electric.
  - 3. Hoffman; a Pentair company.
  - 4. Hubbell Incorporated; Killark Division.
  - 5. O-Z/Gedney; a brand of EGS Electrical Group.
  - 6. RACO; a Hubbell Company.
  - 7. Robroy Industries.
  - 8. Thomas & Betts Corporation.
  - 9. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, Type FD, with gasketed cover.
- D. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

- E. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- F. Gangable boxes are prohibited.
- G. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- H. Cabinets:
  - 1. NEMA 250, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.
  - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.4 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
  - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
  - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
  - 1. Manufacturers:
    - a. Jensen Precast Inc.
    - b. CDR Systems Corporation; Hubbell Power Systems.
    - c. Oldcastle Precast, Inc.; Christy Concrete Products.
    - d. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
  - 2. Standard: Comply with SCTE 77.
  - 3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
  - 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  - 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  - 6. Cover Legend: Molded lettering. Boxes containing conductors and cables over 600V, the cover shall include permanently engraved name of the utility company (e.g SCE), type of utility (e.g. ELECTRIC), DANGER-HIGH VOLTAGE-KEEP OUT" in minimum 1/2" inch size, block letters.

## 2.5 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

### PART 3 - EXECUTION

#### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  1. Exposed Conduit: GRC 12 inches and higher above grade, PVC-Coated Steel Conduit within 12 inches of grade.
  2. Underground Conduit: Type EPC-80-PVC.
  3. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X Stainless Steel.
- B. Minimum Raceway Size: 3/4-inch trade size.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
  1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  3. EMT: Use compression fittings. Comply with NEMA FB 2.10.
  4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- D. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface raceways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

#### 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Complete raceway installation before starting conductor installation.
- C. Arrange stub-ups so curved portions of bends are not visible above finished grade.

- D. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- E. Conceal conduit unless otherwise indicated. Install conduits parallel or perpendicular to site lines.
- F. Support conduit within 12 inches of enclosures to which attached.
- G. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- H. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- J. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- K. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- M. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 250lbs (113 kgs) tensile strength. Leave at least 12 inches of slack at each end of pull wire. Provide acrylic identification tags (2"X4") at each end indicating the source. Cap underground raceways designated as spare above grade alongside raceways in use.
- O. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- P. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- Q. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where an underground service raceway enters a building or structure.
  3. Where otherwise required by NFPA 70.
- R. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- S. Expansion-Joint Fittings:
1. RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
  2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
  3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- T. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations.
- U. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- V. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- W. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- X. Locate boxes so that cover or plate will not span different building finishes.
- Y. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- Z. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- AA. Set metal floor boxes level and flush with finished floor surface.
- BB. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment.
5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances. Top of conduits inside the handhole/box shall be minimum 4 inches above the bottom of the handhole/box.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel (minimum 6 inch high), graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
  - 2. Labels.
  - 3. Bands and tubes.
  - 4. Tapes and stencils.
  - 5. Tags.
  - 6. Signs.
  - 7. Cable ties.
  - 8. Paint for identification.
  - 9. Fasteners for labels and signs.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service' feeder and branch-circuit conductors.
  - 1. Color shall be factory applied.
  - 2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  - 3. Colors for 240-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
  - 4. Color for Neutral: White.
  - 5. Color for Equipment Grounds: Green.
  - 6. Colors for Isolated Grounds: Green with white stripe.
- C. Warning Label Colors:
  - 1. Identify system voltage with black letters on an orange background.
- D. Warning labels and signs shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
- E. Equipment Identification Labels:
  - 1. Black letters on a white field for equipment connected to normal power and Red letters on a white field for solar or battery equipment unless otherwise indicated

## 2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Brady Corporation.
  - b. HellermannTyton.
  - c. Marking Services, Inc.
  - d. Panduit Corp.
  - e. Seton Identification Products.
  
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. HellermannTyton.
    - c. Marking Services, Inc.
    - d. Panduit Corp.
    - e. Seton Identification Products.
  
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, polyesterflexible label with acrylic pressure-sensitive adhesive.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. .
    - c. Grafoplast Wire Markers.
    - d. Ideal Industries, Inc.
    - e. Marking Services, Inc.
    - f. Panduit Corp.
    - g. Seton Identification Products.
  
  2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
  
  3. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Grafoplast Wire Markers.
    - c. HellermannTyton.
    - d. Ideal Industries, Inc.
    - e. Marking Services, Inc.
    - f. Panduit Corp.
    - g. Seton Identification Products.

2. Minimum Nominal Size:
  - a. 1-1/2 by 6 inches for raceway and conductors.
  - b. 3-1/2 by 5 inches for equipment.
  - c. As required by authorities having jurisdiction.

## 2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. HellermannTyton.
    - c. Marking Services, Inc.
    - d. Panduit Corp.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Panduit Corp.

## 2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlton Industries, LP.
    - b. HellermannTyton.
    - c. Ideal Industries, Inc.
    - d. Marking Services, Inc.
    - e. Panduit Corp.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. emedco.
    - d. Marking Services, Inc.

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- C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. HellermannTyton.
    - b. LEM Products Inc.
    - c. Marking Services, Inc.
    - d. Seton Identification Products.
- D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlton Industries, LP.
    - b. Seton Identification Products.
- E. Underground-Line Warning Tape:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Ideal Industries, Inc.
    - c. Marking Services, Inc.
    - d. Seton Identification Products.
  2. Tape:
    - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
    - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
    - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
  3. Color and Printing:
    - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
    - b. Inscriptions for Red-Colored Tapes: "CAUTION BURIED ELECTRIC LINE, HIGH VOLTAGE" .
    - c. Inscriptions for Orange-Colored Tapes: "CAUTION BURIED TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE" .
  4. Tag: Type IID:
    - a. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, continuous-

printed on one side with the inscription of the utility, compounded for direct-burial service.

- b. Width: 6 inches.
- c. Overall Thickness: 5 mils.
- d. Foil Core Thickness: 0.35 mil.
- e. Weight: 34 lb/1000 sq. ft..
- f. Tensile according to ASTM D 882: 300 lbf and 12,500 psi.

## 2.6 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. emedco.
    - d. Marking Services, Inc.
    - e. Seton Identification Products.

## 2.7 SIGNS

- A. Baked-Enamel Signs:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlton Industries, LP.
    - b. Champion America.
    - c. emedco.
    - d. Marking Services, Inc.
  - 2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
  - 3. 1/4-inch grommets in corners for mounting.
  - 4. Nominal Size: 7 by 10 inches.
- B. Metal-Backed Butyrate Signs:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Champion America.
    - c. emedco.
    - d. Marking Services, Inc.
  - 2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
  - 3. 1/4-inch grommets in corners for mounting.

4. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Brady Corporation.
  - b. Carlton Industries, LP.
  - c. emedco.
  - d. Marking Services, Inc.
2. Engraved legend.
3. Thickness:
  - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
  - b. For signs larger than 20 sq. in., 1/8 inch thick.
  - c. Engraved legend with black letters on white face background for equipment connected to normal power and red letters on white face background for solar and battery equipment.
  - d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
  - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.8 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. HellermannTyton.
  2. Ideal Industries, Inc.
  3. Marking Services, Inc.
  4. Panduit Corp.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
  1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
  3. Temperature Range: Minus 40 to plus 185 deg F.
  4. Color: Black.

## 2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

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PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer. Refer to drawings for additional information.
- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. "SOLAR PHOTOVOLTAIC SYSTEM."
  - 2. "BATTERY SYSTEM."
- L. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.

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2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- M. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- N. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- O. Self-Adhesive Labels:
1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
- P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- V. Underground Line Warning Tape:
1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
  2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- W. Metal Tags:
1. Place in a location with high visibility and accessibility.
  2. Secure using general-purpose UV-stabilized cable ties for all area except use plenum-rated cable ties in plenum areas.
- X. Nonmetallic Preprinted Tags:
1. Place in a location with high visibility and accessibility.
  2. Secure using general-purpose UV-stabilized in all areas except use plenum-rated cable ties in plenum areas.

- Y. Baked-Enamel Signs:
  - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.
- Z. Metal-Backed Butyrate Signs:
  - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.
- AA. Laminated Acrylic or Melamine Plastic Signs:
  - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.
- BB. Cable Ties: General purpose, for attaching tags, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.

### 3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10-foot maximum intervals unless otherwise indicated.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
  - 1. "SOLAR PHOTOVOLTAIC SYSTEM."
  - 2. "BATTERY SYSTEM."
- E. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.

- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.
- H. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- I. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- J. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.
- K. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- L. Equipment Identification Labels:
  - 1. Outdoor Equipment: Laminated acrylic or melamine sign. Stenciled legend 4 inches high shall also be provided when requested by Architect.
  - 2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Power-transfer equipment.
    - e. Contactors.
    - f. Remote-controlled switches, dimmer modules, and control devices.
    - g. Battery-inverter units.
    - h. Battery racks.
    - i. Power-generating units.
    - j. Monitoring and control equipment.

END OF SECTION 260553

## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Service-entrance rated lighting and appliance branch-circuit panelboards.
- B. Related Sections include the following:
  - 1. Section 260553 "Identification for Electrical Systems".

#### 1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. RMS: Root mean square.
- C. SPD: Surge Protective Device

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.

4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:
  1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field Quality-Control Reports:
  1. Test procedures used.
  2. Test results that comply with requirements.
  3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
  4. Submit within two (2) weeks of completion of tests.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

#### 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Keys: Two spares for each type of panelboard cabinet lock.
  2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.

1.9 QUALITY ASSURANCE

- A. If alternate manufacturer of products other than what are specified in this section are submitted, all necessary documents not limited to cut sheets, technical information, test reports from recognized testing labs and factory test reports shall be submitted to the satisfaction of the owner/engineer to ensure quality and conformance to the specifications. Additional testing shall be undertaken if it is concluded by the owner/engineer that the submitted test reports are either insufficient or do not include all tests necessary for product acceptance. The tests shall be conducted by a recognized lab acceptable to the owner/engineer and all tests shall be witnessed by owner's/engineer's personnel. All testing procedures and test results shall be satisfactory to the owner/engineer. Contractor shall be responsible for arranging the tests, for transportation, food and lodging for minimum of one owner's/engineer's representative to witness the test at the testing lab. Include all costs for the above in the bid.
- B. Contractor shall ensure that the manufacturer has a minimum of 15 years experience in the production of Panelboards similar to the type and size specified in this project.
- C. Manufacturer shall have ISO 9001 or 9002 Certification.
- D. Manufacturer shall have ability to readily provide replacement parts for a minimum period of ten (10) years, from the date of completion of the project. Furnish a letter from the manufacturer confirming the availability.
- E. Panelboards shall be assembled at the manufacturer's own manufacturing facility using its own major devices (e.g., circuit breakers) for the assembly. These devices shall be normally carried by the manufacturer as standard catalog items.
- F. Panelboard shall comply with seismic zone applicable to the project.
- G. Materials and equipment shall be new, modern in design and shall not have been in prior service except as required by factory tests. Major components (e.g. Circuit breakers) shall be manufactured within six months of installation.
- H. Source Limitations: Obtain panelboards, overcurrent protective devices and accessories through one source from a single manufacturer through a local distributor unless otherwise indicated. All power distribution equipment shall be of the same manufacturer as the substation.
- I. Comply with NFPA 70.
- J. Comply with NEMA PB 1.
- K. Comply with UL 891.
- L. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- M. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Part 2 "Product Requirements."
- N. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in NFPA 70, Article 100—and marked for intended location and application.
- O. Testing Agency Qualifications: Member of NETA;

1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of ten (10) years and has permanent in-house testing engineers and technicians involved with testing of switchboards, panelboards and OCPDs similar to those specified on this project.
2. Testing company shall be located with 50 miles radius of the project.
3. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing to supervise on-site testing specified in Part 3.
4. Field Testing technician and supervisor shall have minimum ten (10) years experience in field testing of switchboards similar to the type and rating specified on this project.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards.
- B. Handle and prepare panelboards for installation according to NECA 407.

#### 1.11 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates grade, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

#### 1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: Five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Free-Standing cabinets.
  1. Rated for environmental conditions at installed location.
    - a. Outdoor Locations: NEMA 250, Type 4X Stainless Steel.
  2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  3. Finishes:

- a. Panels and Trim: Factory finished Powder coated, color to match adjacent finishes.
- 4. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: Bottom.
- D. Phase, Neutral, and Ground Buses:
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
  - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
  - 2. Main and Neutral Lugs: Mechanical type.
  - 3. Ground Lugs and Bus-Configured Terminators: Compression type.
  - 4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- F. Service Equipment Label: UL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

## 2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers
  - 1. Myers Power Products
  - 2. StrongBox
  - 3. Tesco Controls Inc.
  - 4. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Interiors shall be completely factory assembled. These shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus interiors.
- D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- E. Mains: Circuit breaker.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NECA 407.
- B. Equipment Mounting: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness.
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
  - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
  - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Install overcurrent protective devices and controllers not already factory installed.
- E. Install filler plates in unused spaces.
- F. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection report. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly and lubricate as recommended by manufacturer.

END OF SECTION 262416

## SECTION 262726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Weather-resistant GFCI receptacles.
  - 2. Outdoor multioutlet assemblies.

#### 1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Weather-resistant GFCI Receptacles: One for every 10, but no fewer than one.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer. Switches, receptacles and cover plates shall be of the same manufacturer.
- B. Comply with National Electrical Manufacturer's Association (NEMA) standards. Furnish products listed and classified by Underwriter's Laboratories Inc. as suitable for purpose specified and shown.
- C. Manufacturer shall have a minimum of ten (10) years experience in the production of wiring devices specified and shall have ISO 9001 and 9002 certifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  - 2. Leviton Mfg. Company Inc. (Leviton).
  - 3. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: UL Listed and labeled, and marked for intended location and application.
- B. Comply with NFPA 70.

2.3 DECORATOR-STYLE DEVICES

- A. GFCI, Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and UL 943 Class A.
  - 1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
    - a. Hubbell; GFTR20.
    - b. Pass & Seymour; 2094TRWR.
  - 2. Description: Labeled to comply with NFPA 70.

2.4 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.

- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with while-in-use lockable cover.

## 2.5 OUTDOOR POWER PEDESTAL

### A. Description:

1. Factory-assembled to extend power from below grade.
2. Poles: Nominal 3-inch- (65-mm-) deep and 6" wide, minimum 30: high extending from grade, with weather-resistant cover.
3. Mounting: Concrete base plate, provided by manufacturer.
4. Finishes: Manufacturer's standard painted finish and trim combination.
5. Wiring: Sized for minimum of six No. 12 AWG power and ground conductors.
6. Power Receptacles: Two duplex, 20-A, straight-blade weather-resistant GFCI receptacles complying with requirements in this Section.

## 2.6 FINISHES

### A. Device Color:

1. Wiring Devices: White unless otherwise indicated or required by NFPA 70 or device listing.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

- B. Coordination with Other Trades:

1. Protect installed devices and their boxes.
2. Keep outlet boxes free of plaster, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all finish preparation, including painting, is complete.

- C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

- a. Cut back and pigtail, or replace all damaged conductors.
- b. Straighten conductors that remain and remove corrosion and foreign matter.

- c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

### 3.2 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with white-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  1. Test Instruments: Use instruments that comply with UL 1436.
  2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Convenience Receptacles:
  1. Line Voltage: Acceptable range is 105 to 132 V.
  2. Percent Voltage Drop under 20-A Load: A value of 6 percent or higher is unacceptable.
  3. Ground Impedance: Values of up to 2 ohms are acceptable.
  4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  5. Using the test plug, verify that the device and its outlet box are securely mounted.
  6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

- C. Wiring device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports. Submit reports within two (2) weeks of completion of tests.

END OF SECTION 262726

## SECTION 262753 – ELECTRIC VEHICLE SERVICE EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Section includes EVSE that provides AC Level 1 and Level 2 EV charging.
- B. Related Requirements:
  - 1. Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
  - 2. Section 260526 "Grounding & Bonding."
  - 3. Section 260553 "Identification for Electrical Systems."

#### 1.3 DEFINITIONS

- A. EV: Electric vehicle.
- B. EV Cable: The off-board cable containing the conductor(s) to connect the EV power controller to the EV that provides both power and communications during energy transfer.
- C. EV Charger or EV Charging Equipment: See "EVSE."
- D. EV Connector: A conductive device that, when electrically coupled to an EV inlet, establishes an electrical connection to the EV for the purpose of power transfer and information exchange. This device is part of the EV coupler.
- E. EV Coupler: A mating EV inlet and connector set.
- F. EV Inlet: The device in the vehicle into which the EV connector is inserted, and a conductive connection is made for the transfer of power and communication. This device is part of the EV coupler.
- G. EVSE: Electric-Vehicle Supply Equipment. It includes the EV charging equipment and conductors, including the ungrounded, grounded, and equipment grounding conductors and EV cables, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for transferring energy between the premise wiring and the EV.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for EV charging equipment.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For EVSE.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of mounting assemblies for EV charging equipment.
4. Include diagrams for power, signal, and control wiring.
5. Include verification of wireless communications service at each location of EVSE.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Data: Certificates, for EVSE, accessories, and components, from manufacturer.

C. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

D. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

E. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Field quality-control reports.

G. Sample Warranty: For manufacturer's warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For EVSE to include in operation and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating manuals.
2. Program Software Backup: On USB, CD, Cloud, or approved media, complete with configuration files.
3. Device address and password list.
4. Printout of software application and graphic screens.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. EV cord and plug set: One for every 10, but no fewer than one.

## 1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain each product through one source from a single manufacturer.
- B. Comply with UL 1703 and UL 1741. Furnish products listed and classified by Underwriter's Laboratories Inc. as suitable for purpose specified and shown.
- C. Manufacturer shall have a minimum of ten (10) years experience in the production of solar photovoltaic equipment specified and shall have ISO 9001 certification.

## 1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of EVSE that fail(s) in materials or workmanship within specified warranty period.
  1. Warranty Period: Five year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 ELECTRIC VEHICLE SERVICE EQUIPMENT

- A. Basis of Design Product: Subject to compliance with requirements, provide product indicated on the drawings or comparable by one of the following manufacturers:
  1. Chargepoint Inc.
  2. EVgo Services LLC.
  3. Electrify America.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: EVSE shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  2. Component Importance Factor: 1.0.
- B. Ambient Temperature: 41 to 110 deg F.
- C. Relative Humidity: Zero to 95 percent.
- D. Altitude: Sea level to 1000 feet.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
- F. Surge Withstand: 6 kV at 3000 A.

- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- H. EV Charging Levels:
  - 1. Single vehicle, AC Level 2 at up to 7.2 kW per vehicle.

### 2.3 EVSE DESCRIPTION

- A. Comply with NFPA 70.
- B. Comply with:
  - 1. UL 2231-1.
  - 2. UL 2594.
  - 3. SAE J1772 for SAE combo chargers.
- C. Comply with ADA-ABA Accessibility Guidelines.
- D. Metering: Revenue grade meter.
- E. Control Power: 20 A, 110/120-V ac, 60 Hz, single phase per charger.
- F. Input Power:
  - 1. 40 A, 208/240-V ac, 60 Hz, single-phase services per charger.
- G. Integral GFCI.
- H. Auto-GFCI fault retry.
- I. EVSE Mounting: Bollard mount.
- J. Enclosures:
  - 1. Rated for environmental conditions at installed location.
    - a. Outdoor Locations: NEMA 250, Type 3R.
    - b. Lockable.
    - c. Tamper resistant.
- K. EV Cable and Connectors:
  - 1. SAE J1772 connector.
  - 2. Single connectors with locking holster.
  - 3. 18-foot (6-m) cable with cable management system.
  - 4. Field-replaceable connector and cable assembly.
- L. Status Indicators:
  - 1. LEDs to indicate power, charging, charging complete, system status, faults, and service.
- M. Display Screen:
  - 1. Daylight viewable, UV-protected display with human-machine interface capability.
  - 2. Displays power, charging, charging complete, remote control, system status, faults, and service.

- N. Networking:
  - 1. WAN Communications: Cellular GSM/GPRS or CDMA.
  - 2. LAN Communications: 802.11b/g/n.
  - 3. Capable of remote configuration and reporting.
  
- O. Payment System:
  - 1. NFC reader.
  - 2. PCI compliant.
  - 3. Capable of remote control and authorization.
  
- P. Charging Network: Compatible with the Chargepoint EV charging network.
  - 1. Multiple units shall independently connect to charging network.
  - 2. Individual units shall be capable of indicating station status and availability.

## 2.4 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by utilizing cushioning materials or foam or by applying a strippable, temporary protective covering before shipping.
  
- B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  
- B. Examine roughing-in for EVSE electrical conduit to verify actual locations of conduit connections before equipment installation.
  
- C. Examine pavement for suitable conditions where EVSE will be installed.
  
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 413.
  
- B. Concrete Base Mounting:
  - 1. Install EVSE on 6-inch (150-mm) nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

- a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  - b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - d. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - e. Secure EVSE to concrete base according to manufacturer's written instructions.
- C. Wiring Method: Conceal conductors and cables below grade where possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking from enclosures and components.
- F. Secure covers to enclosure.
- G. Cybersecurity:
- 1. Software:
    - a. Coordinate security requirements with Owner's IT department.
    - b. Ensure that latest stable software release is installed and properly operating.
    - c. Disable or change default passwords to password of at least eight characters in length, using a combination of uppercase and lower letters, numbers, and symbols. Record passwords and turn over to party responsible for system operation and administration.
  - 2. Hardware:
    - a. Coordinate location and access requirements with IT department.
    - b. Enable highest level of wireless encryption that is compatible with Owner's ICT network.
    - c. Disable dual network connections.

### 3.3 CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Comply with grounding requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Comply with requirements for installation of conduit in Section 260533 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.

- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- E. Verify that all electrical connections have been made according to the manufacturer's instructions. Remove all burrs, shavings, and detritus from inside the enclosure.
- F. After confirming all connections, install covers and tighten fasteners to according to manufacturer's instructions.

### 3.4 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify EVSE with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with white-filled lettering, and durable wire markers or tags inside wiring enclosure.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Visual Inspection: Prior to startup, examine installation for the following:
    - a. All equipment shall be mechanically secured and provided with adequate ventilation.
    - b. All electrical terminations and connections shall be made using approved products and installation methods.
    - c. All electrical equipment shall be marked with the manufacturer's identification and applicable specifications and ratings.
    - d. Sufficient working spaces shall be provided about any electrical equipment that is likely to be serviced or maintained while energized.
  - 2. For each unit of EVSE, perform the following tests and inspections:
    - a. Unit self-test.
    - b. Operation test with load bank.
    - c. Operation test with EV.
    - d. Network communications test.
- B. EVSE will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports. Submit reports within two (2) weeks of completion of tests.

### 3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions.

3.7 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for four years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within four years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
- C. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain EV charging equipment.

END OF SECTION 262743

**SECTION 263100 - SOLAR ENERGY POWER GENERATION EQUIPMENT**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. PV Modules.
2. Inverters.
3. Battery Storage Systems.
4. Mounting Structures.

B. Related Requirements:

1. Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
2. Section 260526 "Grounding & Bonding."
3. Section 260553 "Identification for Electrical Systems."

1.3 DEFINITIONS

- A. AC: Alternating Current.
- B. CEC: California Energy Commission.
- C. DC: Direct Current.
- D. IP Code: Required ingress protection to comply with IEC 60529. Retain terms that remain after this Section has been edited for a project.
- E. MPPT: Maximum Power Point Tracking.
- F. PTC: USA standard conditions for PV.
- G. PV: Photovoltaic.
- H. STC: Standard Test Conditions defined in IEC 61215.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Support Structure: Provide mounting hardware.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Submit plans and calculations showing the following:
  - 1. Canopy support structure for deferred agency approval.
  - 2. Photovoltaic panel and inverter layout and calculations for deferred agency approval.
  - 3. Include plans, elevations, sections, and mounting details.
  - 4. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 5. Detail fabrication and assembly.
  - 6. Include diagrams for power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's special materials and workmanship warranty and minimum power output warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For PV modules and inverters to include in operation and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Photovoltaic Panels: One for every 10, but no fewer than one.
  - 2. Connectors: One for every 10 of each type, but no fewer than one.
  - 3. Fuses: One for every 10 of each type, but no fewer than one.

1.9 QUALITY ASSURANCE

- A. Source Limitations: Obtain each product through one source from a single manufacturer.
- B. Comply with UL 1703 and UL 1741. Furnish products listed and classified by Underwriter's Laboratories Inc. as suitable for purpose specified and shown.
- C. Manufacturer shall have a minimum of ten (10) years experience in the production of solar photovoltaic equipment specified and shall have ISO 9001 certification.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace system components that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
  - a. Structural failures, including support components.
  - b. System DC power decline exceeding 0.6% per year.
  - c. Inverter failure.
  - d. Racking failures.
  - e. Ground faults.
  - f. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: 25-years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PV MODULES

- A. Basis of Design Product: Subject to compliance with requirements, provide product indicated on the drawings or comparable by one of the following manufacturers:
  1. LG Electronics USA Inc.
  2. SunPower Corporation.
  3. Panasonic Corporation of North America.
- B. Description: 60-cell Monocrystalline panel with tempered glass and anodized aluminum frame.
- C. Module Efficiency: 19% minimum.

### 2.2 INVERTERS

- A. Basis of Design Product: Subject to compliance with requirements, provide product indicated on the drawings or comparable by one of the following manufacturers:
  1. Fronius USA LLC.
  2. SolarEdge Technologies Inc.
  3. Sungrow USA Corporation.
- B. Description: Transformer-free string inverter with two MPPT inputs and rapid-shutdown compliant.
- C. Enclosure: NEMA 4X with variable speed fan.

### 2.3 BATTERY STORAGE SYSTEMS

- A. Basis of Design Product: Subject to compliance with requirements, provide product indicated on the drawings or comparable by one of the following manufacturers:
  1. Sunverge Energy Inc.
  2. Enphase Energy.
  3. Victron Energy
- B. Description: AC-coupled storage system rated for outdoor installation.

- C. Enclosure: NEMA 4X with variable speed fan.
- D. Warranty: 10 years minimum.

## 2.4 MOUNTING STRUCTURES

- A. Canopy Mount: Powder-coated steel construction, minimum two supporting columns, with caisson foundations.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrate areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Do not begin installation until mounting surfaces have been properly prepared.
- C. If preparation of mounting surfaces is the responsibility of another installer, notify Owner of unsatisfactory preparation before proceeding.
- D. Examine modules and array frame before installation. Reject modules and arrays that are wet, moisture damaged, or mold damaged.
- E. Examine supporting structures for suitable conditions where PV system will be installed.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Conductors:
  - 1. Do not strip insulation from conductors until right before they are spliced or terminated on their connector.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
- C. PV Module Installation:
  - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
  - 2. Keep each module protected until it is time to attach to structure.
  - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  - 4. Connect modules into strings as indicated on the drawings.
  - 5. Use a torque screwdriver when a torque is recommended or required by manufacturer.

3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify inverter and battery systems with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with white-filled lettering, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Visual Inspection: Prior to startup, examine installation for the following:
    - a. All equipment shall be mechanically secured and provided with adequate ventilation.
    - b. All electrical terminations and connections shall be made using approved products and installation methods.
    - c. All electrical equipment shall be marked with the manufacturer's identification and applicable specifications and ratings.
    - d. Sufficient working spaces shall be provided about any electrical equipment that is likely to be serviced or maintained while energized.
  - 2. Test Instruments: Use instruments that comply with the latest edition of IEC 62446-2.
- B. Tests for PV Systems:
  - 1. DC Voltage: 1000 V Maximum.
  - 2. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. PV system components will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports. Submit reports within two (2) weeks of completion of tests.

END OF SECTION 263100

## SECTION 265619 – LED EXTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
  - 2. Luminaire supports.
  - 3. Luminaire-mounted photoelectric relays.

#### 1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaire.
  - 4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
  - 5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project and testing procedures and criteria required by IES LM-79 and LM-80.
    - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.

- b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
      - 6. Wiring diagrams for power, control, and signal wiring.
      - 7. Photoelectric relays.
      - 8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
    - B. Sustainable Design Submittals:
      - 1. "BUG ratings" Light Pollution Reduction for both uplight and light trespass.
    - C. Delegated-Design Submittal: For luminaire supports.
      - 1. Include design calculations for luminaire supports and seismic restraints.
- 1.5 INFORMATIONAL SUBMITTALS
  - A. Qualification Data: For testing laboratory providing photometric data for luminaires.
  - B. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
    - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
    - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  - C. Product Certificates: For each type of the following:
    - 1. Luminaire.
    - 2. Photoelectric relay.
  - D. Test reports complying with LM-79 (IES approved method for electrical and photometric measurements of Solid-State Lighting) providing total luminous flux, luminous intensity distribution, electrical power characteristics, luminous efficacy and color characteristics (CRI, CCT) shall be submitted. Test reports complying with LM-80 (IES approved standard for measuring lumen maintenance of LED light sources) providing lumen maintenance of LED light sources shall be submitted.
  - E. ISTMT (IN SITU TEMPERATURE MEASUREMENT TEST) – It is the measure of the LED source case temperature within the LED system (luminaire or lamp or it is the temperature of the LED within the luminaire. This measurement should be performed according to the temperature measurement point (TMP) indicated by the particular LED package manufacturer. The temperature measured within the luminaire shall be within the temperature of the LM-80-08 LED source report.
  - F. All LED lifetime projections shall be made per TM-21-11 (approved method for taking LM-80 data and making useful LED lifetime projections).
  - G. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency as follows:

1. Test reports complying with LM-79 (IES approved method for electrical and photometric measurements of Solid-State Lighting) providing total luminous flux, luminous intensity distribution, electrical power characteristics, luminous efficacy and color characteristics (CRI, CCT) shall be submitted.
2. Test reports complying with LM-80 (IES approved standard for measuring lumen maintenance of LED light sources) providing lumen maintenance of LED light sources shall be submitted.
3. ISTMT (IN SITU TEMPERATATURE MEASUREMENT TEST) – It is the measure of the LED source case temperature within the LED system (luminaire or lamp or it is the temperature of the LED within the luminaire. This measurement should be performed according to the temperature measurement point (TMP) indicated by the particular LED package manufacturer. The temperature measured within the luminaire shall be within the temperature of the LM-80-08 LED source report.
4. All LED lifetime projections shall be made per TM-21-11 (approved method for taking LM-80 data and making useful LED lifetime projections).

H. Source quality-control reports.

I. Sample warranty.

#### 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: Furnish at least one of each type.
2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: Furnish at least one of each type.
3. Diffusers and Lenses: Furnish at least one of each type.
4. Globes and Guards: Furnish at least one of each type.

#### 1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including luminaire support components.
    - b. Faulty operation of luminaires and accessories.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Period: 5-years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
  - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. UL Compliance: Comply with UL 1598 and listed for wet location.
- D. CRI of minimum 80. CCT of 3000 K.
- E. L70 lamp life of 50,000 hours.
- F. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- G. Internal driver.
- H. Nominal Operating Voltage: 120V AC.
- I. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.
- J. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
  - 1. Relay with locking-type receptacle shall comply with ANSI C136.10.
  - 2. Adjustable window slide for adjusting on-off set points.

2.4 LUMINAIRE TYPES

- A. Area and Site:
  - 1. Luminaire Shape: Round or Square
  - 2. Mounting: Pole or Building with extruded-aluminum rectangular arm, 11 inches in length.
  - 3. Luminaire-Mounting Height: See plans.
  - 4. Distribution: See plans.
  - 5. Housings:
    - a. Aluminum housing and heat sink.
    - b. Painted finish.
- B. Canopy:
  - 1. Shape: Round.
  - 2. Dimensions: 12 inches in diameter.
  - 3. Housings:
    - a. Aluminum housing and heat sink.
    - b. Painted finish.
- C. Decorative Post Top:
  - 1. Luminaire-Mounting Height: See plans.
  - 2. Distribution: See plans.
  - 3. Housings:
    - a. Aluminum housing and heat sink.
    - b. Painted finish.

2.5 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

- C. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- D. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- E. Housings:
  - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
  - 2. Provide filter/breather for enclosed luminaires.
- F. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter, shape, size, wattage and coating.
    - c. CCT and CRI for all luminaires.

## 2.6 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
  - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
  - 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
  - 4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
    - a. Color: See plans.
- C. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish sur-

- faces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    - a. Color: See plans.

### PART 3 - EXECUTION

#### 3.1 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

#### 3.2 EXAMINATION

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Owner prior to the start of luminaire installation.
- C. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- D. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- E. Examine suitable conditions where luminaires will be installed.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
  1. Sized and rated for luminaire weight.
  2. Able to maintain luminaire position after cleaning and relamping.
  3. Support luminaires without causing deflection of finished surface.
  4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

- F. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.
- H. Coordinate layout and installation of luminaires with other construction.
- I. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

### 3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

- A. Aim as indicated on Drawings.
- B. Install on concrete base with top minimum 2 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

### 3.5 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

### 3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.7 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:
  - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):

- a. IES LM-5.
- b. IES LM-50.
- c. IES LM-52.
- d. IES LM-64.
- e. IES LM-72.

2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### 3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

### 3.9 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Owner.

END OF SECTION 265619

# **PART VI**

# **ATTACHMENTS**

**ATTACHMENT "A"**

**GEOTECHNICAL REPORT**



Construction Testing & Engineering, South, Inc.

Inspection | Testing | Geotechnical | Environmental & Construction Engineering | Civil Engineering | Surveying

**GEOTECHNICAL INVESTIGATION  
PARKING LOT "D" IMPROVEMENT PROJECT  
CITY OF HERMOSA BEACH, CALIFORNIA**

**PREPARED FOR:**

**ADAMS STREETER CIVIL ENGINEERS, INC.  
MR RANDAL L. STREETER  
15 CORPORATE PARK  
IRVINE, CALIFORNIA**

**PREPARED BY:**

**CONSTRUCTION TESTING & ENGINEERING, SOUTH, INC.  
14538 MERIDIAN PARKWAY, SUITE A  
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**CTE JOB NO. 40-3547G**

**JANUARY 22, 2018**

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### FIGURES

FIGURE 1	SITE LOCATION MAP
FIGURE 2	EXPLORATION LOCATION MAP
FIGURE 3	RETAINING WALL DRAIN DETAIL

### APPENDICES

APPENDIX A	FIELD EXPLORATION METHODS AND EXPLORATION LOGS
APPENDIX B	LABORATORY METHODS AND RESULTS

## 1.0 EXECUTIVE SUMMARY

Our investigation was performed to provide site-specific geotechnical and pavement design information for the City of Hermosa Beach, California Parking Lot “D” improvement project. The site location is shown on Figure 1, Site Location Map. Observations, drilling and sampling activities were conducted within the existing paved parking lot. Selected samples of subgrade soil were submitted for laboratory testing.

Subgrade soils encountered during the field investigation consisted of artificial fill, consisting of sand with silt, and medium dense to dense poorly graded eolian sand. The existing parking lot was paved with approximately 3 to 3-1/2 inches of asphalt concrete over subgrade soils. Groundwater was not encountered in the borings. Sampling locations were backfilled with soil and capped with asphalt cold patch.

## 2.0 INTRODUCTION AND SCOPE OF SERVICES

### 2.1 Introduction

Construction Testing and Engineering, Inc. (CTE) has prepared this report for Adams Streeter Civil Engineers, Inc. Presented herein are the results of the investigation performed as well as recommendations regarding the proposed improvements and reconstruction of the existing parking lot.

### 2.2 Scope of Services

Our scope of services included the following:

- Collect and review readily available geologic literature and maps pertaining to soil and geologic conditions within and adjacent to the site.
- Coordinate with the local underground utilities locating service (Underground Service Alert) and a knowledgeable site representative to obtain an underground utilities clearance prior to commencement of the subsurface investigation.
- Perform an independent underground utility clearance at the proposed boring locations.
- Drill two exploratory borings using a truck-mounted hollow-stem auger drill rig to evaluate the existing pavement sections and subgrade soils.
- Log and classify materials encountered in the borings.
- Collect representative bulk and/or undisturbed soil samples for laboratory analysis.
- Perform appropriate laboratory analyses on soil samples which included in-situ dry density and moisture content, R-value, gradation, and corrosion analyses.
- Perform appropriate geologic and engineering analyses of data collected.
- Perform percolation tests for storm water infiltration design.
- Prepare a geotechnical report for the proposed construction presenting the results of our investigation and recommendations for the proposed improvements. Recommendations are provided for asphalt and concrete pavement, pavers and retaining walls.

### 3.0 SITE LOCATION AND PROPOSED CONSTRUCTION

The existing parking lot is located at the southwest corner of 14<sup>th</sup> Street and Manhattan Avenue in the City of Hermosa Beach, California. It is currently comprised of a paved parking and a short retaining wall.

Proposed development will consist of demolishing and repaving the existing parking lot. Several options are considered for the redevelopment. Included will be asphalt concrete pavement, concrete trash enclosure pad, pavers, hardscape, bioswale, retaining wall, wheelchair/platform lift, and landscaping.

#### 4.0 FIELD AND LABORATORY INVESTIGATION

##### 4.1 Field Investigation

Our field investigation was performed on December 6, 2017 and included two exploratory borings identified as B-1 and B-2. The borings were drilled at the parking lot location. In addition, two borings (P-1 and P-2) were drilled for percolation testing. The exploration locations are shown on Figure 2.

The explorations were excavated to investigate and obtain bulk and undisturbed samples of the subsurface soils. The borings were excavated using a truck-mounted, eight-inch diameter, hollow-stem auger drill rig to a maximum explored depth of 16-½ feet below the existing surface.

Soils encountered within the explorations were classified in the field in accordance with the Unified Soil Classification System. The field descriptions were later modified (as appropriate) based on the results of our laboratory testing program. In general, soil samples were obtained at 5-foot intervals with a split spoon (California Modified) sampler. Specifics of the soils encountered can be found on the Exploration Logs, which are presented in Appendix A.

##### 4.2 Laboratory Analyses

Laboratory tests were conducted on representative soil samples to evaluate their physical properties and engineering characteristics. Specific laboratory tests included: in-place moisture and density, “R” value, gradation and chemical analyses. These tests were conducted to

determine the properties and corrosivity of the on-site soils. Test method descriptions and laboratory results are presented in Appendix B and on the Exploration Logs.

## 5.0 FIELD OBSERVATIONS

### 5.1 Findings

This section summarizes the findings of our field investigation and laboratory testing program. Subgrade soil material was found to consist of poorly graded sand. Laboratory tests were assigned in order to determine soils properties and for R-value testing. Based on our laboratory testing, the R-value was 52. Groundwater was not encountered in the borings. Groundwater is not expected to impact the planned improvements, provided that appropriate surface drainage is maintained. However, localized perched water and/or saturated areas cannot be precluded.

## 6.0 CONCLUSIONS AND RECOMMENDATIONS

### 6.1 General

Based on our investigation, the proposed construction on the site is feasible from a geotechnical standpoint, provided the recommendations in this report are incorporated into design and construction of the project. Preliminary recommendations for the design and construction of the proposed development are included in the subsequent sections of this report. Additional recommendations could be required based on the actual conditions encountered during earthwork and/or improvement construction.

## 6.2 Site Preparation

### 6.2.1 General

Prior to grading, the site should be cleared of debris, pavement and deleterious materials. Organic and other deleterious materials not suitable for use as structural backfill should be disposed of offsite at a legal disposal site.

### 6.2.2 Excavations

In order to provide uniform structural support for the new pavement, the upper foot of subgrade should be excavated. The soils exposed at the bottom of the excavation should be documented by a geotechnical representative of this office to determine their suitability. If unsuitable materials are encountered at the bottom of the excavation, they should be removed to the depth of competent natural material.

Temporary, unsurcharged excavations up to four feet deep may be cut vertically. Deeper excavations should be sloped back or shored. Temporary sloped excavations should be cut at a slope of 1:1 (horizontal:vertical) or flatter. Vehicles and storage loads should not be placed within 10 feet of the top of the excavation. If temporary slopes are to be maintained during the rainy season, berms are recommended along the tops of slopes to divert runoff water from entering the excavation and eroding the slope faces.

### 6.2.3 Preparation of Areas to Receive Fill

Exposed excavation bottoms and subgrade surfaces to receive fill should be scarified to a minimum depth of 8 inches, brought to at least 2 percent above optimum moisture

content and compacted to at least 95 percent of the maximum dry density as determined by ASTM D 1557.

#### 6.2.4 Fill Placement and Compaction

Fill should be compacted to at least 95 percent of the maximum dry density (as determined by ASTM D 1557) at a moisture content at least 2 percent above optimum. The upper 12-inches of pavement subgrade should be compacted to at least 95 percent of the maximum dry density (per ASTM D 1557) at a moisture content at least 2 percent above optimum. Compaction equipment should be appropriate for the materials being compacted. The optimum lift thickness for fill soils will be dependent on the type of compaction equipment being utilized. Fill should be placed in uniform horizontal lifts not exceeding 8 inches in loose thickness. Placement and compaction of fill should be performed in general conformance with geotechnical recommendations and local ordinances.

Granular soils generated from on-site excavations are anticipated to be suitable for use as structural fill, provided they are free from debris and deleterious material. Rocks or other soil fragments greater than four inches in size should not be used in the fills. Proposed import material should be evaluated by the project geotechnical engineer prior to being placed at the site. Import materials should consist of non-corrosive, granular material with an expansion index less than 20.

### 6.2.5 Utility Trenches

Utility trenches should be excavated in accordance with the recommendations presented in Section 6.2.2. Backfill should be placed in loose lifts no greater than eight inches and mechanically compacted to a relative compaction of at least 90 percent of the maximum dry density (per ASTM D 1557) at a moisture content at least 2 percent above optimum.

### 6.3 Seismic Design Criteria

The seismic ground motion values listed in Table 1 below were derived in accordance with the ASCE 7-10 Standard that is incorporated into the California Building Code, 2016. This was accomplished by establishing the Site Class based on the soil properties at the site, and then calculating the site coefficients and parameters using the United States Geological Survey Seismic Design Maps application for the CBC values. These values are intended for the design of structures to resist the effects of earthquake ground motions. The site coordinates used in the application were 33.8637°N and 118.3997°W.

TABLE 1 SEISMIC GROUND MOTION VALUES		
PARAMETER	VALUE	CBC REFERENCE (2016)
Site Class	D	ASCE 7, Chapter 20
Mapped Spectral Response Acceleration Parameter, $S_S$	1.636	Figure 1613.3.1 (1)
Mapped Spectral Response Acceleration Parameter, $S_1$	0.624g	Figure 1613.3.1 (2)
Seismic Coefficient, $F_a$	1.000	Table 1613.3.3 (1)
Seismic Coefficient, $F_v$	1.500	Table 1613.3.3 (2)
MCE Spectral Response Acceleration Parameter, $S_{MS}$	1.636g	Section 1613.3.3
MCE Spectral Response Acceleration Parameter, $S_{M1}$	0.936g	Section 1613.3.3
Design Spectral Response Acceleration, Parameter $S_{DS}$	1.090g	Section 1613.3.4
Design Spectral Response Acceleration, Parameter $S_{D1}$	0.624g	Section 1613.3.4
Mapped MCE Geometric Peak Ground Acceleration, $PGA_M$	0.636 g	ASCE 7, Chapter 11
Seismic Design Category	D	ASCE 7 Chapter 11

#### 6.4 Vehicular Pavements

Pavement sections were evaluated using a design ‘R’ value of 50 and a modulus of subgrade reaction of approximately 200 pci for site subgrade soil. The laboratory determined R value for site soil was 52. The pavement section recommendations are based on the assumption that the subgrade soil (the top 12-inches minimum) will be compacted to a minimum of 95 percent of the maximum dry density (per ASTM D 1557).

Concrete trash pad pavement should have a minimum modulus of rupture (flexural strength) of 600 psi. We estimate that a 4,500 psi 28-day compressive strength concrete would generally

provide the minimum required flexural strength; however, other mix designs could also meet the requirements. As such, we recommend that the contractor submit the proposed mix design with necessary documentation to offer a proper level of confidence in the proposed concrete materials. Recommended concrete pavement sections are presented below in Table 2.

TABLE 2 PORTLAND CEMENT CONCRETE (PCC) PAVEMENT SECTION			
Traffic Area	Assumed Traffic Index	Design Modulus of Subgrade Reaction (pci)	PCC Thickness (inches)
Parking and Drive Lanes	5.5	200	6.0

Recommended asphalt concrete pavement sections are presented below in Table 3.

TABLE 3 ASPHALT CONCRETE (AC) PAVEMENT SECTIONS				
Traffic and Drive Lanes	Assumed Traffic Index	Design ‘R’ Value	AC Thickness (inches)	Aggregate Base Thickness* (inches)
Asphalt Concrete	5.5	50	3.0	4.0

\* Minimum R Value of 78.

Our analysis indicates that a paver section, as a minimum, consist of a 4” paver over 4” of compacted base. The permeable base may be utilized as part of a reservoir, if constructed.

In addition, it is recommended that pavement areas conform to the following criteria:

- Placement and construction of the recommended pavement section should be performed in accordance with the Standard Specifications for Public Works Construction (Greenbook, latest edition).
- Aggregate base should conform to the specification for Caltrans Class 2 Aggregate Base or Greenbook Crushed Aggregate Base (CAB).
- Pavement sections are prepared assuming that periodic maintenance will be done, including sealing of cracks and other measures.

### 6.5 Retaining Walls

Retaining walls bearing on undisturbed subgrade soil or compacted fill may be designed for an allowable bearing pressure of 2000 psf, a passive resistance of 250 pcf, and a coefficient of friction of 0.3. For the design of walls where the surface of the backfill is level, it may be assumed that the on-site sandy soils will exert an active lateral pressure equal to that developed by a fluid with a density of 40 pounds per cubic foot (pcf). The active pressure should be used for walls free to yield at the top at least 0.2 percent of the wall height. For walls restrained at the top so that such movement is not permitted, a pressure corresponding to an equivalent fluid density of 60 pcf should be used, based on at-rest soil conditions. These pressures should be increased by 20 pcf for walls retaining soils inclined at 2:1 (horizontal:vertical). In addition to the recommended earth pressures, the wall should be designed to resist a uniform lateral pressure of 72 pounds per square foot acting as a result of a vehicle surcharge. This assumes a traffic surcharge load equivalent to two feet of soil.

Retaining walls over six feet high should be designed for earthquake forces. Lateral pressures on cantilever retaining walls (yielding walls) due to earthquake motions may be calculated based on

work by Seed and Whitman (1970). The total lateral thrust against a properly drained and backfilled cantilever retaining wall above the groundwater level can be expressed as:

$$P_{AE} = P_A + \Delta P_{AE}$$

For non-yielding (or “restrained”) walls, the total lateral thrust may be similarly calculated based on work by Wood (1973):

$$P_{KE} = P_K + \Delta P_{KE}$$

Where:

$P_A$  = Static Active Thrust

$P_K$  = Static Restrained Wall Thrust

$\Delta P_{AE}$  = Dynamic Active Thrust Increment =  $(3/8) k_h \gamma H^2$

$\Delta P_{KE}$  = Dynamic Restrained Thrust Increment =  $k_h \gamma H^2$

$k_h$  = 2/3 Peak Ground Acceleration =  $2/3 (PGA_M) = 0.48g$

$H$  = Total Height of the Wall

$\gamma$  = Total Unit Weight of Soil  $\approx$  135 pounds per cubic foot

The increment of dynamic thrust in both cases should be distributed as an inverted triangle, with a resultant located at 0.6H above the bottom of the wall.

Recommendations for waterproofing the walls to reduce moisture infiltration should be provided by the project architect or structural engineer.

We recommend that walls be backfilled with soil having an expansion index of 20 or less with less than 30 percent passing the #200 sieve. The backfill area should include the zone defined by

a 1:1 sloping plane, extended back from the base of the wall footing. Wall backfill should be compacted to at least 90 percent relative compaction, based on ASTM D 1557. Backfill should not be placed until walls have achieved adequate structural strength. Heavy compaction equipment, which could cause distress to walls, should not be used. The recommended lateral earth pressures presented herein assume that drainage will be provided behind the walls to prevent the accumulation of hydrostatic pressures. A back-drain system (similar to that shown on Figure 3) should be provided to reduce the potential for the accumulation of hydrostatic pressures.

#### 6.6 Corrosive Soils

Sulfate-containing solutions or soil can have a deleterious effect on the in-service performance of concrete. In order to evaluate the foundation environment, a representative sample of site soil was laboratory tested for pH, resistivity, soluble sulfate and chloride. The results of the tests are summarized in Table 4.

TABLE 4 SUMMARY OF CHEMICAL ANALYSES				
Sample Location	pH	Resistivity (ohm-cm)	Sulfate (ppm)	Chloride (ppm)
B-1 @ 1-5 ft.	7.1	3,900	160	ND*

\*ND Not detected

Based on ACI 18 Building Code and Commentary Table 4.3.1, sulfate exposure is considered *moderate*. We recommend that Type II/V cement be used. The concrete should also have maximum water-cementitious material ratio of 0.50 and a minimum compressive strength of

4000 psi. We further recommend that at least a 3-inch thick concrete cover be maintained over the reinforcing steel in concrete in contact with the soil.

Based on the results of the resistivity tests, site soil appears to be *moderately corrosive* to ferrous metals. CTE does not practice in the field of corrosion engineering. Therefore, a corrosion engineer could be consulted to determine the appropriate protection for metallic improvements in contact with site soils.

#### 6.7 Drainage

Positive drainage should be established for the project and as recommended by the project civil engineer of record. To facilitate this, the proper use of construction elements such as earthen and/or concrete swales and subdrains may be employed. The project civil engineer should thoroughly evaluate the on-site drainage and make provisions as necessary to keep surface water from entering structural areas.

#### 6.8 Percolation Test Results

Percolation tests were conducted in the proposed retention areas. Field percolation test results were converted to infiltration rates, and are presented below in Table 5.

TABLE 5 PERCOLATION TEST RESULTS			
Test No.	Depth of Test (feet below surface)	Soil Description (USCS Symbol)	Infiltration Rate (in/hr)
P-1	2	Poorly-graded Sand w/Silt (SP- SM)	53
P-2	2	Poorly-graded Sand (SP)	66

Infiltration rates can be affected by such factors as build-up of silt, debris, degree of soil saturation, and compaction of soil from grading. For design, an appropriate factor of safety should be applied to the slower infiltration rate to accommodate subsurface inconsistencies, potential compaction from grading, and potential silting of the soils.

#### 6.9 Plan Review

CTE should be authorized to review project grading and foundation plans and the project specifications before the start of earthwork to identify potential conflicts with the recommendations contained in this report.

#### 7.0 LIMITATIONS

The recommendations provided in this report are based on the anticipated construction and the subsurface conditions found in our explorations. The interpolated subsurface conditions should be checked in the field during construction to document that conditions are as anticipated.

Recommendations provided in this report are based on the understanding and assumption that CTE will provide the observation and testing services for the project. Earthwork should be observed and tested to document that grading activity has been performed according to the recommendations contained within this report.

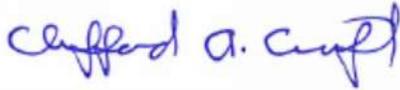
The field evaluation, laboratory testing and geotechnical analysis presented in this report have been conducted according to current engineering practice and the standard of care exercised by reputable geotechnical consultants performing similar tasks in this area. No other warranty, expressed or implied, is made regarding the conclusions, recommendations and opinions expressed in this report. Variations may exist and conditions not observed or described in this report may be encountered during construction.

This report is applicable to the site for a period of three years after the issue date provided the project remains as described herein. Modifications to the standard of practice and regulatory requirements may necessitate an update to this report prior to the three years from issue.

Our conclusions and recommendations are based on an analysis of the observed conditions. If conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if required, will be provided upon request. CTE should review project specifications for earthwork and paving activities prior to the solicitation of construction bids.

We appreciate this opportunity to be of service on this project. If you have questions regarding this report, please do not hesitate to contact the undersigned.

Respectfully submitted,  
CONSTRUCTION TESTING & ENGINEERING, SOUTH, INC.



Clifford A. Craft, GE #243  
Senior Geotechnical Engineer



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Senior Engineering Geologist



Robert L. Ellerbusch  
Staff Geologist



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6. Seed, H.B., and R.V. Whitman, 1970, "Design of Earth Retaining Structures for Dynamic Loads," in Proceedings, ASCE Specialty Conference on Lateral Stresses in the Ground and Design of Earth-Retaining Structures, pp. 103-147, Ithaca, New York: Cornell University.
7. Webb, R.W. and Norris, R.M., 1990, Geology of California.
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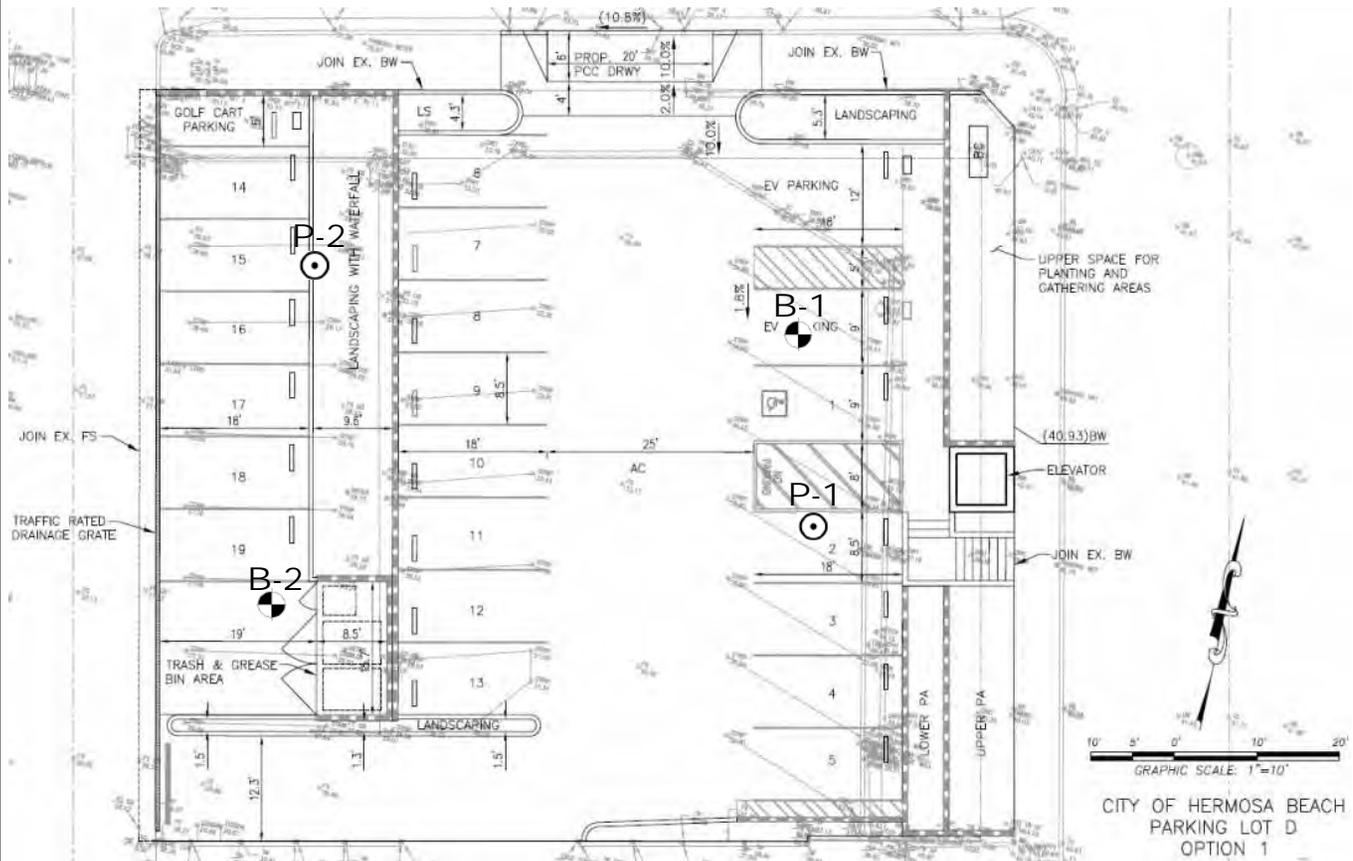


NO SCALE



**SITE LOCATION MAP**  
**PARKING LOT D IMPROVEMENTS**  
**HERMOSA BEACH, CALIFORNIA**

Job No.	Date	Figure
40-3547G	JAN 2018	1



CITY OF HERMOSA BEACH  
 PARKING LOT D  
 OPTION 1

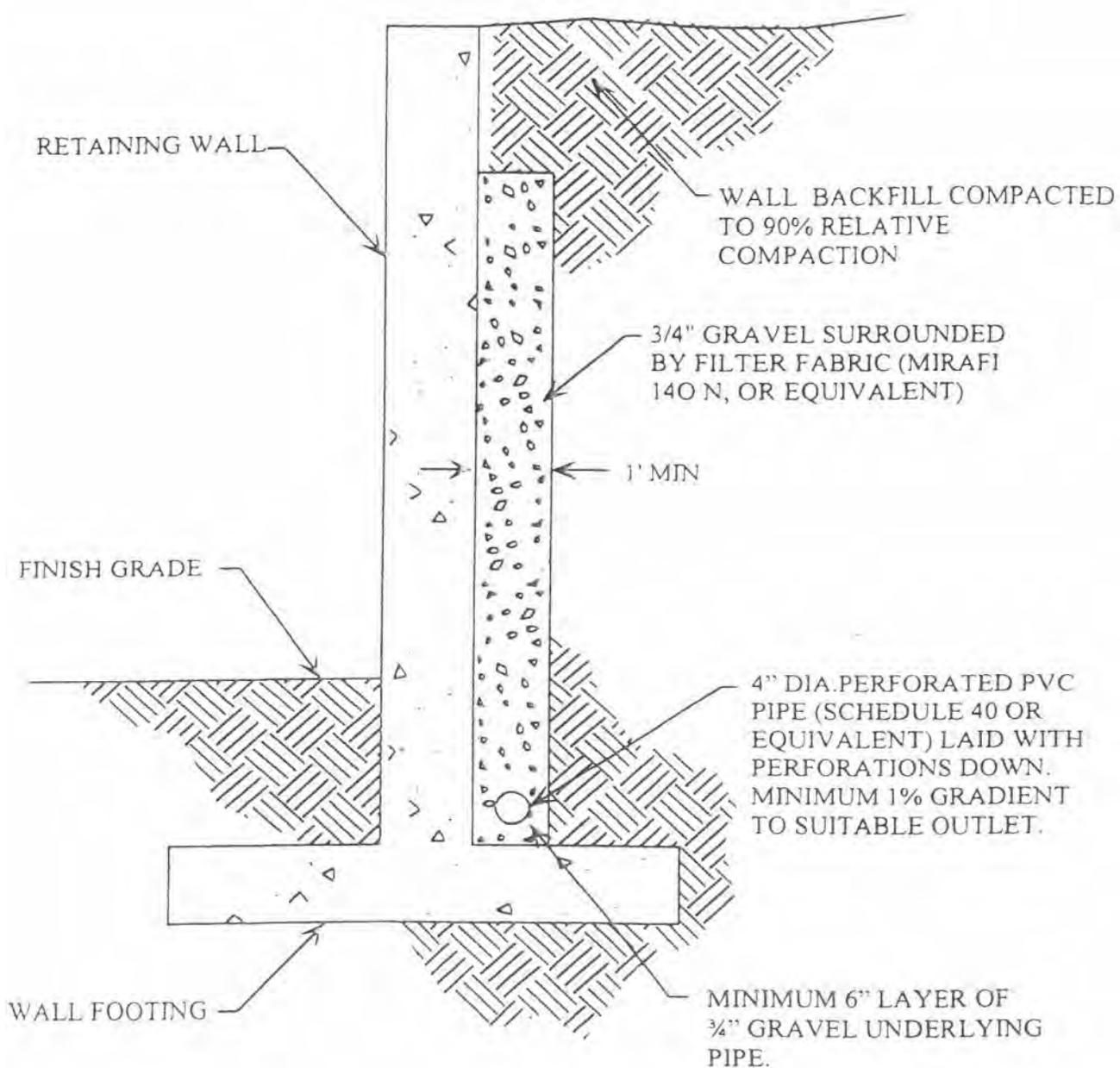
**GEOTECHNICAL LEGEND**

-  B-1 Approximate Boring Location
-  P-1 Approximate Percolation Test Location



**EXPLORATION LOCATION MAP  
 PARKING LOT D IMPROVEMENTS  
 HERMOSA BEACH, CALIFORNIA**

Job No.	Date	Figure
40-3547G	JAN 2018	2



**RETAINING WALL DRAIN DETAIL**  
**PARKING LOT D IMPROVEMENTS**  
**HERMOSA BEACH, CALIFORNIA**

Job No.	Date	Figure
40-3547G	JAN 2018	3

APPENDIX A

FIELD EXPLORATION METHODS AND EXPLORATION LOGS

## APPENDIX A

### FIELD EXPLORATION METHODS AND EXPLORATION LOGS

#### Soil Boring Methods

##### Relatively “Undisturbed” Soil Samples

Relatively “undisturbed” soil samples were collected using a modified California-drive sampler (2.4-inch inside diameter, 3-inch outside diameter) lined with sample rings. Drive sampling was conducted in general accordance with ASTM D-3550. The steel sampler was driven into the bottom of the borehole with successive drops of a 140-pound weight falling 30-inches. Blow counts (N) required for sampler penetration are shown on the boring logs in the column “Blows/Foot.” The soil was retained in brass rings (2.4 inches in diameter, 1.0 inch in height) and sealed in waterproof plastic containers for shipment to the CTE, South, Inc. geotechnical laboratory.

##### Disturbed Soil Sampling

Bulk soil samples of the drill cuttings were collected in large plastic bags. The disturbed soil samples were returned to the CTE, South, Inc. geotechnical laboratory for analysis.



## DEFINITION OF TERMS

PRIMARY DIVISIONS		SYMBOLS		SECONDARY DIVISIONS
<b>COARSE GRAINED SOILS</b> MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	<b>GRAVELS</b> MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS < 5% FINES	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES LITTLE OR NO FINES
		GRAVELS WITH FINES	GP	POORLY GRADED GRAVELS OR GRAVEL SAND MIXTURES, LITTLE OF NO FINES
			GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES
		<b>SANDS</b> MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS < 5% FINES	GC
	SW			WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	<b>FINE GRAINED SOILS</b> MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	<b>SILTS AND CLAYS</b> LIQUID LIMIT IS LESS THAN 50	SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES
			ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, SLIGHTLY PLASTIC CLAYEY SILTS
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY, SANDY, SILTS OR LEAN CLAYS
OL			ORGANIC SILTS AND ORGANIC CLAYS OF LOW PLASTICITY	
<b>SILTS AND CLAYS</b> LIQUID LIMIT IS GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS		
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTY CLAYS		
<b>HIGHLY ORGANIC SOILS</b>		PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

### GRAIN SIZES

BOULDERS	COBBLES	GRAVEL		SAND			SILTS AND CLAYS
		COARSE	FINE	COARSE	MEDIUM	FINE	
12"	3"	3/4"	4	10	40	200	
CLEAR SQUARE SIEVE OPENING				U.S. STANDARD SIEVE SIZE			

### ADDITIONAL TESTS

(OTHER THAN TEST PIT AND BORING LOG COLUMN HEADINGS)

MAX- Maximum Dry Density  
 GS- Grain Size Distribution  
 SE- Sand Equivalent  
 EI- Expansion Index  
 CHM- Sulfate and Chloride Content, pH, Resistivity  
 COR - Corrosivity  
 SD- Sample Disturbed

PM- Permeability  
 SG- Specific Gravity  
 HA- Hydrometer Analysis  
 AL- Atterberg Limits  
 RV- R-Value  
 CN- Consolidation  
 CP- Collapse Potential  
 HC- Hydrocollapse  
 RDS- Remolded Direct Shear

PP- Pocket Penetrometer  
 WA- Wash Analysis  
 DS- Direct Shear  
 UC- Unconfined Compression  
 MD- Moisture/Density  
 M- Moisture  
 SC- Swell Compression  
 OI- Organic Impurities



PROJECT:  
CTE JOB NO:  
LOGGED BY:

DRILLER:  
DRILL METHOD:  
SAMPLE METHOD:

SHEET: of  
DRILLING DATE:  
ELEVATION:

# BORING LEGEND

Laboratory Tests

## DESCRIPTION

Depth (Feet)	Bulk Sample Driven Type	Blows/Foot	Dry Density (pcf)	Moisture (%)	U.S.C.S. Symbol	Graphic Log	DESCRIPTION	Laboratory Tests
0							Block or Chunk Sample	
							Bulk Sample	
5								
							Standard Penetration Test	
-10							Modified Split-Barrel Drive Sampler (Cal Sampler)	
-15							Groundwater Table	
-20							Soil Type or Classification Change	
							Formation Change [(Approximate boundaries queried (?))]	
-25					"SM"		Quotes are placed around classifications where the soils exist in situ as bedrock	



PROJECT: Parking Lot D Improvements      DRILLER: 2R Drilling CME 75      SHEET: 1 of 1  
 CTE JOB NO: 40-3547G      DRILL METHOD: 8" Hollow Stem Auger      DRILLING DATE: 12/6/2017  
 LOGGED BY: R. Ellerbusch      SAMPLE METHOD: 140 lb/30" Autohammer      ELEVATION: ~35' msl

Depth (Feet)	Bulk Sample Driven Type	Blows/6 inches	Dry Density (pcf)	Moisture (%)	U.S.C.S. Symbol	Graphic Log	BORING: B-1	
							Laboratory Tests	
DESCRIPTION								
0							<b>3.5" AC on Subgrade</b>	
					SP-SM		<b>Artificial Fill</b> Poorly-graded SAND with Silt, dry, brown, trace gravel.  gray in color starting at 2 ft.  asphalt fragments encountered at 4-5 ft.	MAX, CHM GS (8% fines)
5		5 10 13	93.0	0.9	SP		<b>Eolian and Dune Deposits (Qe)</b> Poorly-graded SAND, medium dense, dry, light brown, trace gravel.	WA (1% fines) MD
10		8 16 22	98.5	1.1			Poorly-graded SAND, dense, dry, light brown.	WA (1% fines) MD
15		13 19 29	92.3	1.4			Poorly-graded SAND, dense, damp, light brown.	MD
							Total Depth = 16.5 ft. below pavement surface. No Groundwater encountered. Bore hole backfilled with soil cuttings and capped with asphalt patch.	
20								
25								

B-1



PROJECT: Parking Lot D Improvements	DRILLER: 2R Drilling CME 75	SHEET: 1 of 1
CTE JOB NO: 40-3547G	DRILL METHOD: 8" Hollow Stem Auger	DRILLING DATE: 12/6/2017
LOGGED BY: R. Ellerbusch	SAMPLE METHOD: 140 lb/30" Autohammer	ELEVATION: ~29' msl

Depth (Feet)	Bulk Sample Driven Type	Blows/6 inches	Dry Density (pcf)	Moisture (%)	U.S.C.S. Symbol	Graphic Log	BORING: B-2	Laboratory Tests
							DESCRIPTION	
0							<b>3" AC on Subgrade</b>	
1	X				SP		<b>Eolian and Dune Deposits (Qe)</b> Poorly-graded SAND, damp, light brown.	RV WA (1% fines)
5	Z	8 12 16		2.0			Poorly-graded SAND, medium dense, damp, light brown.	
6.5							Total Depth = 6.5 ft. below pavement surface. No Groundwater encountered. Bore hole backfilled with soil cuttings and capped with asphalt patch.	
10								
15								
20								
25								

B-2

APPENDIX B  
LABORATORY METHODS AND RESULTS

## APPENDIX B

### LABORATORY METHODS AND RESULTS

Laboratory tests were performed on selected soil samples to evaluate their engineering properties. Tests were performed following test methods of the American Society for Testing and Materials (ASTM), or other accepted standards. The following presents a brief description of the various test methods used. Laboratory results are presented in the following section of this Appendix.

#### Chemical Analysis

Soil materials were collected and tested for Sulfate and Chloride content, pH, and Resistivity.

#### Classification

Soils were classified visually according to the Unified Soil Classification System. Visual classifications were supplemented by laboratory testing of selected samples according to ASTM D 2487.

#### In-Place Moisture/Density

The in-place moisture content and dry unit weight of selected relatively undisturbed samples in accordance with ASTM D 2216 and D 2937, respectively.

#### Resistance “R” Value

The resistance “R”-value was measured by the CTM 301. The graphically determined “R” value at an exudation pressure of 300 pounds per square inch is the value used for pavement section calculation.

#### Sieve Analysis (Gradation)

Sieve analyses and/or 200 washes were performed on selected representative samples according to ASTM C 136 and D 1140 to determine grain-size distribution.



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## REPORT OF RESISTANCE 'R' VALUE-EXPANSION PRESSURE

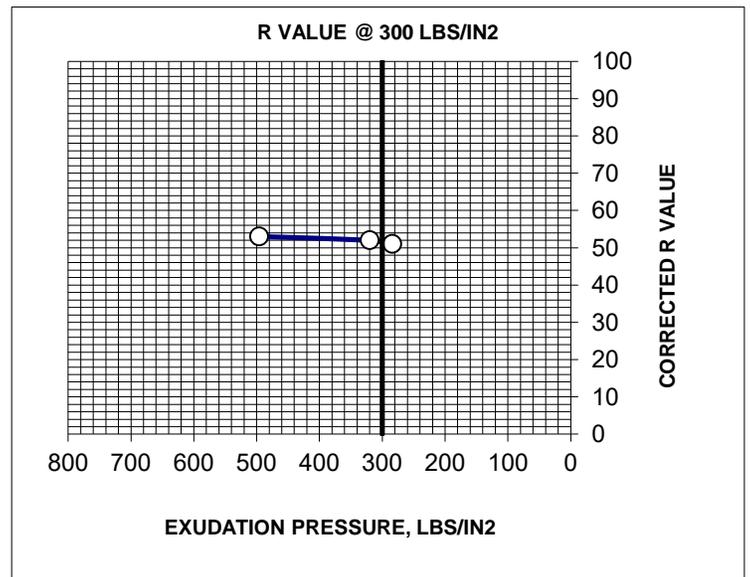
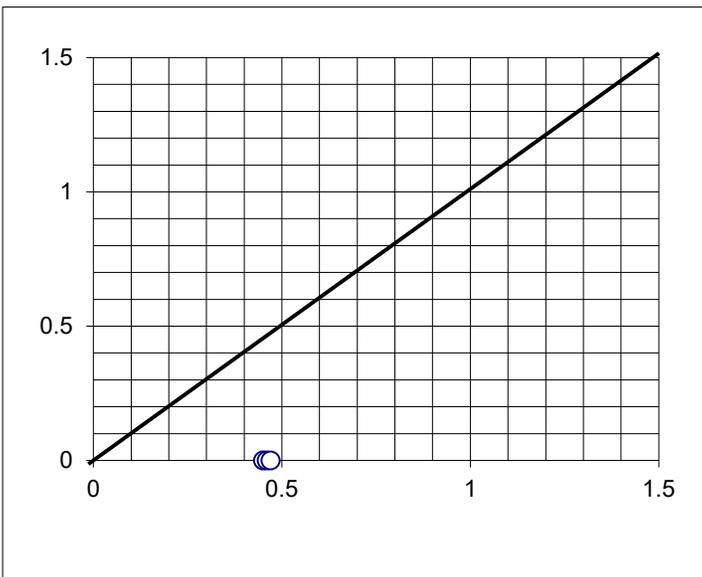
**Project Name:** Parking Lot D Improvements  
**Project No.:** 40-3547  
**Sample Location:** B-2 @ 1-4'  
**Soil Description:** Light Brown SP  
**Test Procedure:** Cal 301

**Lab No.:** 27985  
**Sampled By:** RE **Date:** 12/6/2017  
**Submitted By:** RE **Date:** 12/6/2017  
**Tested By:** Larry Sachs **Date:** 12/14/2017  
**Reviewed By:** Chase Velarde **Date:** 12/14/2017

Specimen/ Mold No.	7	8	9
Compactor Air Pressure, ft.lbs.	250	250	250
Initial Moisture, %	0.2	0.2	0.2
Wet Weight / Tare (g)	1945.5	1945.5	1945.5
Dry Weight / Tare (g)	1943.3	1943.3	1943.3
Tare (g)	745.1	745.1	745.1
Water Added, ml	130	185	205
Moisture at Compaction, %	11.0	15.6	17.3
Wt. Of Briquette and Mold, g	2998	3017	3078
Wt. Of Mold, g	2079	2079	2079
Wt. Of Briquette, g	919	938	999
Height of Briquette, in	2.56	2.47	2.63
Dry Density, pcf	98.0	99.6	98.2
Stabilometer PH @ 1000 lbs	26	25	28
Stabilometer PH @ 2000 lbs	47	46	49
Displacement	5.20	5.50	5.71
R' Value	53	52	49
Corrected 'R' Value	53	52	51
Exudation Pressure, lbs	6200	4000	3550
Exudation Pressure, psi	496	320	284
Stabilometer Thickness - ft	0.45	0.46	0.47
Expansion Pressure	0.0000	0.0000	0.0000
Expansion Press, Thick-ft	0.00	0.00	0.00

**Exudation** 52  
**Expansion** 100  
**R-value** 52

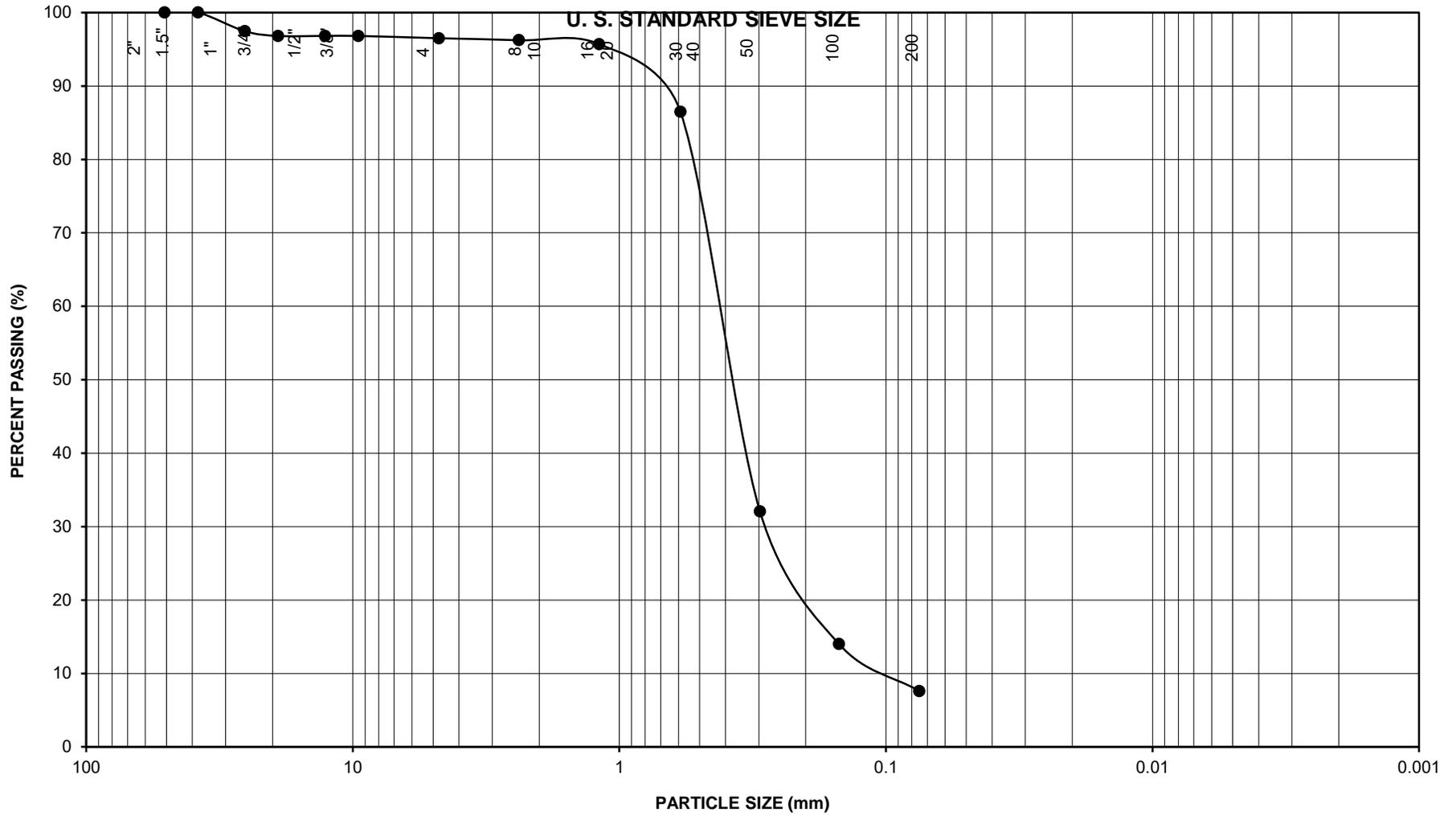
TI	4.5
Expansion	100



Cover Thickness by Expansion Pressure-Feet

Expansion From Graph: 0

TS-255 Chase Velarde  
 Laboratory Manager



**PARTICLE SIZE ANALYSIS**



Sample Designation	Sample Depth (feet)	Symbol	Liquid Limit (%)	Plasticity Index	Classification
B-1	1-5	●	NP	NP	SP-SM
		■			
CTE JOB NUMBER:			40-3547G	Parking Lot D Improvements	



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Client Name: Construction Testing & Eng., Inc.  
Contact: Robert Ellerbusch  
Address: 14538 Meridian Parkway, Suite A  
Riverside, CA 92518

Analytical Report: Page 1 of 3  
Project Name: Const. Test.-Soils  
Project Number: Parking Lot D Hermosa Beach, CA

Report Date: 27-Dec-2017

**Work Order Number: B7L0910**

Received on Ice (Y/N): No Temp: °C

Attached is the analytical report for the sample(s) received for your project. Below is a list of the individual sample descriptions with the corresponding laboratory number(s). Also, enclosed is a copy of the Chain of Custody document (if received with your sample(s)). Please note any unused portion of the sample(s) may be responsibly discarded after 30 days from the above report date, unless you have requested otherwise.

Thank you for the opportunity to serve your analytical needs. If you have any questions or concerns regarding this report please contact our client service department.

**Sample Identification**

<u>Lab Sample #</u>	<u>Client Sample ID</u>	<u>Matrix</u>	<u>Date Sampled</u>	<u>By</u>	<u>Date Submitted</u>	<u>By</u>
B7L0910-01	40-3547: B-1 @ 1-5'	Soil	12/06/17 08:00	Robert Ellerbusch	12/12/17 08:55	Jason Collins

*mailing*  
P.O Box 432  
Riverside, CA 92502-0432

*location*  
6100 Quail Valley Court  
Riverside, CA 92507-0704

P 951 653 3351  
~~ES-257~~662  
www.babcocklabs.com

CA ELAP No. 2698  
EPA No. CA00102  
NELAP No. OR4035  
LACSD No. 10119



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Client Name: Construction Testing & Eng., Inc.  
 Contact: Robert Ellerbusch  
 Address: 14538 Meridian Parkway, Suite A  
 Riverside, CA 92518

Analytical Report: Page 2 of 3  
 Project Name: Const. Test.-Soils  
 Project Number: Parking Lot D Hermosa Beach, CA

Report Date: 27-Dec-2017

**Work Order Number: B7L0910**  
 Received on Ice (Y/N): No Temp: °C

Laboratory Reference Number  
**B7L0910-01**

<u>Sample Description</u>	<u>Matrix</u>	<u>Sampled Date/Time</u>	<u>Received Date/Time</u>
40-3547: B-1 @ 1-5'	Soil	12/06/17 08:00	12/12/17 8:55

Analyte(s)	Result	RDL	Units	Method	Analysis Date	Analyst	Flag
Anions							
Chloride	ND	5.0	mg/kg	Cal Trans 422	12/13/17 21:42	KBS	
Sulfate	160	5.0	mg/kg	Cal Trans 417	12/13/17 21:42	KBS	
Saturated Paste							
pH	7.1	0.1	pH Units	S-1.10 W.S.	12/20/17 15:50	RER	
Minimum Resistivity	3900	10	ohm-cm	Cal Trans 643	12/20/17 15:50	RER	

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 Riverside, CA 92502-0432

*location*  
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 NELAP No. OR4035  
 LACSD No. 10119

TS-258



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Client Name: Construction Testing & Eng., Inc.  
Contact: Robert Ellerbusch  
Address: 14538 Meridian Parkway, Suite A  
Riverside, CA 92518

Analytical Report: Page 3 of 3  
Project Name: Const. Test.-Soils  
Project Number: Parking Lot D Hermosa Beach, CA

Report Date: 27-Dec-2017

**Work Order Number: B7L0910**

Received on Ice (Y/N): No Temp: °C

**Notes and Definitions**

- ND: Analyte NOT DETECTED at or above the Method Detection Limit (if MDL is reported), otherwise at or above the Reportable Detection Limit (RDL)
- NR: Not Reported
- RDL: Reportable Detection Limit
- MDL: Method Detection Limit
- \* / " : NELAP does not offer accreditation for this analyte/method/matrix combination

**Approval**

Enclosed are the analytical results for the submitted sample(s). Babcock Laboratories certify the data presented as part of this report meet the minimum quality standards in the referenced analytical methods. Any exceptions have been noted.

**Mary Mazurkiewicz For KayeLani A. Deener**

cc:

e-Short\_No Alias.rpt

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LACSD No. 10119

**ATTACHMENT "B"**

**ORCO WALL STRUCTURAL  
CALCULATIONS**

**ORCO WALL SYSTEM**  
**STRUCTURAL CALCULATIONS**

**PREPARED FOR**

**CITY OF HERMOSA BEACH**

**PARKING LOT D**  
**1331 MANHATTAN AVENUE**

**HERMOSA BEACH, CALIFORNIA**

**ENGINEERING STAMP APPROVAL IS CONDITIONAL;  
REQUIRING USE OF ORCO MANUFACTURED CMU ON  
ALL ORCO WALL SYSTEM DESIGNS.**



**PREPARED BY**

**ORCO BLOCK & HARDSCAPE**

**11100 BEACH BLVD STANTON, CA. 90680**

**TEL. (714) 527-2239**

**TS-261**

**FAX. (714) 897-1904**

# ORCO WALL SYSTEM FORCES PER 2019 CBC CHAPTER 16

HERMOSA BEACH, CA

## WIND FORCES TO WALLS PER ASCE 7-16 SECTION 29.4

CHECK WIND FORCE CALCULATION FOR BASIC 85 MPH & 95 MPH 3 SECOND GUST SPEED EXPOSURE C CONDITION

USING ASCE 7-16 CHAPTER 29 WIND LOADS & USING SECTION 29.3.1 TO FIND THE 3 SEC. VELOCITY PRESSURE  $Q_H$ .  
 $Q_H = 0.00256 K_z K_{zt} K_d V^2 \dots$  (26.10-1), WHERE:  $K_z = 0.57$  FOR EXP B AND  $K_z = 0.85$  FOR EXP C

FROM TABLE 26.10-1:  $K_{zt} = 1.0$  DEFAULT PER SECTION 26.8-1 &  $K_d = 0.85$  FROM TABLE 26.6-1

THEREFORE, FOR 85 MPH & 95 MPH 3 SEC. WIND GUST SPEED:

$$Q_H = (0.00256)(0.85)(1.0)(0.85)(110)^2 = 22.4 \text{ PSF} \quad \& \quad Q_H = (0.00256)(0.85)(1.0)(0.85)(120)^2 = 26.6 \text{ PSF}$$

DESIGN WIND FORCE,  $F_H = Q_H G C_F A_s \dots$  (29.3-1), WHERE:  $G = 0.85$  FROM SECTION 26.11.1

$C_F = 1.40$  PER FIGURE 29.4-1 USING AVERAGE ASPECT RATIO (WALL LENGTH TO HIGHT) OF 2.

NOTE:  $C_F$  RANGES FROM 1.48 FOR A 5' WIDE RETURN WALL TO 1.3 FOR A 60' PANEL.

THEREFORE: FOR 110 MPH =  $(22.4 \text{ PSF})(0.85)(1.4) A_s = 26.7 \text{ PSF}$ . & FOR 120 MPH =  $(26.6 \text{ PSF})(0.85)(1.4) A_s = 31.7 \text{ PSF}$

WIND FORCE FOR EXPOSURE C CONDITIONS						
$V_{ULT}$ IN MPH	100	110	120	130	140	150
$Q_H = 0.00256 K_z K_{zt} K_d V^2$ WHERE $K_z = 0.85, K_{zt} = 1.0, K_d = 0.85$	18.5 PSF	22.4 PSF	26.6 PSF	32.2 PSF	36.3 PSF	41.6 PSF
$F_H =$ WIND FORCE PER SQ. FT. $F_H = Q_H G C_F A_s$ PER SECTION 29.4-1 WHERE $G=0.85$ AND $C_F = 1.4$ AVE.	22.0 PSF	26.7 PSF	31.7 PSF	38.4 PSF	43.2 PSF	49.5 PSF
$F_H =$ WIND FORCE BY USING 0.60 LOAD FACTOR PER CBC 1605.3.1 EQN 16-5.	78	85	93	101	108	116

PROJECT SITE WIND ZONE:  $V_{ULT} = 110$  MPH EXPOSURE C  
 THEREFORE WIND FORCE = 26.7 PSF

## SEISMIC FORCES PER 2019 CBC (ASCE 7-16 SECT. 15.4.1B)

FOR NONBUILDING STRUCTURES:

- FREE STANDING WALLS AND PILASTERS
- PROJECT SITE CLASS D
- FUNDAMENTAL PERIOD T GREATER THAN 0.06 SEC  
 CALCULATED USING EQUATION 12.8-7 AND TABLE 12.8-2



PER EQN. 15.4-2, SEISMIC BASE SHEAR FOR FLEXIBLE NONBUILDING STRUCTURES NOT SIMILAR TO BUILDINGS:  
 $V = [(0.80)(S_1)/(R/I)] W$ , WHERE  $I = 1.0$  &  $F_A = 1.1$  FROM TABLE 11.4-1 &  $R = 1.25$  FROM TABLE 15.4.2

SEISMIC FORCE FOR 1 SEC. PERIOD CONDITIONS						
$S_1$ FROM FIG. 22-2	60	70	80	90	100	110
$V = [(0.80)(S_1)/(R/I)] W$	0.38W	0.45W	0.51W	0.58W	0.64W	0.70W

PROJECT SITE SEISMIC INFORMATION:  $S_1 = 70$  &  $V = 0.45W$

CMU WALL WEIGHTS PER SQ. FT.										
BLOCK TYPE	6" CMU W/ JOINT REINFORCEMENT					8" CMU				16X16 PILASTER
ROUTED @ 0/C	48"0/C	40"0/C	32"0/C	24"0/C	16"0/C	32"0/C	24"0/C	16"0/C	SOLID	SOLID
WT. PER SQ. FT.	34 PSF	35 PSF	37 PSF	39 PSF	45 PSF	48 PSF	52 PSF	60 PSF	80 PSF	160 PSF

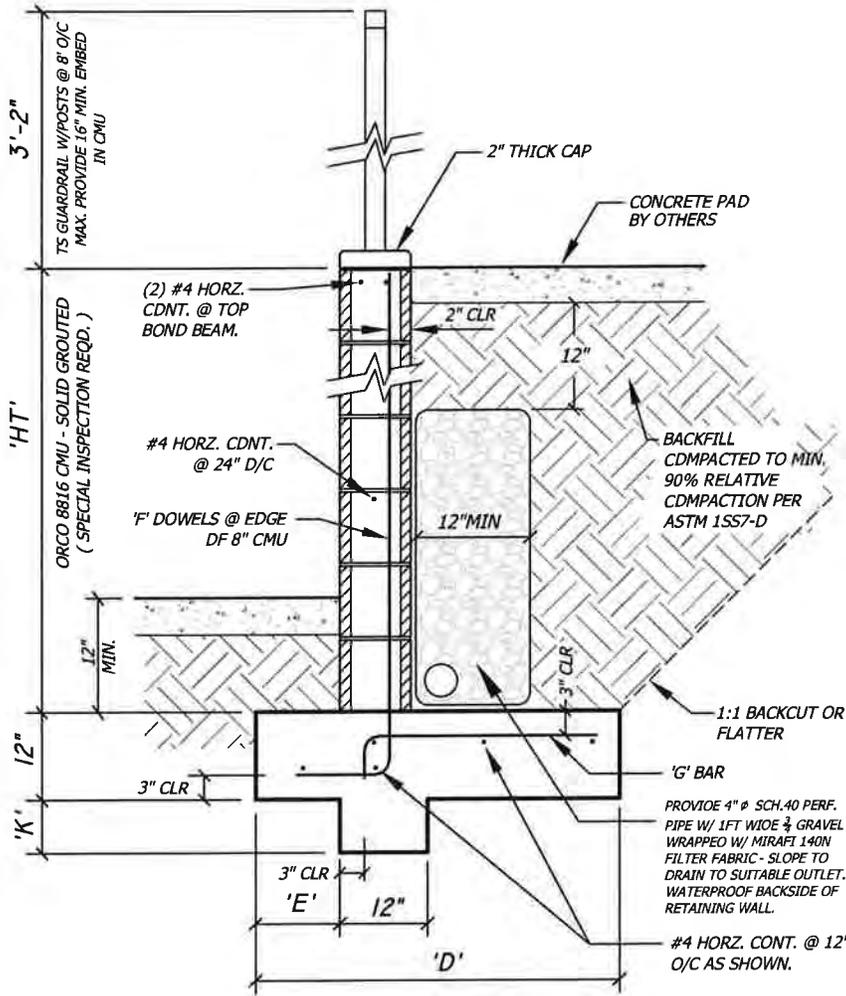
THEREFORE SEISMIC FORCE IS:  $V = (0.45)(52 \text{ PSF}) = 23.4 \text{ PSF}$   
 TS-262

# ORCO 2'-0" TO 4'-0" HIGH RETAINING WALL W/ 36" GUARDRAIL FOR 110 MPH 3 SEC. GUST @ EXP C

**SPECIAL INSPECTION NOTE:**  
 PROVIDE LEVEL 2 SPECIAL INSPECTION PER  
 TMS-602-16 TABLES 3 AND 4 OF THE  
 MASONRY STEM.

**DESIGN CRITERIA PER 2019 CBC:**

1. ALLOWABLE SDIL BEARING PRESSURE FOR FDDTINGS = 2000 PSF PER SOILS REP.
2. EQUIVALENT FLUID PRESSURE FOR LEVEL BACKFILL = 40 PCF PER SDILS REPORT.
3. ALLDWBABLE LATERAL PASSIVE PRESSURE = 250 PCF PER SDILS REPORT.
4. GROUT STRENGTH = 2000 PSI @ 28 DAYS & REINFORCING STEEL : GRADE 60.
5. EARTH COEFFICIENT DF FRICTION = 0.30.
6. 2000 PSI MASONRY COMPRESSIDN STRENGTH - SPECIAL INSPECTION REQUIRED.



NOTE: DIMENSIONS ARE NDT TD SCALE.

**NOTES:**

1. CONCRETE BLOCK SHALL BE MANUFACTURED BY ORCD ASTM C 90. WEDGELOCK BLOCK, SLUMP BLOCK AND SPLITFACE BLOCK ARE ACCEPTABLE.
2. CDNCRETE FOR FOOTING SHALL BE 1 PART CEMENT TO 2-1/2 PARTS SAND TO 3-1/2 PARTS GRAVEL WITH A MAXIMUM OF 1-1/2 GALLONS OF WATER PER SACK. PORTLAND CEMENT SHALL CNDFRDM TO ASTM C 150 TYPE II/V. Fc = 2500 PSI
3. REINFORCING STEEL SHALL BE DEFORMED AND CNDFORM TO ASTM A 61S GRADE 60. PROVIDE 48 BAR DIAMETER LAP.
4. REBAR SHALL BE CENTERED IN THE CONCRETE BLOCK CELL IN WHICH IT IS LDCATED.
5. CONCRETE BLOCK SHALL BE LAID IN A RUNNING BOND PATTERN WITH VERTICAL CONTINUITY OF THE CELLS UNO.
6. ALL BLOCK CELLS SHALL BE SOLID GROUTED.
7. USE TYPE S MORTAR PROPORITDNED USING ASTM C 270 PART CEMENT TO 1/2 PART LIME TO 4-1/2 PARTS DAMP, LOOSE SAND.
8. GROUT FOR CONCRETE BLOCK PER ASTM C 476 TO BE 1 PART CEMENT TO 3 PARTS SAND (GRDUT MAY CONTAIN 2 PARTS 3/8" PEA GRAVEL IF WEATHER CDNDITIONS ARE FAVDRABLE AND BLDCK UNDBSTRUCTED CELL SIZE IS SUFFICIENT TO ALLOW GOOD GRDUT FLOW). WATER SHALL BE ADDED TO PRODUCE GOOD GRDUT FLOW WITHDUT SEGREGATION OF THE CONSTITUENTS.
9. BLDCK STEM MAY BE WET-SET 1-1/2" INTO THE FOOTING WHILE THE CONCRETE IS PLASTIC. BLOCK STEM MAY BE PLACED TO EITHER EDGE DF THE TRENCH TYPE FOOTING.
10. FOOTING MUST BE POURED ON OR INTD UNDISTURBED NATURAL SDIL OR ON COMPACTED FILL WITH A MINIMUM COMPACTION OF 90%.
11. FIRST INSPECTION TO BE AFTER FODTING TRENCHES ARE READY FOR CONCRETE AND ALL REQUIRED STEEL IS TIED IN PLACE. SECNDND INSPECTION TO BE WHEN THE REQUIRED VERTICAL IS IN PLACE AND THE BLOCK WALL IS READY TO GROUT.
12. MAXIMUM CONTROL JOINT SPACING: 40' D/C. 20' D/C FOR WALLS TD BE MORTAR WASHED DR STUCCO COATED.

## WALL "A"

'HT'	'D'	'E'	'F' DOWEL	'G' BAR	'K'
2'-0"	2'-6"	6"	#4@32" O/C 8" 33"	#4@16" O/C 6" 18"	N/A
2'-8"	2'-6"	6"	#4@32" O/C 8" 41"	#4@16" O/C 6" 18"	N/A
3'-4"	2'-9"	6"	#4@16" O/C 8" 49"	#4@16" O/C 6" 21"	N/A
4'-0"	2'-9"	6"	#4@16" O/C 8" 57"	#4@16" O/C 8" 21"	4"

**ENGINEERING STAMP APPROVAL IS CONDITIONAL;  
 REQUIRING USE OF ORCO MANUFACTURED CMU ON  
 ALL ORCO WALL SYSTEM DESIGNS.**

**CITY OF  
 HERMOSA BEACH**  
 PARKING LOT D  
 HERMOSA BEACH, CALIFORNIA



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### Cantilevered Retaining Wall

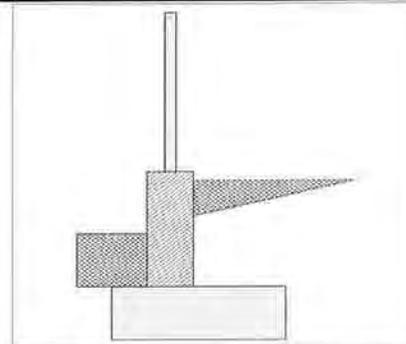
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	2.00 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	2.09 OK
Sliding	=	2.42 OK
Total Bearing Load	=	972 lbs
...resultant ecc.	=	6.71 in
Soil Pressure @ Toe	=	938 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable	=	2,000 psf
ACI Factored @ Toe	=	1,313 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	3.2 psi OK
Footing Shear @ Heel	=	3.4 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	275.0 lbs
less 100% Passive Force	=	375.0 lbs
less 100% Friction Force	=	291.5 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

Design Height Above Ftg	ft =	2.17
Wall Material Above "Ht"	=	Fence
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	32.00
Rebar Placed at	=	Edge

##### Design Data

fb/FB + fa/Fa	=	0.377
---------------	---	-------

##### Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	89.9 286.3

##### Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	134.6 652.5
Moment.....Allowable	ft-# =	1,727.9

##### Shear.....Actual

Service Level	psi =	
Strength Level	psi =	3.1
Shear.....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25

##### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.50 ft
Heel Width	=	2.00
Total Footing Width	=	2.50
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.25 ft
$f'c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm = 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	1,313	0 psf
Mu' : Upward	=	151	79 ft-#
Mu' : Downward	=	71	560 ft-#
Mu: Design	=	80	481 ft-#
Actual 1-Way Shear	=	3.16	3.43 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: No key defined

Min footing T&S reinf Area 0.50 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: If two layers of horizontal bars:  
 #4 @ 11.90 in #4 @ 23.81 in  
 #5 @ 18.45 in #5 @ 36.90 in  
 #6 @ 26.19 in #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	180.0	1.00	180.0	Soil Over Heel	=	360.0	1.83	660.0
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	95.0	4.58	435.3	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	67.5	0.25	16.9
					Surcharge Over Toe	=			
<b>Total</b>		<b>275.0</b>	<b>O.T.M.</b>	<b>615.3</b>	Stem Weight(s)	=	169.3	0.83	141.1
					Earth @ Stem Transitions	=			
<b>Resisting/Overturning Ratio</b>			<b>= 2.09</b>		Footing Weight	=	375.0	1.25	468.8
Vertical Loads used for Soil Pressure			<b>= 971.8 lbs</b>		Key Weight	=		0.75	
					Vert. Component	=			
					<b>Total =</b>	<b>971.8 lbs</b>	<b>R.M.=</b>	<b>1,286.7</b>	

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.054	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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**Cantilevered Retaining Wall**

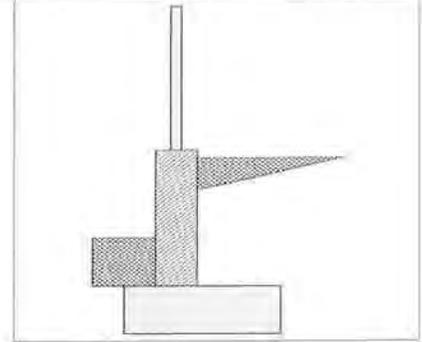
Code: CBC 2019,ACI 318-14,TMS 402-16

**Criteria**

Retained Height	=	2.67 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

**Soil Data**

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



**Surcharge Loads**

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

**Lateral Load Applied to Stem**

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

**Adjacent Footing Load**

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

**Axial Load Applied to Stem**

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

**Design Summary**

<b>Wall Stability Ratios</b>	
Overturning	= 1.87 OK
Sliding	= 1.97 OK
Total Bearing Load	= 1,144 lbs
...resultant ecc.	= 7.42 in
Soil Pressure @ Toe	= 1,208 psf OK
Soil Pressure @ Heel	= 0 psf OK
Allowable Soil Pressure Less Than Allowable	= 2,000 psf
ACI Factored @ Toe	= 1,691 psf
ACI Factored @ Heel	= 0 psf
Footing Shear @ Toe	= 4.5 psi OK
Footing Shear @ Heel	= 4.8 psi OK
Allowable	= 75.0 psi
<b>Sliding Calcs</b>	
Lateral Sliding Force	= 364.4 lbs
less 100% Passive Force	= - 375.0 lbs
less 100% Friction Force	= - 343.2 lbs
Added Force Req'd	= 0.0 lbs OK
....for 1.5 Stability	= 0.0 lbs OK

**Stem Construction**

	2nd	Bottom
Design Height Above Ftg	ft = 2.83	Stem OK
Wall Material Above "Ht"	= Fence	Masonry
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	32.00
Rebar Placed at	=	Edge

<b>Design Data</b>		
fb/FB + fa/Fa	=	0.506

<b>Total Force @ Section</b>	
Service Level	lbs =
Strength Level	lbs = 90.2 386.4
<b>Moment....Actual</b>	
Service Level	ft-# =
Strength Level	ft-# = 135.5 876.3
Moment....Allowable	ft-# = 1,727.9

<b>Shear.....Actual</b>	
Service Level	psi =
Strength Level	psi = 4.2
Shear.....Allowable	= 80.5
Anet (Masonry)	in2 = 91.50
Rebar Depth 'd'	in = 5.25

<b>Masonry Data</b>	
f'm	psi = 2,000
Fy	psi = 60,000
Solid Grouting	= Yes
Modular Ratio 'n'	= 16.11
Wall Weight	psf = 78.0

Equiv. Solid Thick.	= 7.60
Masonry Block Type	= Medium Weight
Masonry Design Method	= LRFD

<b>Concrete Data</b>	
f'c	psi =
Fy	psi =

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

<b>Load Factors</b>	
Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.50 ft
Heel Width	=	2.00
Total Footing Width	=	2.50
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.25 ft
$f'c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm.= 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	1,691	0 psf
Mu' : Upward	=	193	57 ft-#
Mu' : Downward	=	71	681 ft-#
Mu: Design	=	122	623 ft-#
Actual 1-Way Shear	=	4.47	4.84 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: No key defined

Min footing T&S reinf Area 0.50 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: If two layers of horizontal bars:  
 #4 @ 11.90 in #4 @ 23.81 in  
 #5 @ 18.45 in #5 @ 36.90 in  
 #6 @ 26.19 in #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	269.4	1.22	329.5	Soil Over Heel	=	480.6	1.83	881.1
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	95.0	5.25	498.9	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	67.5	0.25	16.9
					Surcharge Over Toe	=			
<b>Total</b>		<b>364.4</b>	<b>O.T.M.</b>	<b>828.5</b>	Stem Weight(s)	=	220.7	0.83	184.0
					Earth @ Stem Transitions	=			
					Footing Weight	=	375.0	1.25	468.8
<b>Resisting/Overturning Ratio</b>			=	<b>1.87</b>	Key Weight	=		0.75	
Vertical Loads used for Soil Pressure =				1,143.8 lbs	Vert. Component	=			
					<b>Total =</b>		<b>1,143.8 lbs</b>	<b>R.M.=</b>	<b>1,550.7</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.078 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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**Cantilevered Retaining Wall**

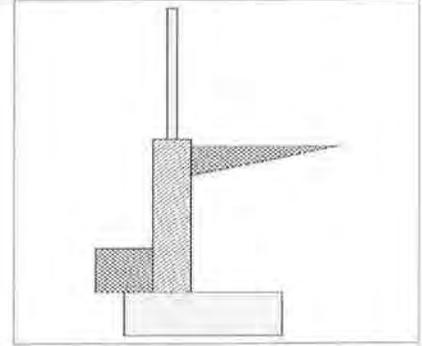
Code: CBC 2019,ACI 318-14,TMS 402-16

**Criteria**

Retained Height	=	3.33 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

**Soil Data**

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



**Surcharge Loads**

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

**Lateral Load Applied to Stem**

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

**Adjacent Footing Load**

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

**Axial Load Applied to Stem**

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

**Design Summary**

**Wall Stability Ratios**

Overturning	=	2.00 OK
Sliding	=	1.73 OK
Total Bearing Load ...resultant ecc.	=	1,465 lbs 7.47 in
Soil Pressure @ Toe	=	1,297 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable	=	2,000 psf
ACI Factored @ Toe	=	1,816 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	5.1 psi OK
Footing Shear @ Heel	=	5.5 psi OK
Allowable	=	75.0 psi

**Sliding Calcs**

Lateral Sliding Force	=	470.0 lbs
less 100% Passive Force	= -	375.0 lbs
less 100% Friction Force	= -	439.4 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

**Stem Construction**

	2nd	Bottom
Design Height Above Ftg	ft = 3.50	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	16.00
Rebar Placed at	=	Edge

**Design Data**

fb/FB + fa/Fa	=	0.347
<b>Total Force @ Section</b>		
Service Level	lbs =	
Strength Level	lbs =	89.9 513.1
<b>Moment....Actual</b>		
Service Level	ft-# =	
Strength Level	ft-# =	134.6 1,171.6
Moment....Allowable	ft-# =	3,368.0

**Shear....Actual**

Service Level	psi =	
Strength Level	psi =	5.6
Shear....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25

**Masonry Data**

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

**Concrete Data**

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

**Load Factors**

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000





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### Cantilevered Retaining Wall

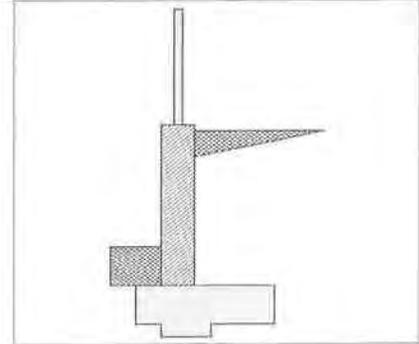
Code: CBC 2019, ACI 318-14, TMS 402-16

#### Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	1.77 OK
Sliding	=	1.80 OK
Total Bearing Load	=	1,709 lbs
...resultant ecc.	=	8.64 in
Soil Pressure @ Toe	=	1,739 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable		2,000 psf
ACI Factored @ Toe	=	2,435 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	7.2 psi OK
Footing Shear @ Heel	=	7.6 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	595.0 lbs
less 100% Passive Force	= -	555.6 lbs
less 100% Friction Force	= -	512.8 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

Design Height Above Ftg	ft =	4.16	Stem OK
Wall Material Above "Ht"	=	Fence	Masonry
Design Method	=		LFRD
Thickness	=	8.00	
Rebar Size	=	# 4	
Rebar Spacing	=	16.00	
Rebar Placed at	=	Edge	

##### Design Data

fb/FB + fa/Fa	=	0.464
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	90.2 670.3
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	135.5 1,566.5
Moment....Allowable	ft-# =	3,368.0

##### Shear....Actual

Service Level	psi =	
Strength Level	psi =	7.3
Shear....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25

##### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LFRD

##### Concrete Data

f'c	psi =	
Fy	psi =	



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**Cantilevered Retaining Wall**

Code: CBC 2019, ACI 318-14, TMS 402-16

**Footing Dimensions & Strengths**

Toe Width	=	0.50 ft
Heel Width	=	2.25
Total Footing Width	=	2.75
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	4.00 in
Key Distance from Toe	=	0.50 ft
f'c =	2,500 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm.= 3.00 in

**Footing Design Results**

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	2,435	0 psf
Mu' : Upward	=	279	105 ft-#
Mu' : Downward	=	71	1,256 ft-#
Mu: Design	=	207	1,151 ft-#
Actual 1-Way Shear	=	7.20	7.63 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

**Other Acceptable Sizes & Spacings**

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.55 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: If two layers of horizontal bars:  
 #4@ 11.90 in #4@ 23.81 in  
 #5@ 18.45 in #5@ 36.90 in  
 #6@ 26.19 in #6@ 52.38 in

**Summary of Overturning & Resisting Forces & Moments**

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	500.0	1.67	833.3	Soil Over Heel	=	855.0	1.96	1,674.4
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	95.0	6.58	625.3	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	67.5	0.25	16.9
					Surcharge Over Toe	=			
<b>Total</b>		<b>595.0</b>	<b>O.T.M.</b>	<b>1,458.6</b>	Stem Weight(s)	=	324.5	0.83	270.4
					Earth @ Stem Transitions	=			
					Footing Weight	=	412.5	1.38	567.2
<b>Resisting/Overturning Ratio</b>			=	<b>1.77</b>	Key Weight	=	50.0	1.00	50.0
Vertical Loads used for Soil Pressure	=			1,709.5 lbs	Vert. Component	=			
					<b>Total =</b>		<b>1,709.5 lbs</b>	<b>R.M.=</b>	<b>2,578.8</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

**Tilt**

**Horizontal Deflection at Top of Wall due to settlement of soil**

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.126	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



# ORCO 2'-0" TO 6'-8" HIGH RETAINING WALL W/ 36" GUARDRAIL FOR 110 MPH 3 SEC. GUST @ EXP C

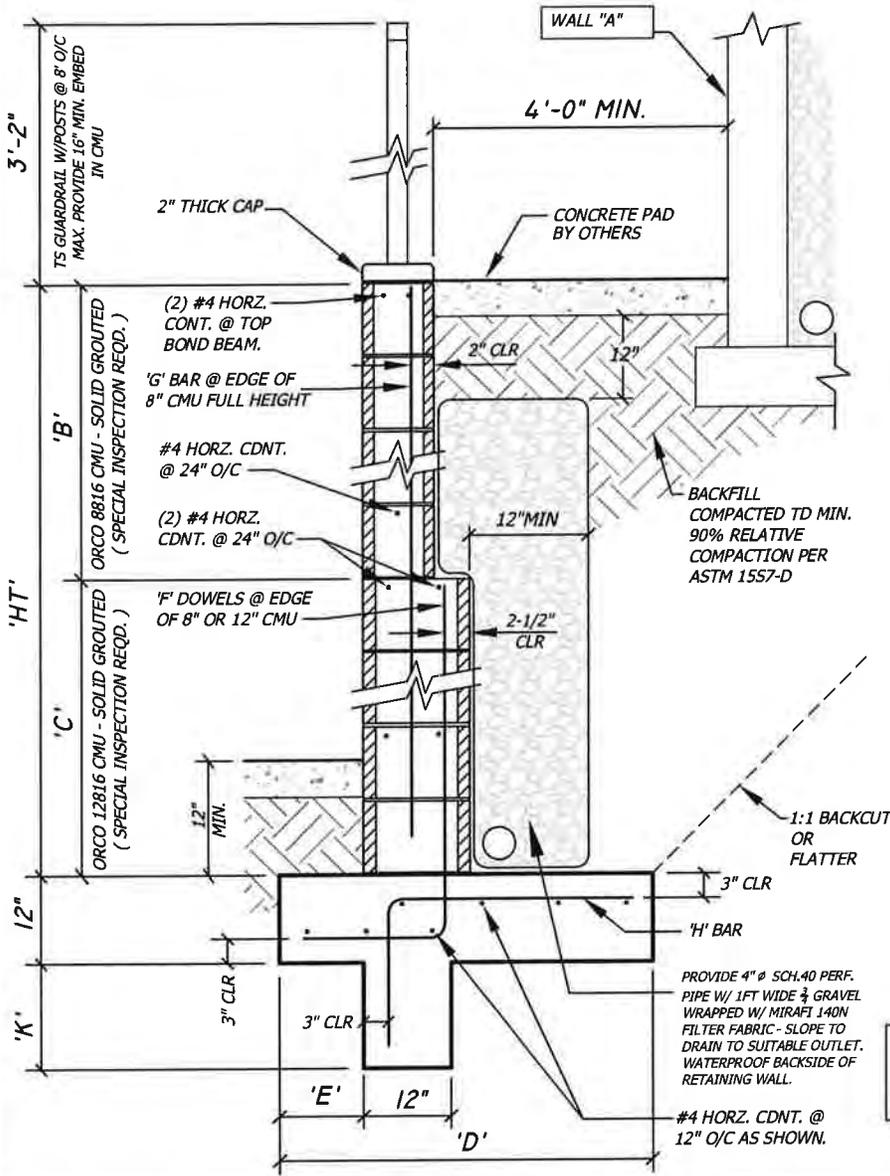
**SPECIAL INSPECTION NOTE:**  
PROVIDE LEVEL 2 SPECIAL INSPECTION PER TMS-602-16 TABLES 3 AND 4 OF THE MASONRY STEM.

DESIGN CRITERIA PER 2019 CBC:

1. ALLOWABLE SDIL BEARING PRESSURE FOR FOOTINGS = 2000 PSF PER SOILS REP.
2. EQUIVALENT FLUID PRESSURE FOR LEVEL BACKFILL = 40 PCF PER SOILS REPORT.
3. ALLOWABLE LATERAL PASSIVE PRESSURE = 250 PCF PER SDILS REPORT.
4. GRDUT STRENGTH = 2000 PSI @ 28 DAYS & REINFORCING STEEL : GRADE 60.
5. EARTH CDEFFICIENT OF FRICTIDN = 0.30.
6. 2000 PSI MASONRY COMPRESSION STRENGTH - SPECIAL INSPECTION REQUIRED.

**NOTES:**

1. CONCRETE BLOCK SHALL BE MANUFACTURED BY ORCO ASTM C 90. WEDGELock BLOCK, SLUMP BLDCCK AND SPLITFACE BLOCK ARE ACCEPTABLE.
2. CONCRETE FOR FOOTING SHALL BE 1 PART CEMENT TD 2-1/2 PARTS SAND TO 3-1/2 PARTS GRAVEL WITH A MAXIMUM DF 1-1/2 GALLONS OF WATER PER SACK. PORTLAND CEMENT SHALL CONFORM TD ASTM C 150 TYPE II/V. Fc = 2500 PSI
3. REINFORCING STEEL SHALL BE DEFORMED AND CONFORM TO ASTM A 615 GRADE 60. PROVIDE 48 BAR DIAMETER LAP.
4. REBAR SHALL BE CENTERED IN THE CONCRETE BLOCK CELL IN WHICH IT IS LOCATED.
5. CONCRETE BLOCK SHALL BE LAID IN A RUNNING BOND PATTERN WITH VERTICAL CONTINUITY DF THE CELLS UNO.
6. ALL BLDCCK CELLS SHALL BE SOLID GROUTED.
7. USE TYPE S MORTAR PROPORTIONED USING ASTM C 270 PART CEMENT TO 1/2 PART LIME TO 4-1/2 PARTS DAMP, LOOSE SAND.
8. GROUT FOR CONCRETE BLOCK PER ASTM C 476 TO BE 1 PART CEMENT TO 3 PARTS SAND (GROUT MAY CDNTAIN 2 PARTS 3/8" PEA GRAVEL IF WEATHER CONDITIONS ARE FAVORABLE AND BLDCCK UNOBSTRUCTED CELL SIZE IS SUFFICIENT TO ALLOW GOOD GROUT FLOW). WATER SHALL BE ADDED TO PRODUCE GOOD GRDUT FLOW WITHOUT SEGREGATION OF THE CDNSTITUENTS.
9. BLOCK STEM MAY BE WET-SET 1-1/2" INTO THE FOOTING WHILE THE CONCRETE IS PLASTIC. BLOCK STEM MAY BE PLACED TO EITHER EDGE OF THE TRENCH TYPE FOOTING.
10. FOOTING MUST BE POURED ON DR INTO UNDISTURBED NATURAL SOIL OR DN CDMPACTED FILL WITH A MINIMUM CDMPACTIDN OF 90%.
11. FIRST INSPECTIDN TO BE AFTER FOOTING TRENCHES ARE READY FOR CONCRETE AND ALL REQUIRED STEEL IS TIED IN PLACE. SECOND INSPECTION TO BE WHEN THE REQUIRED VERTICAL IS IN PLACE AND THE BLOCK WALL IS READY TO GROUT.
12. MAXIMUM CONTRDL JDINT SPACING: 40' O/C. 20' O/C FOR WALLS TD BE MORTAR WASHED OR STUCCD COATED.



**ENGINEERING STAMP APPROVAL IS CONDITIONAL;  
REQUIRING USE OF ORCO MANUFACTURED CMU ON  
ALL ORCO WALL SYSTEM DESIGNS.**



## WALL "B"

**CITY OF  
HERMOSA BEACH**  
PARKING LOT D  
HERMOSA BEACH, CALIFORNIA

**NOTE: DIMENSIONS ARE NOT TO SCALE.**

'HT'	'B'	'C'	'D'	'E'	'F' DOWEL	'G' VERT	'H' BAR	'K'
2'-0"	2'-0"	N/A	2'-6"	6"	#4@32" O/C 8" ⊥ 33"	N/A	#4@32" O/C 6" ⊥ 18"	N/A
2'-8"	2'-8"	N/A	2'-6"	6"	#4@32" O/C 8" ⊥ 41"	N/A	#4@32" O/C 6" ⊥ 18"	N/A
3'-4"	3'-4"	N/A	2'-9"	6"	#4@16" O/C 8" ⊥ 49"	N/A	#4@16" O/C 6" ⊥ 21"	N/A
4'-0"	4'-0"	N/A	3'-0"	6"	#4@16" O/C 8" ⊥ 57"	N/A	#4@16" O/C 8" ⊥ 24"	4"
4'-8"	4'-8"	N/A	3'-3"	9"	#4@16" O/C 11" ⊥ 65"	N/A	#4@16" O/C 8" ⊥ 24"	8"
5'-4"	3'-4"	2'-0"	3'-6"	9"	#4@16" O/C 15" ⊥ 33"	#4@16" O/C	#4@16" O/C 18" ⊥ 27"	1'-0"
6'-0"	3'-4"	2'-8"	4'-0"	1'-0"	#4@16" O/C 18" ⊥ 41"	#4@16" O/C	#4@8" O/C 20" ⊥ 30"	1'-2"
6'-8"	4'-0"	2'-8"	5'-3"	1'-0"	#4@8" O/C 18" ⊥ 41"	#4@16" O/C	#4@8" O/C 20" ⊥ 45"	1'-2"

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### Cantilevered Retaining Wall

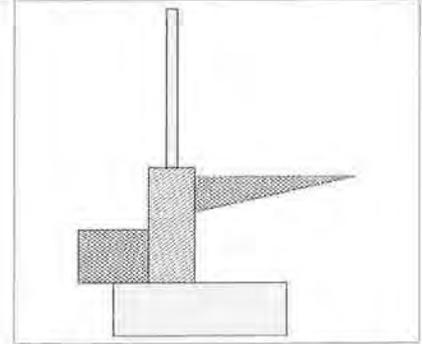
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	2.00 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	1,709.0 lbs
Footing Width	=	2.75 ft
Eccentricity	=	9.62 in
Wall to Ftg CL Dist	=	4.87 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	2.09 OK
Sliding	=	2.42 OK
Total Bearing Load	=	972 lbs
...resultant ecc.	=	6.71 in
Soil Pressure @ Toe	=	938 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable	=	2,000 psf
ACI Factored @ Toe	=	1,313 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	3.2 psi OK
Footing Shear @ Heel	=	3.4 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	275.0 lbs
less 100% Passive Force	= -	375.0 lbs
less 100% Friction Force	= -	291.5 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	2nd	Bottom
Design Height Above Ftg	ft = 2.17	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	32.00
Rebar Placed at	=	Edge

##### Design Data

fb/FB + fa/Fa	=	0.377
---------------	---	-------

##### Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	89.9 286.3

##### Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	134.6 652.5
Moment....Allowable	ft-# =	1,727.9

##### Shear.....Actual

Service Level	psi =	
Strength Level	psi =	3.1

Shear.....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25

##### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.50 ft
Heel Width	=	2.00
Total Footing Width	=	2.50
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.25 ft
$f'_c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm = 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	1,313	0 psf
Mu' : Upward	=	151	79 ft-#
Mu' : Downward	=	71	560 ft-#
Mu: Design	=	80	481 ft-#
Actual 1-Way Shear	=	3.16	3.43 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $M_u < \phi * 5 * \lambda * \sqrt{f'_c} * S_m$   
Heel: Not req'd:  $M_u < \phi * 5 * \lambda * \sqrt{f'_c} * S_m$   
Key: No key defined

Min footing T&S reinf Area	0.50	in <sup>2</sup>
Min footing T&S reinf Area per foot	0.20	in <sup>2</sup> /ft
If one layer of horizontal bars:		If two layers of horizontal bars:
#4 @ 11.90 in		#4 @ 23.81 in
#5 @ 18.45 in		#5 @ 36.90 in
#6 @ 26.19 in		#6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	180.0	1.00	180.0	Soil Over Heel	=	360.0	1.83	660.0
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=	0.0	0.02	0.0	Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	95.0	4.58	435.3	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	67.5	0.25	16.9
					Surcharge Over Toe	=			
<b>Total</b>		<b>275.0</b>	<b>O.T.M.</b>	<b>615.3</b>	Stem Weight(s)	=	169.3	0.83	141.1
					Earth @ Stem Transitions	=			
					Footing Weight	=	375.0	1.25	468.8
<b>Resisting/Overturning Ratio</b>			=	<b>2.09</b>	Key Weight	=		0.75	
Vertical Loads used for Soil Pressure =				971.8 lbs	Vert. Component	=			
					<b>Total =</b>		<b>971.8 lbs</b>	<b>R.M.=</b>	<b>1,286.7</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.054	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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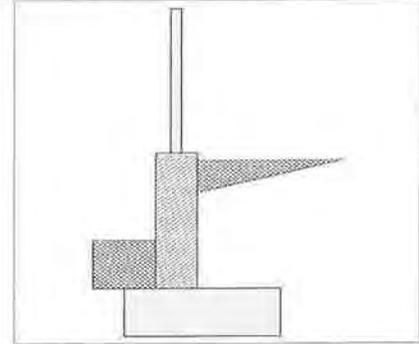
Code: CBC 2019, ACI 318-14, TMS 402-16

#### Criteria

Retained Height	=	2.67 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	1,709.0 lbs
Footing Width	=	2.75 ft
Eccentricity	=	9.62 in
Wall to Ftg CL Dist	=	4.87 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	1.87 OK
Sliding	=	1.90 OK
Total Bearing Load	=	1,144 lbs
...resultant ecc.	=	7.45 in
Soil Pressure @ Toe	=	1,212 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable	=	2,000 psf
ACI Factored @ Toe	=	1,697 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	4.5 psi OK
Footing Shear @ Heel	=	4.9 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	377.8 lbs
less 100% Passive Force	= -	375.0 lbs
less 100% Friction Force	= -	343.2 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

Design Height Above Ftg	ft =	2.83
Wall Material Above "Ht"	=	Fence
Design Method	=	LFRD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	32.00
Rebar Placed at	=	Edge

##### Design Data

fb/FB + fa/Fa	=	0.506
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	90.2 386.4
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	135.5 876.3
Moment....Allowable	ft-# =	1,727.9

##### Shear.....Actual

Service Level	psi =	
Strength Level	psi =	4.2
Shear.....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25

##### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LFRD

##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.50 ft
Heel Width	=	2.00
Total Footing Width	=	2.50
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.25 ft
$f'c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm = 3.00 in

#### Footing Design Results

	Toe	Heel
Factored Pressure	= 1,697	0 psf
Mu' : Upward	= 193	56 ft-#
Mu' : Downward	= 71	681 ft-#
Mu: Design	= 122	625 ft-#
Actual 1-Way Shear	= 4.48	4.86 psi
Allow 1-Way Shear	= 40.00	40.00 psi
Toe Reinforcing	= None Spec'd	
Heel Reinforcing	= None Spec'd	
Key Reinforcing	= None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd;  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd;  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: No key defined

Min footing T&S reinf Area 0.50 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4 @ 11.90 in  
 #5 @ 18.45 in  
 #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in  
 #5 @ 36.90 in  
 #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 269.4	1.22	329.5	Soil Over Heel	= 480.6	1.83	881.1
Surcharge over Heel	=			Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	=		
Adjacent Footing Load	= 13.4	0.20	2.7	Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	= 95.0	5.25	498.9	* Axial Live Load on Stem	=		
	=			Soil Over Toe	= 67.5	0.25	16.9
				Surcharge Over Toe	=		
				Stem Weight(s)	= 220.7	0.83	184.0
				Earth @ Stem Transitions	=		
<b>Total</b>	<b>377.8</b>	<b>O.T.M.</b>	<b>831.2</b>	Footing Weight	= 375.0	1.25	468.8
				Key Weight	=	0.75	
				Vert. Component	=		
<b>Resisting/Overturning Ratio</b>		=	<b>1.87</b>	<b>Total =</b>	<b>1,143.8 lbs</b>	<b>R.M.=</b>	<b>1,550.7</b>
Vertical Loads used for Soil Pressure =			1,143.8 lbs				

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0 pci
Horizontal Defl @ Top of Wall (approximate only)	0.079 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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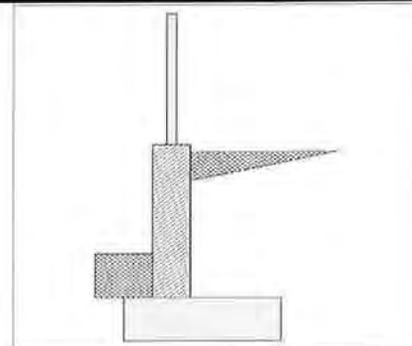
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	3.33 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	1,709.0 lbs
Footing Width	=	2.75 ft
Eccentricity	=	9.62 in
Wall to Ftg CL Dist	=	4.87 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

<b>Wall Stability Ratios</b>	
Overturning	= 1.96 OK
Sliding	= 1.54 OK
Total Bearing Load	= 1,465 lbs
...resultant ecc.	= 7.67 in
Soil Pressure @ Toe	= 1,327 psf OK
Soil Pressure @ Heel	= 0 psf OK
Allowable Soil Pressure Less Than Allowable	= 2,000 psf
ACI Factored @ Toe	= 1,858 psf
ACI Factored @ Heel	= 0 psf
Footing Shear @ Toe	= 5.2 psi OK
Footing Shear @ Heel	= 5.7 psi OK
Allowable	= 75.0 psi

<b>Sliding Calcs</b>	
Lateral Sliding Force	= 528.4 lbs
less 100% Passive Force	= - 375.0 lbs
less 100% Friction Force	= - 439.4 lbs
Added Force Req'd	= 0.0 lbs OK
....for 1.5 Stability	= 0.0 lbs OK

#### Stem Construction

<b>Design Height Above Ftg</b>	ft =	3.50	<b>2nd</b>	<b>Bottom</b>
Wall Material Above "Ht"	=	Fence		Stem OK
Design Method	=			Masonry
Thickness	=			LRFD
Rebar Size	=			8.00
Rebar Spacing	=			# 4
Rebar Placed at	=			16.00
	=			Edge

<b>Design Data</b>				
fb/FB + fa/Fa	=			0.347

<b>Total Force @ Section</b>				
Service Level	lbs =			
Strength Level	lbs =	89.9		517.1

<b>Moment....Actual</b>				
Service Level	ft-# =			
Strength Level	ft-# =	134.6		1,172.0
Moment....Allowable	ft-# =			3,368.0

<b>Shear....Actual</b>				
Service Level	psi =			
Strength Level	psi =			5.7
Shear....Allowable	=			80.5
Anet (Masonry)	in2 =			91.50
Rebar Depth 'd'	in =			5.25

<b>Masonry Data</b>				
f'm	psi =			2,000
Fy	psi =			60,000
Solid Grouting	=			Yes
Modular Ratio 'n'	=			16.11
Wall Weight	psf =			78.0

Equiv. Solid Thick.	=			7.60
Masonry Block Type	=			Medium Weight
Masonry Design Method	=			LRFD

<b>Concrete Data</b>				
f'c	psi =			
Fy	psi =			

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

<b>Load Factors</b>	
Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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**Cantilevered Retaining Wall**

Code: CBC 2019,ACI 318-14,TMS 402-16

**Footing Dimensions & Strengths**

Toe Width	=	0.50 ft
Heel Width	=	2.25
Total Footing Width	=	2.75
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.25 ft
f'c =	2,500 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm= 3.00 in

**Footing Design Results**

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,858	0 psf
Mu' : Upward	=	215	158 ft-#
Mu' : Downward	=	71	1,092 ft-#
Mu: Design	=	143	934 ft-#
Actual 1-Way Shear	=	5.22	5.69 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

**Other Acceptable Sizes & Spacings**

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: No key defined

Min footing T&S reinf Area 0.55 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: If two layers of horizontal bars:  
 #4@ 11.90 in #4@ 23.81 in  
 #5@ 18.45 in #5@ 36.90 in  
 #6@ 26.19 in #6@ 52.38 in

**Summary of Overturning & Resisting Forces & Moments**

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	375.0	1.44	541.2	Soil Over Heel	=	711.8	1.96	1,393.9
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=	58.4	0.43	24.9	Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	95.0	5.91	561.6	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	67.5	0.25	16.9
	=				Surcharge Over Toe	=			
<b>Total</b>		<b>528.4</b>	<b>O.T.M.</b>	<b>1,127.7</b>	Stem Weight(s)	=	273.0	0.83	227.5
	=				Earth @ Stem Transitions	=			
<b>Resisting/Overturning Ratio</b>			=	<b>1.96</b>	Footing Weight	=	412.5	1.38	567.2
Vertical Loads used for Soil Pressure =		1,464.8	lbs		Key Weight	=		0.75	
					Vert. Component	=			
					<b>Total =</b>	<b>1,464.8 lbs</b>	<b>R.M.=</b>	<b>2,205.5</b>	

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

**Tilt**

**Horizontal Deflection at Top of Wall due to settlement of soil**

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.087	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

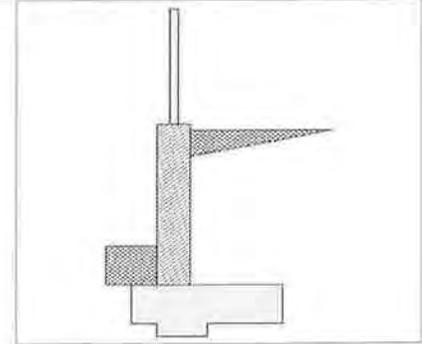
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	0.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	1,709.0 lbs
Footing Width	=	2.75 ft
Eccentricity	=	9.62 in
Wall to Ftg CL Dist	=	4.87 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Design Summary

##### Wall Stability Ratios

Overturning	=	3.35 OK
Sliding	=	1.79 OK
Total Bearing Load	=	1,882 lbs
...resultant ecc.	=	4.26 in
Soil Pressure @ Toe	=	1,072 psf OK
Soil Pressure @ Heel	=	182 psf OK
Allowable Soil Pressure Less Than Allowable		2,000 psf
ACI Factored @ Toe	=	1,501 psf
ACI Factored @ Heel	=	255 psf
Footing Shear @ Toe	=	4.2 psi OK
Footing Shear @ Heel	=	2.9 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	625.7 lbs
less 100% Passive Force	= -	555.6 lbs
less 100% Friction Force	= -	564.6 lbs
Added Force Req'd	=	0.0 lbs OK
...for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	2nd	Bottom
Design Height Above Ftg	ft = 4.16	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	16.00
Rebar Placed at	=	Edge

##### Design Data

fb/FB + fa/Fa	=	0.206
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	563.9
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	698.8
Moment....Allowable	ft-# =	3,368.0
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	6.2
Shear.....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25

##### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD
Concrete Data		
f'c	psi =	
Fy	psi =	



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.50 ft
Heel Width	=	2.50
Total Footing Width	=	3.00
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	4.00 in
Key Distance from Toe	=	0.50 ft
f'c =	2,500 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm = 3.00 in

#### Footing Design Results

	Toe	Heel
Factored Pressure	= 1,501	255 psf
Mu' : Upward	= 179	856 ft-#
Mu' : Downward	= 71	1,645 ft-#
Mu: Design	= 108	789 ft-#
Actual 1-Way Shear	= 4.17	2.93 psi
Allow 1-Way Shear	= 40.00	40.00 psi
Toe Reinforcing	=	None Spec'd
Heel Reinforcing	=	None Spec'd
Key Reinforcing	=	None Spec'd

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.60 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: If two layers of horizontal bars:  
 #4 @ 11.90 in #4 @ 23.81 in  
 #5 @ 18.45 in #5 @ 36.90 in  
 #6 @ 26.19 in #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 500.0	1.67	833.3	Soil Over Heel	= 990.0	2.08	2,062.5
Surcharge over Heel	=			Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	=		
Adjacent Footing Load	= 125.7	0.68	85.8	Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	=			* Axial Live Load on Stem	=		
				Soil Over Toe	= 67.5	0.25	16.9
				Surcharge Over Toe	=		
				Stem Weight(s)	= 324.5	0.83	270.4
				Earth @ Stem Transitions	=		
<b>Total</b>	<b>625.7</b>	<b>O.T.M.</b>	<b>919.1</b>	Footing Weight	= 450.0	1.50	675.0
				Key Weight	= 50.0	1.00	50.0
				Vert. Component	=		
<b>Resisting/Overturning Ratio</b>		<b>= 3.35</b>		<b>Total =</b>	<b>1,882.0 lbs</b>	<b>R.M.=</b>	<b>3,074.8</b>
Vertical Loads used for Soil Pressure =		1,882.0 lbs					

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.071 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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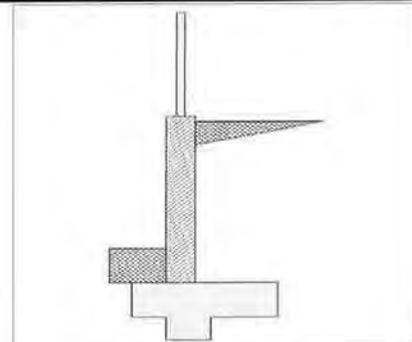
Code: CBC 2019, ACI 318-14, TMS 402-16

#### Criteria

Retained Height	=	4.67 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	1,709.0 lbs
Footing Width	=	2.75 ft
Eccentricity	=	9.62 in
Wall to Ftg CL Dist	=	4.87 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

<b>Wall Stability Ratios</b>	
Overturning	= 1.93 OK
Sliding	= 1.52 OK
Total Bearing Load	= 2,221 lbs
...resultant ecc.	= 8.91 in
Soil Pressure @ Toe	= 1,678 psf OK
Soil Pressure @ Heel	= 0 psf OK
Allowable Soil Pressure Less Than Allowable	= 2,000 psf
ACI Factored @ Toe	= 2,349 psf
ACI Factored @ Heel	= 0 psf
Footing Shear @ Toe	= 10.1 psi OK
Footing Shear @ Heel	= 8.7 psi OK
Allowable	= 75.0 psi
<b>Sliding Calcs</b>	
Lateral Sliding Force	= 939.2 lbs
less 100% Passive Force	= - 763.9 lbs
less 100% Friction Force	= - 666.4 lbs
Added Force Req'd	= 0.0 lbs OK
....for 1.5 Stability	= 0.0 lbs OK

#### Stem Construction

	2nd	Bottom
Design Height Above Ftg	ft = 4.83	Stem OK
Wall Material Above "Ht"	= Fence	0.00
Design Method	=	Masonry
Thickness	=	LRFD
Rebar Size	=	8.00
Rebar Spacing	=	# 4
Rebar Placed at	=	16.00
Design Data		Edge
fb/FB + fa/Fa	=	0.639
<b>Total Force @ Section</b>		
Service Level	lbs =	
Strength Level	lbs =	90.2 1,001.3
<b>Moment....Actual</b>		
Service Level	ft-# =	
Strength Level	ft-# =	135.5 2,156.5
Moment....Allowable	ft-# =	3,368.0
<b>Shear.....Actual</b>		
Service Level	psi =	
Strength Level	psi =	10.9
Shear....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25
<b>Masonry Data</b>		
f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

<b>Load Factors</b>	
Building Code	CBC 2019, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD
<b>Concrete Data</b>		
f'c	psi =	
Fy	psi =	



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.75	ft
Heel Width	=	2.50	
Total Footing Width	=	3.25	
Footing Thickness	=	12.00	in
Key Width	=	12.00	in
Key Depth	=	8.00	in
Key Distance from Toe	=	0.75	ft
f'c	=	2,500	psi
Fy	=	60,000	psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0014	
Cover @ Top	=	2.00	@ Btm= 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,349	0 psf
Mu' : Upward	=	598	276 ft-#
Mu' : Downward	=	139	1,860 ft-#
Mu: Design	=	459	1,584 ft-#
Actual 1-Way Shear	=	10.13	8.70 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None	Spec'd
Heel Reinforcing	=	None	Spec'd
Key Reinforcing	=	None	Spec'd

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.66 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4 @ 11.90 in  
 #5 @ 18.45 in  
 #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in  
 #5 @ 36.90 in  
 #6 @ 52.38 in

### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	643.0	1.89	1,215.2	Soil Over Heel	=	1,155.8	2.33	2,696.9
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=	201.2	0.97	195.2	Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	95.0	7.25	688.9	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	101.3	0.38	38.0
					Surcharge Over Toe	=			
<b>Total</b>		<b>939.2</b>	<b>O.T.M.</b>	<b>2,099.3</b>	Stem Weight(s)	=	376.7	1.08	408.1
					Earth @ Stem Transitions	=			
					Footing Weight	=	487.5	1.63	792.2
<b>Resisting/Overturning Ratio</b>			=	<b>1.93</b>	Key Weight	=	100.0	1.25	125.0
Vertical Loads used for Soil Pressure	=			2,221.3 lbs	Vert. Component	=			
					<b>Total =</b>		<b>2,221.3 lbs</b>	<b>R.M.=</b>	<b>4,060.2</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.112 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

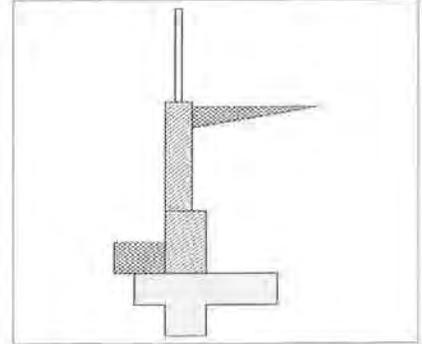
Code: CBC 2019, ACI 318-14, TMS 402-16

#### Criteria

Retained Height	=	5.33 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	1,709.0 lbs
Footing Width	=	2.75 ft
Eccentricity	=	9.62 in
Wall to Ftg CL Dist	=	4.87 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	1.97 OK
Sliding	=	1.56 OK
Total Bearing Load ...resultant ecc.	=	2,767 lbs 9.28 in
Soil Pressure @ Toe	=	1,889 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable	=	2,000 psf
ACI Factored @ Toe	=	2,645 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	11.9 psi OK
Footing Shear @ Heel	=	10.0 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	1,170.9 lbs
less 100% Passive Force	= -	1,000.0 lbs
less 100% Friction Force	= -	830.0 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	3rd	2nd	Bottom
Design Height Above Ftg	ft = 5.50	Stem OK	Stem OK
Wall Material Above "Ht"	= Fence	2.00	0.00
Design Method	=	Masonry	Masonry
Thickness	=	LRFD	LRFD
Rebar Size	=	8.00	12.00
Rebar Spacing	=	# 4	# 4
Rebar Placed at	=	16.00	16.00
Design Data		Edge	Edge
fb/FB + fa/Fa	=	0.347	0.494
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	89.9	517.1
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =	134.6	1,172.0
Moment....Allowable	ft-# =		
Strength Level	ft-# =	3,368.0	5,899.2
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =	5.7	9.5
Shear.....Allowable	=	80.5	80.5
Anet (Masonry)	in2 =	91.50	139.50
Rebar Depth 'd'	in =	5.25	9.00
Masonry Data			
f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	124.0
Equiv. Solid Thick.	=	7.60	11.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	
Concrete Data			
f'c	psi =		
Fy	psi =		

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.75	ft
Heel Width	=	2.75	
Total Footing Width	=	3.50	
Footing Thickness	=	12.00	in
Key Width	=	12.00	in
Key Depth	=	12.00	in
Key Distance from Toe	=	0.75	ft
f'c	=	2,500	psi
Fy	=	60,000	psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0014	
Cover @ Top	=	2.00	@ Btm = 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,645	0 psf
Mu' : Upward	=	680	247 ft-#
Mu' : Downward	=	160	2,054 ft-#
Mu: Design	=	520	1,808 ft-#
Actual 1-Way Shear	=	11.94	9.99 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.71 in<sup>2</sup>  
Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
If one layer of horizontal bars: #4 @ 11.90 in  
#5 @ 18.45 in  
#6 @ 26.19 in  
If two layers of horizontal bars: #4 @ 23.81 in  
#5 @ 36.90 in  
#6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	801.4	2.11	1,690.9	Soil Over Heel	=	1,259.2	2.63	3,305.4
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=	274.5	1.28	352.5	Adjacent Footing Load	=	60.4	3.37	203.9
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	95.0	7.91	751.6	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	101.3	0.38	38.0
	=				Surcharge Over Toe	=			
<b>Total</b>		<b>1,170.9</b>	<b>O.T.M.</b>	<b>2,795.0</b>	Stem Weight(s)	=	521.0	1.16	605.8
	=				Earth @ Stem Transitions	=	149.9	1.58	237.3
<b>Resisting/Overturning Ratio</b>				<b>1.97</b>	Footing Weight	=	525.0	1.75	918.8
Vertical Loads used for Soil Pressure	=	2,766.8	lbs		Key Weight	=	150.0	1.25	187.5
	=				Vert. Component	=			
					<b>Total =</b>		<b>2,766.8</b>	<b>lbs R.M.=</b>	<b>5,496.5</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
Horizontal Defl @ Top of Wall (approximate only) 0.127 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

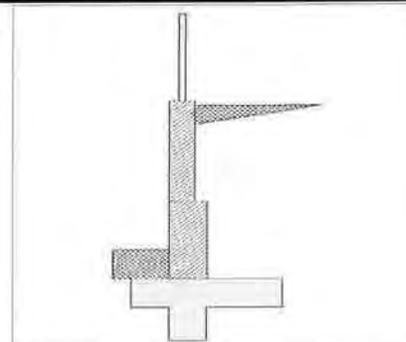
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	1,709.0 lbs
Footing Width	=	2.75 ft
Eccentricity	=	9.62 in
Wall to Ftg CL Dist	=	4.87 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	2.23 OK
Sliding	=	1.53 OK
Total Bearing Load	=	3,460 lbs
...resultant ecc.	=	8.40 in
Soil Pressure @ Toe	=	1,775 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable		2,000 psf
ACI Factored @ Toe	=	2,485 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	14.8 psi OK
Footing Shear @ Heel	=	9.6 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	1,417.6 lbs
less 100% Passive Force	= -	1,128.5 lbs
less 100% Friction Force	= -	1,038.1 lbs
Added Force Req'd	=	0.0 lbs OK
...for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	3rd	2nd	Bottom
Design Height Above Ftg	ft = 6.16	Stem OK	Stem OK
Wall Material Above "Ht"	= Fence	2.67	0.00
Design Method	=	Masonry	Masonry
Thickness	=	LRFD	LRFD
Rebar Size	=	8.00	12.00
Rebar Spacing	=	# 4	# 4
Rebar Placed at	=	16.00	16.00
		Edge	Edge

##### Design Data

fb/FB + fa/Fa	=	0.347	0.666
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##### Total Force @ Section

Service Level	lbs =			
Strength Level	lbs =	90.2	517.1	1,691.8
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	135.5	1,172.0	3,932.8
Moment....Allowable	ft-# =		3,368.0	5,899.2

##### Shear....Actual

Service Level	psi =			
Strength Level	psi =		5.7	12.1
Shear....Allowable	=		80.5	80.5
Anet (Masonry)	in2 =		91.50	139.50
Rebar Depth 'd'	in =		5.25	9.00

##### Masonry Data

f'm	psi =		2,000	2,000
Fy	psi =		60,000	60,000
Solid Grouting	=		Yes	Yes
Modular Ratio 'n'	=		16.11	16.11
Wall Weight	psf =		78.0	124.0

Equiv. Solid Thick.	=		7.60	11.60
Masonry Block Type	=		Medium Weight	
Masonry Design Method	=		LRFD	

##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	3.00
Total Footing Width	=	4.00
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	14.00 in
Key Distance from Toe	=	1.00 ft
f'c	=	2,500 psi
Fy	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	=	2.00
@ Btm	=	3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,485	0 psf
Mu' : Upward	=	1,136	727 ft-#
Mu' : Downward	=	257	2,880 ft-#
Mu: Design	=	880	2,153 ft-#
Actual 1-Way Shear	=	14.75	9.62 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.81 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4 @ 11.90 in  
 #5 @ 18.45 in  
 #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in  
 #5 @ 36.90 in  
 #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	980.0	2.33	2,286.7	Soil Over Heel	=	1,620.0	3.00	4,860.0
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=	342.6	1.63	559.7	Adjacent Footing Load	=	177.2	3.58	634.7
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	95.0	8.58	815.2	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	135.0	0.50	67.5
					Surcharge Over Toe	=			
<b>Total</b>		<b>1,417.6</b>	<b>O.T.M.</b>	<b>3,661.6</b>	Stem Weight(s)	=	603.3	1.42	859.6
					Earth @ Stem Transitions	=	149.9	1.83	274.7
<b>Resisting/Overturning Ratio</b>			<b>= 2.23</b>		Footing Weight	=	600.0	2.00	1,200.0
Vertical Loads used for Soil Pressure	=		3,460.4 lbs		Key Weight	=	175.0	1.50	262.5
					Vert. Component	=			
					<b>Total</b>	<b>=</b>	<b>3,460.4 lbs</b>	<b>R.M.=</b>	<b>8,159.0</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.113 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

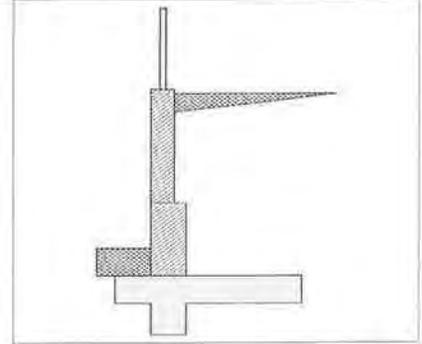
Code: CBC 2019, ACI 318-14, TMS 402-16

#### Criteria

Retained Height	=	6.67 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	1,709.0 lbs
Footing Width	=	2.75 ft
Eccentricity	=	9.62 in
Wall to Ftg CL Dist	=	4.87 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	3.45 OK
Sliding	=	1.63 OK
Total Bearing Load	=	5,332 lbs
...resultant ecc.	=	5.67 in
Soil Pressure @ Toe	=	1,564 psf OK
Soil Pressure @ Heel	=	468 psf OK
Allowable Soil Pressure Less Than Allowable	=	2,000 psf
ACI Factored @ Toe	=	2,189 psf
ACI Factored @ Heel	=	655 psf
Footing Shear @ Toe	=	13.7 psi OK
Footing Shear @ Heel	=	3.7 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	1,673.4 lbs
less 100% Passive Force	= -	1,128.5 lbs
less 100% Friction Force	= -	1,599.6 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

##### Design Height Above Ftg

ft =	6.83	Stem OK	Stem OK
Wall Material Above "Ht"	=	Fence	Masonry
Design Method	=		LRFD
Thickness	=	8.00	12.00
Rebar Size	=	# 4	# 4
Rebar Spacing	=	16.00	8.00
Rebar Placed at	=	Edge	Edge

##### Design Data

fb/FB + fa/Fa	=	0.469	0.453
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##### Total Force @ Section

Service Level	lbs =		
Strength Level	lbs =	90.2	721.8

##### Moment....Actual

Service Level	ft-# =		
Strength Level	ft-# =	135.5	1,581.8
Moment.....Allowable	ft-# =		3,368.0

##### Shear.....Actual

Service Level	psi =		
Strength Level	psi =	7.9	14.9
Shear.....Allowable	=	80.5	80.5
Anet (Masonry)	in2 =	91.50	139.50
Rebar Depth 'd'	in =	5.25	9.00

##### Masonry Data

f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	124.0

Equiv. Solid Thick.	=	7.60	11.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	

##### Concrete Data

fc	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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**Cantilevered Retaining Wall**

Code: CBC 2019, ACI 318-14, TMS 402-16

**Footing Dimensions & Strengths**

Toe Width	=	1.00 ft
Heel Width	=	4.25
Total Footing Width	=	5.25
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	14.00 in
Key Distance from Toe	=	1.00 ft
$f'c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	=	2.00
	@ Btm=	3.00 in

**Footing Design Results**

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	2,189	655 psf
Mu' : Upward	=	1,046	5,129 ft-#
Mu' : Downward	=	257	7,680 ft-#
Mu: Design	=	789	2,551 ft-#
Actual 1-Way Shear	=	13.73	3.73 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

**Other Acceptable Sizes & Spacings**

Toe: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: #4 @ 11.89 in, #5 @ 18.44 in, #6 @ 26.18 in, #7 @ 35.70 in, #8 @ 47.01 in, #9 @ 5  
 Key: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 1.06 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup>/ft  
 If one layer of horizontal bars: #4 @ 11.90 in, #5 @ 18.45 in, #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in, #5 @ 36.90 in, #6 @ 52.38 in

**Summary of Overturning & Resisting Forces & Moments**

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	1,176.3	2.56	3,006.9	Soil Over Heel	=	2,926.0	3.63	10,606.8
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=	402.1	2.01	809.1	Adjacent Footing Load	=	473.1	4.04	1,910.6
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	95.0	9.25	878.8	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	135.0	0.50	67.5
					Surcharge Over Toe	=			
<b>Total</b>		<b>1,673.4</b>	<b>O.T.M.</b>	<b>4,694.8</b>	Stem Weight(s)	=	655.6	1.42	929.3
					Earth @ Stem Transitions	=	180.0	1.83	329.9
<b>Resisting/Overturning Ratio</b>			<b>= 3.45</b>		Footing Weight	=	787.5	2.63	2,067.2
Vertical Loads used for Soil Pressure =		5,332.1 lbs			Key Weight	=	175.0	1.50	262.5
					Vert. Component	=			
					<b>Total =</b>	<b>5,332.1 lbs</b>	<b>R.M.=</b>	<b>16,173.8</b>	

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

**Tilt**

**Horizontal Deflection at Top of Wall due to settlement of soil**

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.081	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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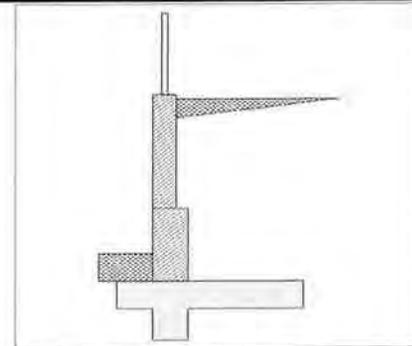
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	6.67 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	0.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	1,709.0 lbs
Footing Width	=	2.75 ft
Eccentricity	=	9.62 in
Wall to Ftg CL Dist	=	4.87 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Earth Pressure Seismic Load

Method : Inverted Triangular

Load at top of Inverted Triangular Distribution (Strength)	=	162.000 psf	Total Strength-Level Seismic Load.....	=	621.189 lbs
			Total Service-Level Seismic Load.....	=	434.832 lbs

#### Design Summary

<b>Wall Stability Ratios</b>	
Overturning	= 2.68 OK
Sliding	= 1.36 Ratio < 1.5!
Total Bearing Load	= 5,332 lbs
...resultant ecc.	= 8.69 in
Soil Pressure @ Toe	= 1,856 psf OK
Soil Pressure @ Heel	= 175 psf OK
Allowable	= 2,000 psf
Soil Pressure Less Than Allowable	
ACI Factored @ Toe	= 2,599 psf
ACI Factored @ Heel	= 245 psf
Footing Shear @ Toe	= 16.5 psi OK
Footing Shear @ Heel	= 8.2 psi OK
Allowable	= 75.0 psi
<b>Sliding Calcs</b>	
Lateral Sliding Force	= 2,013.2 lbs
less 100% Passive Force	= - 1,128.5 lbs
less 100% Friction Force	= - 1,599.6 lbs
Added Force Req'd	= 0.0 lbs OK
...for 1.5 Stability	= 291.7 lbs NG

#### Stem Construction

	3rd	2nd	Bottom
Design Height Above Ftg	ft = 6.83	Stem OK 2.67	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry	Masonry
Design Method	=	LRFD	LRFD
Thickness	=	8.00	12.00
Rebar Size	=	# 4	# 4
Rebar Spacing	=	16.00	8.00
Rebar Placed at	=	Edge	Edge
<b>Design Data</b>			
fb/FB + fa/Fa	=	0.524	0.562
<b>Total Force @ Section</b>			
Service Level	lbs =		
Strength Level	lbs =	1,042.5	2,529.8
<b>Moment....Actual</b>			
Service Level	ft-# =		
Strength Level	ft-# =	1,768.4	6,444.6
Moment....Allowable	ft-# =	3,368.0	11,446.9
<b>Shear....Actual</b>			
Service Level	psi =		
Strength Level	psi =	11.4	18.1
Shear....Allowable	=	80.5	80.5
Anet (Masonry)	in2 =	91.50	139.50
Rebar Depth 'd'	in =	5.25	9.00
<b>Masonry Data</b>			
f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	124.0
		7.60	11.60
<b>Concrete Data</b>			
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	
Concrete Data			
f'c	psi =		
Fy	psi =		

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	4.25
Total Footing Width	=	5.25
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	14.00 in
Key Distance from Toe	=	1.00 ft
f'c =	2,500 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm. = 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,599	245 psf
Mu' : Upward	=	1,225	3,859 ft-#
Mu' : Downward	=	257	7,680 ft-#
Mu: Design	=	968	3,822 ft-#
Actual 1-Way Shear	=	16.49	8.18 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: #4 @ 11.89 in, #5 @ 18.44 in, #6 @ 26.18 in, #7 @ 35.70 in, #8 @ 47.01 in, #9 @ 5  
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 1.06 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft

If one layer of horizontal bars: If two layers of horizontal bars:

#4 @ 11.90 in	#4 @ 23.81 in
#5 @ 18.45 in	#5 @ 36.90 in
#6 @ 26.19 in	#6 @ 52.38 in

### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	1,176.3	2.56	3,006.9	Soil Over Heel	=	2,926.0	3.63	10,606.8
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=	402.1	2.01	809.1	Adjacent Footing Load	=	473.1	4.04	1,910.6
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=				* Axial Live Load on Stem	=			
Seismic Earth Load	=	434.8	5.11	2,223.2	Soil Over Toe	=	135.0	0.50	67.5
	=				Surcharge Over Toe	=			
<b>Total</b>		<b>2,013.2</b>	<b>O.T.M.</b>	<b>6,039.2</b>	Stem Weight(s)	=	655.6	1.42	929.3
	=				Earth @ Stem Transitions	=	180.0	1.83	329.9
<b>Resisting/Overturning Ratio</b>			<b>= 2.68</b>		Footing Weight	=	787.5	2.63	2,067.2
Vertical Loads used for Soil Pressure	=	5,332.1	lbs		Key Weight	=	175.0	1.50	262.5
					Vert. Component	=			
					<b>Total =</b>	<b>5,332.1 lbs</b>	<b>R.M.=</b>	<b>16,173.8</b>	

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.097	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



# ORCO 2'-0" TO 5'-4" HIGH RETAINING WALL W/ 36" GUARDRAIL FOR 110 MPH 3 SEC. GUST @ EXP C

**SPECIAL INSPECTION NOTE:**

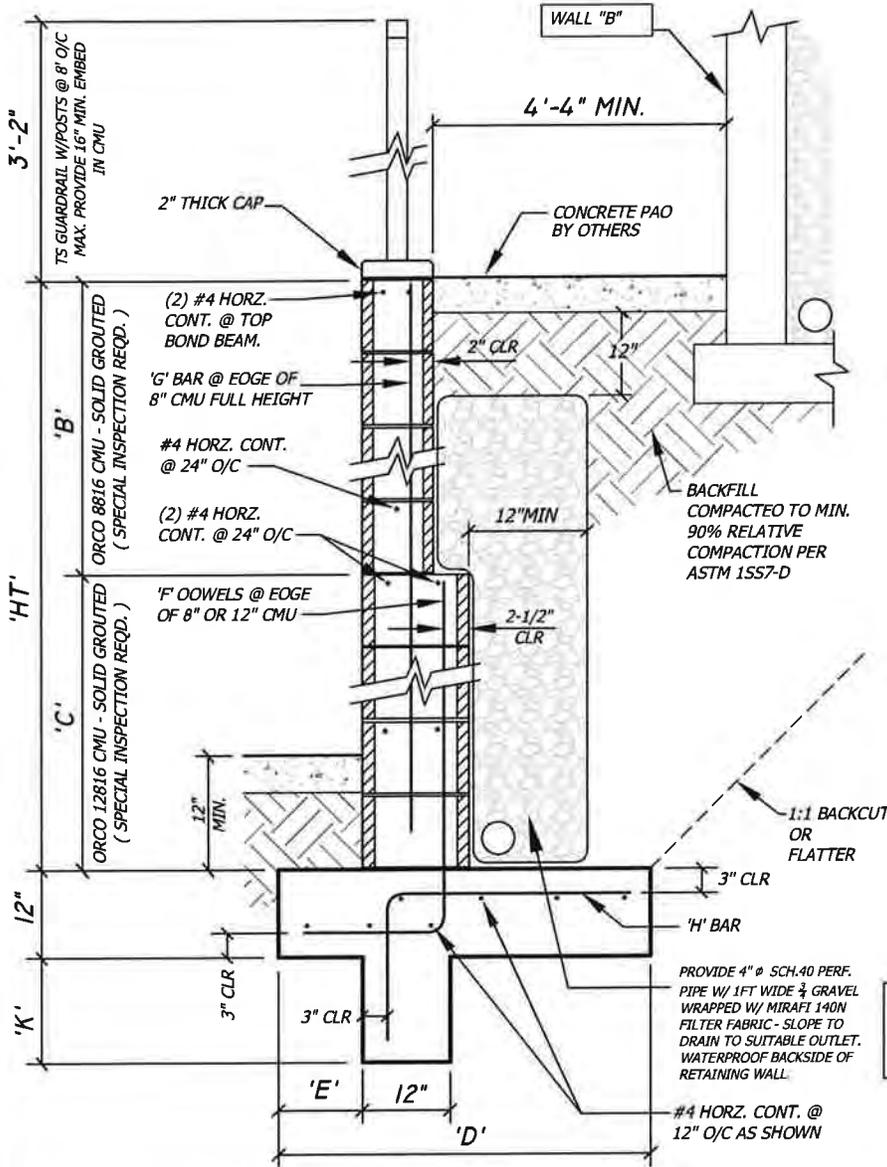
PROVIDE LEVEL 2 SPECIAL INSPECTION PER TMS 602-16 TABLES 3 AND 4 OF THE MASONRY STEM.

**DESIGN CRITERIA PER 2019 CBC:**

1. ALLOWABLE SOIL BEARING PRESSURE FOR FOOTINGS = 2000 PSF PER SOILS REP.
2. EQUIVALENT FLUID PRESSURE FOR LEVEL BACKFILL = 40 PCF PER SOILS REPORT.
3. ALLOWABLE LATERAL PASSIVE PRESSURE = 250 PCF PER SOILS REPORT.
4. GROUT STRENGTH = 2000 PSI @ 28 DAYS & REINFORCING STEEL : GRADE 60.
5. EARTH COEFFICIENT OF FRICTION = 0.30.
6. 2000 PSI MASONRY COMPRESSION STRENGTH - SPECIAL INSPECTION REQUIRED.

**NOTES:**

1. CONCRETE BLOCK SHALL BE MANUFACTURED BY ORCO ASTM C 90. WEDGELOCK BLOCK, SLUMP BLOCK AND SPLITFACE BLOCK ARE ACCEPTABLE.
2. CONCRETE FOR FOOTING SHALL BE 1 PART CEMENT TO 2-1/2 PARTS SAND TO 3-1/2 PARTS GRAVEL WITH A MAXIMUM OF 1-1/2 GALLONS OF WATER PER SACK. PORTLAND CEMENT SHALL CONFORM TO ASTM C 150 TYPE II/V.  $f_c = 2500$  PSI
3. REINFORCING STEEL SHALL BE DEFORMED AND CONFORM TO ASTM A 615 GRADE 60. PROVIDE 48 BAR DIAMETER LAP.
4. REBAR SHALL BE CENTERED IN THE CONCRETE BLOCK CELL IN WHICH IT IS LOCATED.
5. CONCRETE BLOCK SHALL BE LAID IN A RUNNING BOND PATTERN WITH VERTICAL CONTINUITY OF THE CELLS UNO.
6. ALL BLOCK CELLS SHALL BE SOLID GROUTED.
7. USE TYPE S MORTAR PROPORTIONED USING ASTM C 270 PART CEMENT TO 1/2 PART LIME TO 4-1/2 PARTS DAMP, LOOSE SAND.
8. GROUT FOR CONCRETE BLOCK PER ASTM C 476 TO BE 1 PART CEMENT TO 3 PARTS SAND (GROUT MAY CONTAIN 2 PARTS 3/8" PEA GRAVEL IF WEATHER CONDITIONS ARE FAVORABLE AND BLOCK UNOBSTRUCTED CELL SIZE IS SUFFICIENT TO ALLOW GOOD GROUT FLOW). WATER SHALL BE ADDED TO PRODUCE GOOD GROUT FLOW WITHOUT SEGREGATION OF THE CONSTITUENTS.
9. BLOCK STEM MAY BE WET-SET 1-1/2" INTO THE FOOTING WHILE THE CONCRETE IS PLASTIC. BLOCK STEM MAY BE PLACED TO EITHER EDGE OF THE TRENCH TYPE FOOTING.
10. FOOTING MUST BE POUROED ON OR INTO UNOISTURBED NATURAL SOIL OR ON COMPACTED FILL WITH A MINIMUM COMPACTION OF 90%.
11. FIRST INSPECTION TO BE AFTER FOOTING TRENCHES ARE READY FOR CONCRETE AND ALL REQUIRED STEEL IS TIED IN PLACE. SECONO INSPECTION TO BE WHEN THE REQUIRED VERTICAL IS IN PLACE AND THE BLOCK WALL IS READY TO GROUT.
12. MAXIMUM CONTROL JOINT SPACING: 40' O/C. 20' O/C FOR WALLS TO BE MORTAR WASHED OR STUCCO COATED.



**ENGINEERING STAMP APPROVAL IS CONDITIONAL;  
REQUIRING USE OF ORCO MANUFACTURED CMU ON  
ALL ORCO WALL SYSTEM DESIGNS.**



## WALL "C"

**CITY OF  
HERMOSA BEACH**  
PARKING LOT D  
HERMOSA BEACH, CALIFORNIA

'HT'	'B'	'C'	'D'	'E'	'F' DOWEL	'G' VERT	'H' BAR	'K'
2'-0"	2'-0"	N/A	2'-6"	6"	#4@32" O/C 8" $\perp$ 33"	N/A	#4@32" O/C 6" $\perp$ 18"	N/A
2'-8"	2'-8"	N/A	2'-6"	6"	#4@32" O/C 8" $\perp$ 41"	N/A	#4@32" O/C 6" $\perp$ 18"	N/A
3'-4"	3'-4"	N/A	2'-9"	6"	#4@16" O/C 8" $\perp$ 49"	N/A	#4@16" O/C 8" $\perp$ 21"	4"
4'-0"	4'-0"	N/A	3'-0"	6"	#4@16" O/C 8" $\perp$ 57"	N/A	#4@16" O/C 8" $\perp$ 24"	8"
4'-8"	4'-8"	N/A	3'-3"	9"	#4@16" O/C 11" $\perp$ 65"	N/A	#4@16" O/C 19" $\perp$ 24"	1'-1"
5'-4"	3'-4"	2'-0"	3'-9"	9"	#4@16" O/C 15" $\perp$ 33"	#4@16" O/C	#4@8" O/C 23" $\perp$ 30"	1'-5"

**NOTE: DIMENSIONS ARE NOT TO SCALE.**

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### Cantilevered Retaining Wall

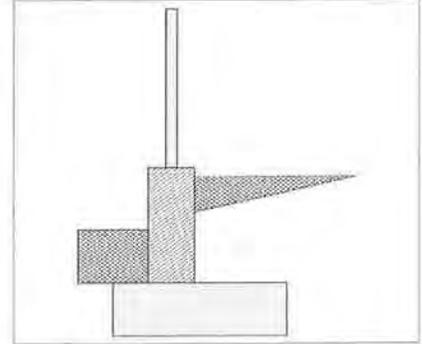
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	2.00 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	5,332.0 lbs
Footing Width	=	5.87 ft
Eccentricity	=	6.01 in
Wall to Ftg CL Dist	=	5.87 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	2.09 OK
Sliding	=	2.42 OK
Total Bearing Load	=	972 lbs
...resultant ecc.	=	6.71 in
Soil Pressure @ Toe	=	938 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable	=	2,000 psf
ACI Factored @ Toe	=	1,313 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	3.2 psi OK
Footing Shear @ Heel	=	3.4 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	275.3 lbs
less 100% Passive Force	= -	375.0 lbs
less 100% Friction Force	= -	291.5 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	2nd	Bottom
Design Height Above Ftg	ft = 2.17	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry
Design Method	=	LRFD LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	32.00
Rebar Placed at	=	Edge

##### Design Data

fb/FB + fa/Fa	=	0.377
---------------	---	-------

##### Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	89.9 286.3

##### Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	134.6 652.5
Moment....Allowable	ft-# =	1,727.9

##### Shear.....Actual

Service Level	psi =	
Strength Level	psi =	3.1
Shear....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25

##### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.50	ft
Heel Width	=	2.00	
Total Footing Width	=	2.50	
Footing Thickness	=	12.00	in
Key Width	=	12.00	in
Key Depth	=	0.00	in
Key Distance from Toe	=	0.25	ft
f'c	=	2,500	psi
Fy	=	60,000	psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0014	
Cover @ Top	=	2.00	
@ Btm	=	3.00	in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	1,313	0 psf
Mu' : Upward	=	151	78 ft-#
Mu' : Downward	=	71	560 ft-#
Mu: Design	=	80	482 ft-#
Actual 1-Way Shear	=	3.16	3.43 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None	Spec'd
Heel Reinforcing	=	None	Spec'd
Key Reinforcing	=	None	Spec'd

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: No key defined

Min footing T&S reinf Area 0.50 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4 @ 11.90 in  
 #5 @ 18.45 in  
 #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in  
 #5 @ 36.90 in  
 #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....		
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	180.0	1.00	180.0		
Surcharge over Heel	=					
Surcharge Over Toe	=					
Adjacent Footing Load	=	0.3	0.05	0.0		
Added Lateral Load	=					
Load @ Stem Above Soil	=	95.0	4.58	435.3		
	=					
<b>Total</b>	=	<b>275.3</b>	<b>O.T.M.</b>	<b>615.3</b>		
	=					
<b>Resisting/Overturning Ratio</b>	=		<b>2.09</b>			
Vertical Loads used for Soil Pressure =		971.8	lbs			
Soil Over Heel	=	360.0	1.83	660.0		
Sloped Soil Over Heel	=					
Surcharge Over Heel	=					
Adjacent Footing Load	=					
Axial Dead Load on Stem	=					
* Axial Live Load on Stem	=					
Soil Over Toe	=	67.5	0.25	16.9		
Surcharge Over Toe	=					
Stem Weight(s)	=	169.3	0.83	141.1		
Earth @ Stem Transitions	=					
Footing Weight	=	375.0	1.25	468.8		
Key Weight	=		0.75			
Vert. Component	=					
<b>Total =</b>		<b>971.8</b>	<b>lbs</b>	<b>R.M.=</b>	<b>1,286.7</b>	

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.054 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

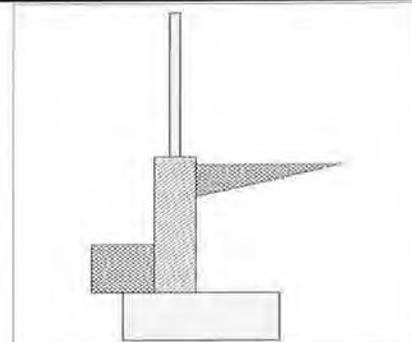
Code: CBC 2019, ACI 318-14, TMS 402-16

#### Criteria

Retained Height	=	2.67 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	5,332.0 lbs
Footing Width	=	5.87 ft
Eccentricity	=	6.01 in
Wall to Ftg CL Dist	=	5.87 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

<b>Wall Stability Ratios</b>	
Overturning	= 1.86 OK
Sliding	= 1.84 OK
Total Bearing Load	= 1,144 lbs
...resultant ecc.	= 7.49 in
Soil Pressure @ Toe	= 1,218 psf OK
Soil Pressure @ Heel	= 0 psf OK
Allowable Soil Pressure Less Than Allowable	= 2,000 psf
ACI Factored @ Toe	= 1,705 psf
ACI Factored @ Heel	= 0 psf
Footing Shear @ Toe	= 4.5 psi OK
Footing Shear @ Heel	= 4.9 psi OK
Allowable	= 75.0 psi
<b>Sliding Calcs</b>	
Lateral Sliding Force	= 390.1 lbs
less 100% Passive Force	= - 375.0 lbs
less 100% Friction Force	= - 343.2 lbs
Added Force Req'd	= 0.0 lbs OK
....for 1.5 Stability	= 0.0 lbs OK

#### Stem Construction

	2nd	Bottom
<b>Design Height Above Ftg</b>	ft = 2.83	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry
Design Method	=	LRFD LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	32.00
Rebar Placed at	=	Edge
<b>Design Data</b>		
fb/FB + fa/Fa	=	0.506
<b>Total Force @ Section</b>		
Service Level	lbs =	
Strength Level	lbs =	90.2 386.4
<b>Moment....Actual</b>		
Service Level	ft-# =	
Strength Level	ft-# =	135.5 876.3
Moment....Allowable	ft-# =	1,727.9
<b>Shear.....Actual</b>		
Service Level	psi =	
Strength Level	psi =	4.2
Shear....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25
<b>Masonry Data</b>		
f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

Building Code	CBC 2019, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD
<b>Concrete Data</b>		
f'c	psi =	
Fy	psi =	



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**Cantilevered Retaining Wall**

Code: CBC 2019, ACI 318-14, TMS 402-16

**Footing Dimensions & Strengths**

Toe Width	=	0.50 ft
Heel Width	=	2.00
Total Footing Width	=	2.50
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.25 ft
$f'c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm = 3.00 in

**Footing Design Results**

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,705	0 psf
$\mu'$ : Upward	=	194	55 ft-#
$\mu'$ : Downward	=	71	681 ft-#
$\mu$ : Design	=	123	626 ft-#
Actual 1-Way Shear	=	4.51	4.89 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

**Other Acceptable Sizes & Spacings**

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: No key defined

Min footing T&S reinf Area 0.50 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4 @ 11.90 in  
 #5 @ 18.45 in  
 #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in  
 #5 @ 36.90 in  
 #6 @ 52.38 in

**Summary of Overturning & Resisting Forces & Moments**

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	269.4	1.22	329.5	Soil Over Heel	=	480.6	1.83	881.1
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=	25.8	0.23	5.9	Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	95.0	5.25	498.9	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	67.5	0.25	16.9
					Surcharge Over Toe	=			
<b>Total</b>		<b>390.1</b>	<b>O.T.M.</b>	<b>834.4</b>	Stem Weight(s)	=	220.7	0.83	184.0
					Earth @ Stem Transitions	=			
<b>Resisting/Overturning Ratio</b>			=	<b>1.86</b>	Footing Weight	=	375.0	1.25	468.8
Vertical Loads used for Soil Pressure	=			1,143.8 lbs	Key Weight	=		0.75	
					Vert. Component	=			
					<b>Total =</b>		<b>1,143.8 lbs</b>	<b>R.M.=</b>	<b>1,550.7</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

**Tilt**

**Horizontal Deflection at Top of Wall due to settlement of soil**

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.079 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

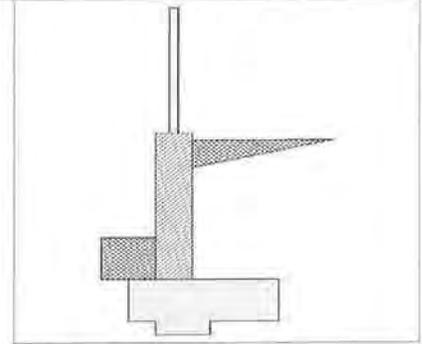
Code: CBC 2019, ACI 318-14, TMS 402-16

#### Criteria

Retained Height	=	3.33 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	5,332.0 lbs
Footing Width	=	5.87 ft
Eccentricity	=	6.01 in
Wall to Ftg CL Dist	=	5.87 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	1.96 OK
Sliding	=	1.74 OK
Total Bearing Load	=	1,515 lbs
...resultant ecc.	=	7.75 in
Soil Pressure @ Toe	=	1,385 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable		2,000 psf
ACI Factored @ Toe	=	1,938 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	5.5 psi OK
Footing Shear @ Heel	=	5.6 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	581.9 lbs
less 100% Passive Force	= -	555.6 lbs
less 100% Friction Force	= -	454.4 lbs
Added Force Req'd	=	0.0 lbs OK
...for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	2nd	Bottom
Design Height Above Ftg	ft = 3.50	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry
Design Method	=	LRFD LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	16.00
Rebar Placed at	=	Edge

##### Design Data

fb/FB + fa/Fa	=	0.347
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	89.9 523.5
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	134.6 1,173.0
Moment....Allowable	ft-# =	3,368.0

##### Shear....Actual

Service Level	psi =	
Strength Level	psi =	5.7
Shear....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25

##### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

##### Concrete Data

f'c	psi =	
Fy	psi =	



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width = 0.50 ft  
 Heel Width = 2.25  
 Total Footing Width = 2.75  
 Footing Thickness = 12.00 in  
 Key Width = 12.00 in  
 Key Depth = 4.00 in  
 Key Distance from Toe = 0.50 ft  
 f'c = 2,500 psi Fy = 60,000 psi  
 Footing Concrete Density = 150.00 pcf  
 Min. As % = 0.0014  
 Cover @ Top 2.00 @ Btm = 3.00 in

#### Footing Design Results

	Toe	Heel
Factored Pressure =	1,938	0 psf
Mu' : Upward =	224	157 ft-#
Mu' : Downward =	71	1,092 ft-#
Mu: Design =	153	934 ft-#
Actual 1-Way Shear =	5.50	5.64 psi
Allow 1-Way Shear =	40.00	40.00 psi
Toe Reinforcing =	None Spec'd	
Heel Reinforcing =	None Spec'd	
Key Reinforcing =	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.55 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4 @ 11.90 in  
 #5 @ 18.45 in  
 #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in  
 #5 @ 36.90 in  
 #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure =	375.0	1.44	541.2	Soil Over Heel =	711.8	1.96	1,393.9
Surcharge over Heel =				Sloped Soil Over Heel =			
Surcharge Over Toe =				Surcharge Over Heel =			
Adjacent Footing Load =	111.9	0.43	47.9	Adjacent Footing Load =			
Added Lateral Load =				Axial Dead Load on Stem =			
Load @ Stem Above Soil =	95.0	5.91	561.6	* Axial Live Load on Stem =			
				Soil Over Toe =	67.5	0.25	16.9
				Surcharge Over Toe =			
<b>Total</b>	<b>581.9</b>	<b>O.T.M.</b>	<b>1,150.7</b>	Stem Weight(s) =	273.0	0.83	227.5
				Earth @ Stem Transitions =			
<b>Resisting/Overturning Ratio</b>			<b>= 1.96</b>	Footing Weight =	412.5	1.38	567.2
Vertical Loads used for Soil Pressure =		1,514.8 lbs		Key Weight =	50.0	1.00	50.0
				Vert. Component =			
				<b>Total =</b>	<b>1,514.8 lbs</b>	<b>R.M.=</b>	<b>2,255.5</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.091 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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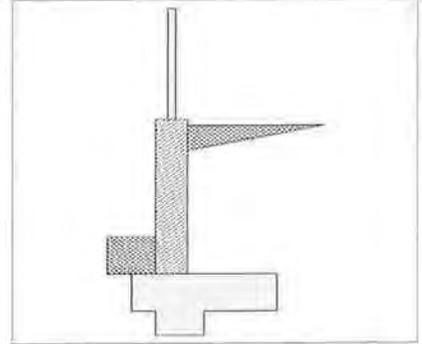
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	5,332.0 lbs
Footing Width	=	5.87 ft
Eccentricity	=	6.01 in
Wall to Ftg CL Dist	=	5.87 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Design Summary

<b>Wall Stability Ratios</b>	
Overturning	= 1.92 OK
Sliding	= 1.57 OK
Total Bearing Load = 1,932 lbs	
...resultant ecc.	= 8.71 in
Soil Pressure @ Toe	= 1,663 psf OK
Soil Pressure @ Heel	= 0 psf OK
Allowable Soil Pressure Less Than Allowable	= 2,000 psf
ACI Factored @ Toe	= 2,328 psf
ACI Factored @ Heel	= 0 psf
Footing Shear @ Toe	= 7.0 psi OK
Footing Shear @ Heel	= 7.1 psi OK
Allowable	= 75.0 psi
<b>Sliding Calcs</b>	
Lateral Sliding Force	= 855.6 lbs
less 100% Passive Force	= - 763.9 lbs
less 100% Friction Force	= - 579.6 lbs
Added Force Req'd	= 0.0 lbs OK
....for 1.5 Stability	= 0.0 lbs OK

#### Stem Construction

<b>Design Height Above Ftg</b>	ft =	4.16	Stem OK
Wall Material Above "Ht"	=	Fence	Masonry
Design Method	=		LRFD
Thickness	=		8.00
Rebar Size	=		# 4
Rebar Spacing	=		16.00
Rebar Placed at	=		Edge
<b>Design Data</b>			
fb/FB + fa/Fa	=		0.473
<b>Total Force @ Section</b>			
Service Level	lbs =		
Strength Level	lbs =	90.2	767.3
<b>Moment....Actual</b>			
Service Level	ft-# =		
Strength Level	ft-# =	135.5	1,598.1
Moment....Allowable	ft-# =		3,368.0
<b>Shear.....Actual</b>			
Service Level	psi =		
Strength Level	psi =		8.4
Shear....Allowable	=		80.5
Anet (Masonry)	in2 =		91.50
Rebar Depth 'd'	in =		5.25
<b>Masonry Data</b>			
f'm	psi =		2,000
Fy	psi =		60,000
Solid Grouting	=		Yes
Modular Ratio 'n'	=		16.11
Wall Weight	psf =		78.0
Equiv. Solid Thick.	=		7.60
Masonry Block Type	=		Medium Weight
Masonry Design Method	=		LRFD
<b>Concrete Data</b>			
f'c	psi =		
Fy	psi =		

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.50 ft
Heel Width	=	2.50
Total Footing Width	=	3.00
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	8.00 in
Key Distance from Toe	=	0.50 ft
$f'c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm = 3.00 in

#### Footing Design Results

	Toe	Heel
Factored Pressure	= 2,328	0 psf
Mu' : Upward	= 270	259 ft-#
Mu' : Downward	= 71	1,645 ft-#
Mu: Design	= 199	1,386 ft-#
Actual 1-Way Shear	= 7.01	7.06 psi
Allow 1-Way Shear	= 40.00	40.00 psi
Toe Reinforcing	= None Spec'd	
Heel Reinforcing	= None Spec'd	
Key Reinforcing	= None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.60 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4 @ 11.90 in  
 #5 @ 18.45 in  
 #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in  
 #5 @ 36.90 in  
 #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 500.0	1.67	833.3	Soil Over Heel	= 990.0	2.08	2,062.5
Surcharge over Heel	=			Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	=		
Adjacent Footing Load	= 260.6	0.65	169.9	Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	= 95.0	6.58	625.3	* Axial Live Load on Stem	=		
	=			Soil Over Toe	= 67.5	0.25	16.9
				Surcharge Over Toe	=		
<b>Total</b>	<b>855.6</b>	<b>O.T.M.</b>	<b>1,628.4</b>	Stem Weight(s)	= 324.5	0.83	270.4
				Earth @ Stem Transitions	=		
				Footing Weight	= 450.0	1.50	675.0
<b>Resisting/Overturning Ratio</b>		=	<b>1.92</b>	Key Weight	= 100.0	1.00	100.0
Vertical Loads used for Soil Pressure	=	1,932.0 lbs		Vert. Component	=		
				<b>Total =</b>	<b>1,932.0 lbs</b>	<b>R.M.=</b>	<b>3,124.8</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.110 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

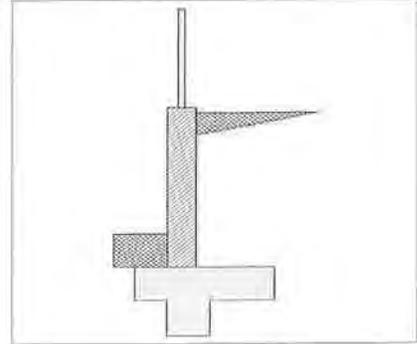
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	4.67 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footings  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	5,332.0 lbs
Footing Width	=	5.87 ft
Eccentricity	=	6.01 in
Wall to Ftg CL Dist	=	5.87 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	1.97 OK
Sliding	=	1.51 OK
Total Bearing Load	=	2,418 lbs
...resultant ecc.	=	8.34 in
Soil Pressure @ Toe	=	1,734 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable		2,000 psf
ACI Factored @ Toe	=	2,427 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	10.7 psi OK
Footing Shear @ Heel	=	7.5 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	1,187.2 lbs
less 100% Passive Force	= -	1,063.4 lbs
less 100% Friction Force	= -	725.3 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	2nd	Bottom	
Design Height Above Ftg	ft = 4.83	Stem OK	
Wall Material Above "Ht"	= Fence	Masonry	
Design Method	=	LRFD	LRFD
Thickness	=	8.00	
Rebar Size	=	# 4	
Rebar Spacing	=	16.00	
Rebar Placed at	=	Edge	

##### Design Data

fb/FB + fa/Fa	=	0.662
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	90.2 1,145.5
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	135.5 2,231.8
Moment....Allowable	ft-# =	3,368.0

##### Shear.....Actual

Service Level	psi =	
Strength Level	psi =	12.5
Shear....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25

##### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.75	ft
Heel Width	=	2.50	
Total Footing Width	=	3.25	
Footing Thickness	=	12.00	in
Key Width	=	12.00	in
Key Depth	=	13.00	in
Key Distance from Toe	=	0.75	ft
$f'c$	=	2,500	psi
$F_y$	=	60,000	psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0014	
Cover @ Top	=	2.00	@ Btm = 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,427	0 psf
Mu' : Upward	=	621	375 ft-#
Mu' : Downward	=	139	1,860 ft-#
Mu: Design	=	483	1,485 ft-#
Actual 1-Way Shear	=	10.66	7.48 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.66 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: If two layers of horizontal bars:  
 #4 @ 11.90 in #4 @ 23.81 in  
 #5 @ 18.45 in #5 @ 36.90 in  
 #6 @ 26.19 in #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			Moment ft-#		
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	643.0	1.89	1,215.2	Soil Over Heel	=	1,155.8	2.33	2,696.9
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=	449.2	0.90	406.2	Adjacent Footing Load	=	133.9	3.13	419.6
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	95.0	7.25	688.9	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	101.3	0.38	38.0
	=				Surcharge Over Toe	=			
<b>Total</b>		<b>1,187.2</b>	<b>O.T.M.</b>	<b>2,310.3</b>	Stem Weight(s)	=	376.7	1.08	408.1
	=				Earth @ Stem Transitions	=			
<b>Resisting/Overturning Ratio</b>				<b>= 1.97</b>	Footing Weight	=	487.5	1.63	792.2
Vertical Loads used for Soil Pressure	=			2,417.7 lbs	Key Weight	=	162.5	1.25	203.1
					Vert. Component	=			
					<b>Total =</b>		<b>2,417.7 lbs</b>	<b>R.M. =</b>	<b>4,558.0</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.116	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

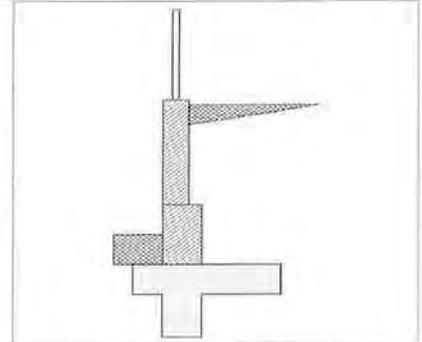
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	5.33 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	5,332.0 lbs
Footing Width	=	5.87 ft
Eccentricity	=	6.01 in
Wall to Ftg CL Dist	=	5.87 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	2.47 OK
Sliding	=	1.55 OK
Total Bearing Load	=	3,538 lbs
...resultant ecc.	=	6.49 in
Soil Pressure @ Toe	=	1,759 psf OK
Soil Pressure @ Heel	=	128 psf OK
Allowable Soil Pressure Less Than Allowable	=	2,000 psf
ACI Factored @ Toe	=	2,463 psf
ACI Factored @ Heel	=	179 psf
Footing Shear @ Toe	=	11.5 psi OK
Footing Shear @ Heel	=	4.3 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	1,549.8 lbs
less 100% Passive Force	= -	1,334.2 lbs
less 100% Friction Force	= -	1,061.3 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	3rd	2nd	Bottom
Design Height Above Ftg	ft = 5.50	Stem OK 2.00	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry	Masonry
Design Method	=	LRFD	LRFD
Thickness	=	8.00	12.00
Rebar Size	=	# 4	# 4
Rebar Spacing	=	16.00	16.00
Rebar Placed at	=	Edge	Edge

##### Design Data

fb/FB + fa/Fa	=	0.347	0.532
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##### Total Force @ Section

Service Level	lbs =			
Strength Level	lbs =	89.9	523.5	1,627.3

##### Moment....Actual

Service Level	ft-# =			
Strength Level	ft-# =	134.6	1,173.0	3,142.2
Moment.....Allowable	ft-# =		3,368.0	5,899.2

##### Shear.....Actual

Service Level	psi =			
Strength Level	psi =		5.7	11.7

Shear.....Allowable	=	80.5	80.5
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Anet (Masonry)	in2 =	91.50	139.50
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Rebar Depth 'd'	in =	5.25	9.00
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##### Masonry Data

f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	124.0

Equiv. Solid Thick.	=	7.60	11.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	

##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.75	ft
Heel Width	=	3.00	
Total Footing Width	=	3.75	
Footing Thickness	=	12.00	in
Key Width	=	12.00	in
Key Depth	=	17.00	in
Key Distance from Toe	=	0.75	ft
f'c =	2,500	psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0014	
Cover @ Top	2.00		@ Btm = 3.00 in

#### Footing Design Results

	Toe	Heel
Factored Pressure	= 2,463	179 psf
Mu' : Upward	= 650	1,169 ft-#
Mu' : Downward	= 160	2,609 ft-#
Mu: Design	= 489	1,439 ft-#
Actual 1-Way Shear	= 11.49	4.26 psi
Allow 1-Way Shear	= 40.00	40.00 psi
Toe Reinforcing	= None Spec'd	
Heel Reinforcing	= None Spec'd	
Key Reinforcing	= None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.76 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4 @ 11.90 in  
 #5 @ 18.45 in  
 #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in  
 #5 @ 36.90 in  
 #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 801.4	2.11	1,690.9	Soil Over Heel	= 1,439.1	2.75	3,957.5
Surcharge over Heel	=			Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	=		
Adjacent Footing Load	= 653.4	1.18	769.7	Adjacent Footing Load	= 551.3	3.22	1,774.4
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	= 95.0	7.91	751.6	* Axial Live Load on Stem	=		
	=			Soil Over Toe	= 101.3	0.38	38.0
				Surcharge Over Toe	=		
<b>Total</b>	<b>1,549.8</b>	<b>O.T.M.</b>	<b>3,212.2</b>	Stem Weight(s)	= 521.0	1.16	605.8
				Earth @ Stem Transitions	= 149.9	1.58	237.3
				Footing Weight	= 562.5	1.88	1,054.7
<b>Resisting/Overturning Ratio</b>		=	<b>2.47</b>	Key Weight	= 212.5	1.25	265.6
Vertical Loads used for Soil Pressure =		3,537.5 lbs		Vert. Component	=		
				<b>Total =</b>	<b>3,537.5 lbs</b>	<b>R.M.=</b>	<b>7,933.2</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.111 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



# ORCO 6'-0" TO 8'-0" HIGH RETAINING WALL W/ 2'-8" CMU AND 36" RAIL FOR 110 MPH 3 SEC. GUST @ EXP C

## SPECIAL INSPECTION NOTE:

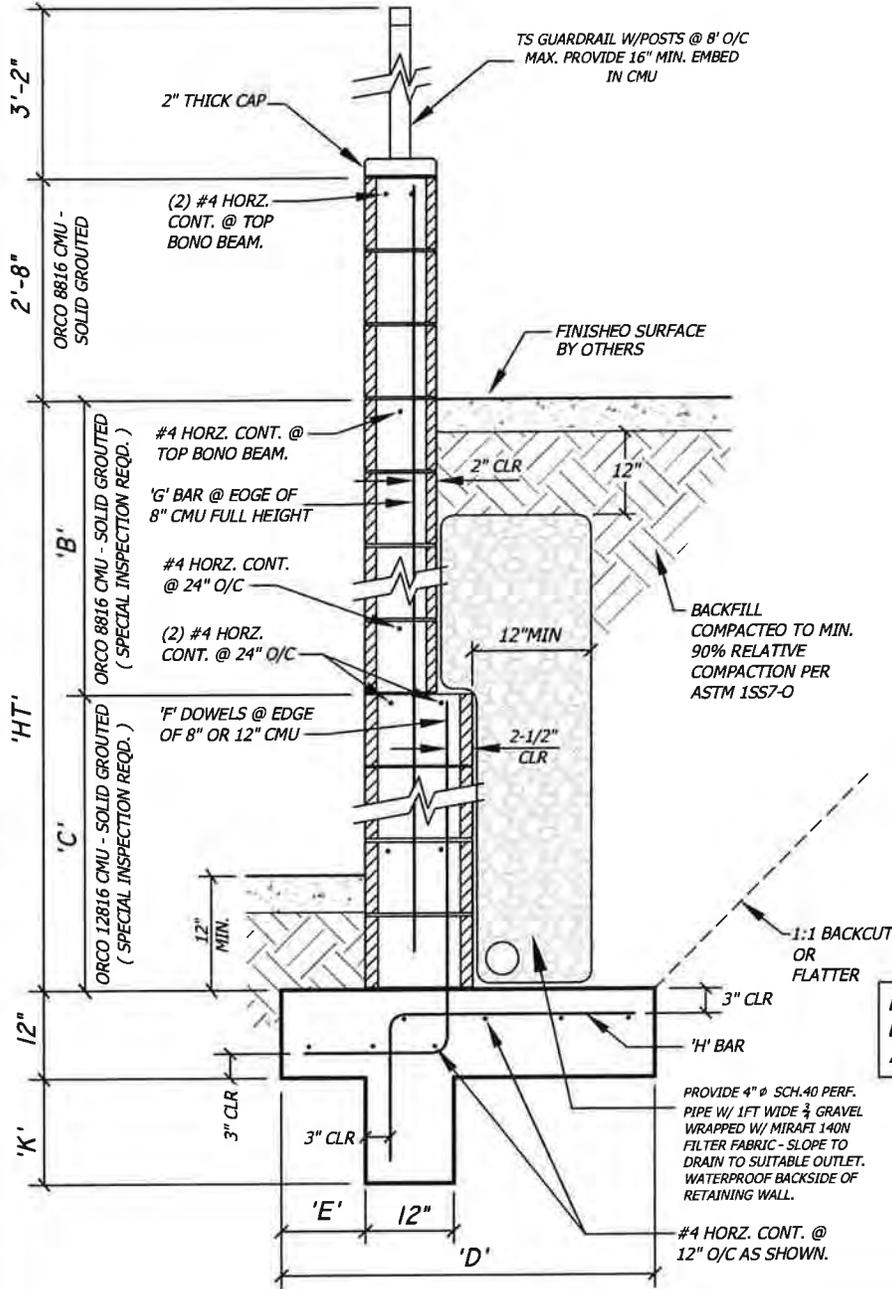
PROVIDE LEVEL 2 SPECIAL INSPECTION PER TMS 602-16 TABLES 3 AND 4 OF THE MASONRY STEM.

## DESIGN CRITERIA PER 2019 CBC:

1. ALLOWABLE SOIL BEARING PRESSURE FOR FOOTINGS = 2000 PSF PER SOILS REP.
2. EQUIVALENT FLUID PRESSURE FOR LEVEL BACKFILL = 40 PCF PER SOILS REPORT.
3. ALLOWABLE LATERAL PASSIVE PRESSURE = 250 PCF PER SOILS REPORT.
4. GROUT STRENGTH = 2000 PSI @ 28 DAYS & REINFORCING STEEL : GRADE 60.
5. EARTH COEFFICIENT OF FRICTION = 0.30.
6. 2000 PSI MASONRY COMPRESSION STRENGTH - SPECIAL INSPECTION REQUIRED.

## NOTES:

1. CONCRETE BLOCK SHALL BE MANUFACTURED BY ORCO ASTM C 90. WEOGELock BLOCK, SLUMP BLOCK AND SPLITFACE BLOCK ARE ACCEPTABLE.
2. CONCRETE FOR FOOTING SHALL BE 1 PART CEMENT TO 2-1/2 PARTS SAND TO 3-1/2 PARTS GRAVEL WITH A MAXIMUM OF 1-1/2 GALLONS OF WATER PER SACK. PORTLAND CEMENT SHALL CONFORM TO ASTM C 150 TYPE II/V.  $f_c = 2500$  PSI
3. REINFORCING STEEL SHALL BE DEFORMED AND CONFORM TO ASTM A 615 GRADE 60. PROVIDE 48 BAR DIAMETER LAP.
4. REBAR SHALL BE CENTERED IN THE CONCRETE BLOCK CELL IN WHICH IT IS LOCATED.
5. CONCRETE BLOCK SHALL BE LAID IN A RUNNING BOND PATTERN WITH VERTICAL CONTINUITY OF THE CELLS UNO.
6. ALL BLOCK CELLS SHALL BE SOLID GROUTED.
7. USE TYPE S MORTAR PROPORTIONED USING ASTM C 270 PART CEMENT TO 1/2 PART LIME TO 4-1/2 PARTS OAMP, LOOSE SAND.
8. GROUT FOR CONCRETE BLOCK PER ASTM C 476 TO BE 1 PART CEMENT TO 3 PARTS SAND (GROUT MAY CONTAIN 2 PARTS 3/8" PEA GRAVEL IF WEATHER CONDITIONS ARE FAVORABLE AND BLOCK UNOBSTRUCTED CELL SIZE IS SUFFICIENT TO ALLOW GOOD GROUT FLOW). WATER SHALL BE ADDED TO PRODUCE GOOD GROUT FLOW WITHOUT SEGREGATION OF THE CONSTITUENTS.
9. BLOCK STEM MAY BE WET-SET 1-1/2" INTO THE FOOTING WHILE THE CONCRETE IS PLASTIC. BLOCK STEM MAY BE PLACED TO EITHER EDGE OF THE TRENCH TYPE FOOTING.
10. FOOTING MUST BE POURED ON OR INTO UNOISTURBED NATURAL SOIL OR ON COMPACTED FILL WITH A MINIMUM COMPACTION OF 90%.
11. FIRST INSPECTION TO BE AFTER FOOTING TRENCHES ARE READY FOR CONCRETE AND ALL REQUIRED STEEL IS TIED IN PLACE. SECONO INSPECTION TO BE WHEN THE REQUIRED VERTICAL IS IN PLACE AND THE BLOCK WALL IS READY TO GROUT.
12. MAXIMUM CONTROL JOINT SPACING: 40' O/C. 20' O/C FOR WALLS TO BE MORTAR WASHED OR STUCCO COATED.



**ENGINEERING STAMP APPROVAL IS CONDITIONAL;  
REQUIRING USE OF ORCO MANUFACTURED CMU ON  
ALL ORCO WALL SYSTEM DESIGNS.**



'HT'	'B'	'C'	'D'	'E'	'F' DOWEL	'G' VERT	'H' BAR	'K'
6'-0"	3'-4"	2'-8"	4'-9"	1'-3"	#4@8" O/C 21" 41"	#4@16" O/C	#4@8" O/C 36" 20"	1'-2"
6'-8"	4'-0"	2'-8"	5'-9"	1'-6"	#4@8" O/C 24" 41"	#4@8" O/C	#4@8" O/C 45" 22"	1'-4"
7'-4"	4'-0"	3'-4"	6'-6"	1'-9"	#4@8" O/C 27" 49"	#4@8" O/C	#4@8" O/C 51" 24"	1'-6"
8'-0"	4'-0"	4'-0"	7'-0"	2'-0"	#5@8" O/C 30" 57"	#4@8" O/C	#5@8" O/C 54" 28"	1'-10"

TS-304

## WALL "D"

**CITY OF  
HERMOSA BEACH**  
PARKING LOT D  
HERMOSA BEACH, CALIFORNIA

**NOTE: DIMENSIONS ARE NOT TO SCALE.**

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### Cantilevered Retaining Wall

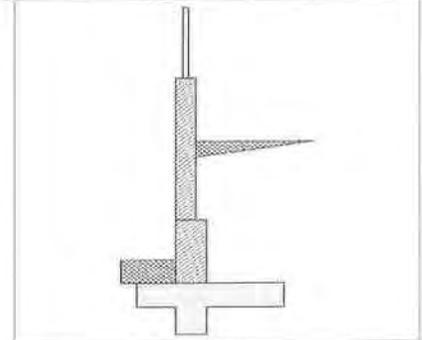
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	5.67 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	26.7 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	2.51 OK
Sliding	=	1.51 OK
Total Bearing Load	=	4,780 lbs
...resultant ecc.	=	8.19 in
Soil Pressure @ Toe	=	1,874 psf OK
Soil Pressure @ Heel	=	139 psf OK
Allowable Soil Pressure Less Than Allowable		2,000 psf
ACI Factored @ Toe	=	2,623 psf
ACI Factored @ Heel	=	195 psf
Footing Shear @ Toe	=	19.9 psi OK
Footing Shear @ Heel	=	17.5 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	1,693.0 lbs
less 100% Passive Force	= -	1,128.5 lbs
less 100% Friction Force	= -	1,434.1 lbs
Added Force Req'd	=	0.0 lbs OK
...for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	3rd	2nd	Bottom
Design Height Above Ftg	ft = 8.67	Stem OK 2.67	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry	Masonry
Design Method	=	LRFD	LRFD
Thickness	=	8.00	12.00
Rebar Size	=	# 4	# 4
Rebar Spacing	=	16.00	8.00
Rebar Placed at	=	Edge	Edge

##### Design Data

fb/FB + fa/Fa	=	0.627	0.541
---------------	---	-------	-------

##### Total Force @ Section

Service Level	lbs =			
Strength Level	lbs =	48.0	979.7	2,156.6

##### Moment....Actual

Service Level	ft-# =			
Strength Level	ft-# =	71.9	2,114.8	6,200.3
Moment....Allowable	ft-# =		3,368.0	11,446.9

##### Shear.....Actual

Service Level	psi =			
Strength Level	psi =		10.7	15.5
Shear.....Allowable	=		80.5	80.5
Anet (Masonry)	in2 =		91.50	139.50
Rebar Depth 'd'	in =		5.25	9.00

##### Masonry Data

f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	124.0

Equiv. Solid Thick.	=	7.60	11.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	

##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	1.25	ft
Heel Width	=	3.50	
Total Footing Width	=	4.75	
Footing Thickness	=	12.00	in
Key Width	=	12.00	in
Key Depth	=	14.00	in
Key Distance from Toe	=	1.25	ft
$f'c$	=	2,500	psi
$F_y$	=	60,000	psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0014	
Cover @ Top	=	2.00	in
		@ Btm	= 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,623	195 psf
Mu' : Upward	=	1,883	1,940 ft-#
Mu' : Downward	=	374	6,120 ft-#
Mu: Design	=	1,509	4,180 ft-#
Actual 1-Way Shear	=	19.87	17.50 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: #4 @ 11.89 in, #5 @ 18.44 in, #6 @ 26.18 in, #7 @ 35.70 in, #8 @ 47.01 in, #9 @ 5  
 Key: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.96 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4 @ 11.90 in, #5 @ 18.45 in, #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in, #5 @ 36.90 in, #6 @ 52.38 in

### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	980.0	2.33	2,286.7	Soil Over Heel	=	2,025.0	3.50	7,087.5
Surcharge over Heel	=	622.2	3.50	2,177.8	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	750.0	3.50	2,625.0
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	90.8	9.83	892.5	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	168.8	0.63	105.5
					Surcharge Over Toe	=			
<b>Total</b>		<b>1,693.0</b>	<b>O.T.M.</b>	<b>5,357.0</b>	Stem Weight(s)	=	799.1	1.65	1,320.4
					Earth @ Stem Transitions	=	149.9	2.08	312.2
<b>Resisting/Overturning Ratio</b>			<b>= 2.51</b>		Footing Weight	=	712.5	2.38	1,692.2
Vertical Loads used for Soil Pressure =			4,780.2 lbs		Key Weight	=	175.0	1.75	306.3
					Vert. Component	=			
					<b>Total =</b>		<b>4,780.2 lbs</b>	<b>R.M.=</b>	<b>13,449.0</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.128 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

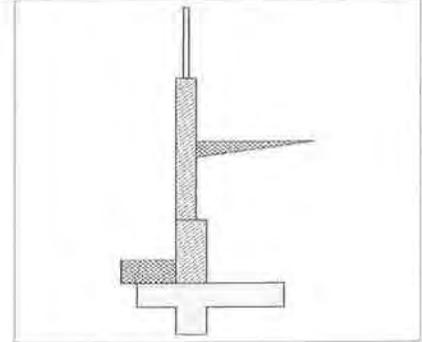
Code: CBC 2019, ACI 318-14, TMS 402-16

#### Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	5.67 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	26.7 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	1,500.0 lbs
Footing Width	=	2.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	2.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Design Summary

##### Wall Stability Ratios

Overturning	=	3.37 OK
Sliding	=	1.89 OK
Total Bearing Load	=	4,630 lbs
...resultant ecc.	=	4.93 in
Soil Pressure @ Toe	=	1,481 psf OK
Soil Pressure @ Heel	=	469 psf OK
Allowable Soil Pressure Less Than Allowable		2,000 psf
ACI Factored @ Toe	=	2,073 psf
ACI Factored @ Heel	=	656 psf
Footing Shear @ Toe	=	15.5 psi OK
Footing Shear @ Heel	=	2.6 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	1,328.7 lbs
less 100% Passive Force	= -	1,128.5 lbs
less 100% Friction Force	= -	1,389.1 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	3rd	2nd	Bottom
Design Height Above Ftg	ft = 8.67	Stem OK 2.67	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry	Masonry
Design Method	=	LRFD	LRFD
Thickness	=	8.00	12.00
Rebar Size	=	# 4	# 4
Rebar Spacing	=	16.00	8.00
Rebar Placed at	=	Edge	Edge

##### Design Data

fb/FB + fa/Fa	=	0.399	0.374
---------------	---	-------	-------

##### Total Force @ Section

Service Level	lbs =			
Strength Level	lbs =	48.0	575.6	1,666.3

##### Moment.....Actual

Service Level	ft-# =			
Strength Level	ft-# =	71.9	1,348.7	4,293.3
Moment.....Allowable	ft-# =		3,368.0	11,446.9

##### Shear.....Actual

Service Level	psi =			
Strength Level	psi =		6.3	11.9
Shear.....Allowable	=		80.5	80.5
Anet (Masonry)	in2 =		91.50	139.50
Rebar Depth 'd'	in =		5.25	9.00

##### Masonry Data

f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	124.0

Equiv. Solid Thick.	=	7.60	11.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	

##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	1.25	ft
Heel Width	=	3.50	
Total Footing Width	=	4.75	
Footing Thickness	=	12.00	in
Key Width	=	12.00	in
Key Depth	=	14.00	in
Key Distance from Toe	=	1.25	ft
$f'c$	=	2,500	psi
$F_y$	=	60,000	psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0014	
Cover @ Top	=	2.00	in
		@ Btm	= 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,073	656 psf
Mu' : Upward	=	1,523	2,827 ft-#
Mu' : Downward	=	374	4,320 ft-#
Mu: Design	=	1,149	1,493 ft-#
Actual 1-Way Shear	=	15.53	2.56 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None	Spec'd
Heel Reinforcing	=	None	Spec'd
Key Reinforcing	=	None	Spec'd

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.96 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4 @ 11.90 in  
 #5 @ 18.45 in  
 #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in  
 #5 @ 36.90 in  
 #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	980.0	2.33	2,286.7	Soil Over Heel	=	2,025.0	3.50	7,087.5
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=	257.9	2.53	651.5	Adjacent Footing Load	=	600.0	3.50	2,100.0
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	90.8	9.83	892.5	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	168.8	0.63	105.5
					Surcharge Over Toe	=			
<b>Total</b>		<b>1,328.7</b>	<b>O.T.M.</b>	<b>3,830.8</b>	Stem Weight(s)	=	799.1	1.65	1,320.4
					Earth @ Stem Transitions	=	149.9	2.08	312.2
<b>Resisting/Overturning Ratio</b>				<b>= 3.37</b>	Footing Weight	=	712.5	2.38	1,692.2
Vertical Loads used for Soil Pressure =				4,630.2 lbs	Key Weight	=	175.0	1.75	306.3
					Vert. Component	=			
					<b>Total =</b>		<b>4,630.2 lbs</b>	<b>R.M.=</b>	<b>12,924.0</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.101 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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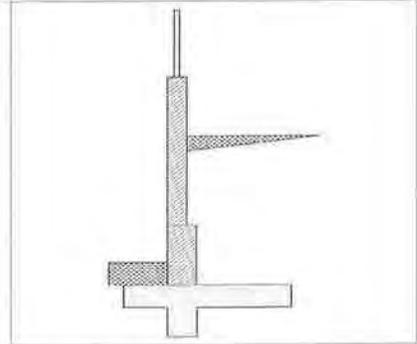
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	6.67 ft
Wall height above soil	=	5.67 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	26.7 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Design Summary

##### Wall Stability Ratios

Overturning	=	3.22 OK
Sliding	=	1.60 OK
Total Bearing Load	=	6,197 lbs
...resultant ecc.	=	6.26 in
Soil Pressure @ Toe	=	1,664 psf OK
Soil Pressure @ Heel	=	491 psf OK
Allowable Soil Pressure Less Than Allowable		2,000 psf
ACI Factored @ Toe	=	2,330 psf
ACI Factored @ Heel	=	688 psf
Footing Shear @ Toe	=	21.5 psi OK
Footing Shear @ Heel	=	16.8 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	1,948.7 lbs
less 100% Passive Force	= -	1,263.9 lbs
less 100% Friction Force	= -	1,859.0 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

#### Stem Construction

	3rd	2nd	Bottom	
Design Height Above Ftg	ft = 9.33	Stem OK 2.67	Stem OK 0.00	
Wall Material Above "Ht"	= Fence	Masonry	Masonry	
Design Method	=	LRFD	LRFD	
Thickness	=	8.00	12.00	
Rebar Size	=	# 4	# 4	
Rebar Spacing	=	8.00	8.00	
Rebar Placed at	=	Edge	Edge	
Design Data				
fb/FB + fa/Fa	=	0.446	0.677	
Total Force @ Section				
Service Level	lbs =			
Strength Level	lbs =	48.1	1,231.8	2,523.0
Moment....Actual				
Service Level	ft-# =			
Strength Level	ft-# =	72.3	2,852.9	7,764.0
Moment....Allowable	ft-# =		6,384.4	11,446.9
Shear.....Actual				
Service Level	psi =			
Strength Level	psi =		13.5	18.1
Shear.....Allowable	=		80.5	80.5
Anet (Masonry)	in2 =		91.50	139.50
Rebar Depth 'd'	in =		5.25	9.00
Masonry Data				
f'm	psi =		2,000	2,000
Fy	psi =		60,000	60,000
Solid Grouting	=		Yes	Yes
Modular Ratio 'n'	=		16.11	16.11
Wall Weight	psf =		78.0	124.0
Equiv. Solid Thick.	=		7.60	11.60
Masonry Block Type	=		Medium Weight	
Masonry Design Method	=		LRFD	
Concrete Data				
f'c	psi =			
Fy	psi =			



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	1.50	ft
Heel Width	=	4.25	
Total Footing Width	=	5.75	
Footing Thickness	=	12.00	in
Key Width	=	12.00	in
Key Depth	=	16.00	in
Key Distance from Toe	=	1.50	ft
f'c	=	2,500	psi
Fy	=	60,000	psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0014	
Cover @ Top	=	2.00	
	@ Btm	=	3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,330	688 psf
Mu' : Upward	=	2,460	5,266 ft-#
Mu' : Downward	=	513	10,605 ft-#
Mu: Design	=	1,947	5,340 ft-#
Actual 1-Way Shear	=	21.49	16.78 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $\mu < \phi \cdot 5 \cdot \lambda \cdot \sqrt{f'c} \cdot S_m$   
 Heel: #4@ 11.89 in, #5@ 18.44 in, #6@ 26.18 in, #7@ 35.70 in, #8@ 47.01 in, #9@ 5  
 Key: Not req'd:  $\mu < \phi \cdot 5 \cdot \lambda \cdot \sqrt{f'c} \cdot S_m$

Min footing T&S reinf Area 1.16 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup>/ft  
 If one layer of horizontal bars: #4@ 11.90 in, #5@ 18.45 in, #6@ 26.19 in  
 If two layers of horizontal bars: #4@ 23.81 in, #5@ 36.90 in, #6@ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	1,176.3	2.56	3,006.9	Soil Over Heel	=	2,926.0	4.13	12,069.8
Surcharge over Heel	=	681.7	3.83	2,613.9	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	975.0	4.13	4,021.9
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	90.8	10.50	953.3	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	202.5	0.75	151.9
					Surcharge Over Toe	=			
<b>Total</b>		<b>1,948.7</b>	<b>O.T.M.</b>	<b>6,574.1</b>	Stem Weight(s)	=	850.6	1.90	1,614.5
					Earth @ Stem Transitions	=	180.0	2.33	419.9
					Footing Weight	=	862.5	2.88	2,479.7
<b>Resisting/Overturning Ratio</b>			=	<b>3.22</b>	Key Weight	=	200.0	2.00	400.0
Vertical Loads used for Soil Pressure =				6,196.5 lbs	Vert. Component	=			
					<b>Total =</b>		<b>6,196.5 lbs</b>	<b>R.M.=</b>	<b>21,157.7</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.099 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe because the wall would then tend to rotate into the retained soil.



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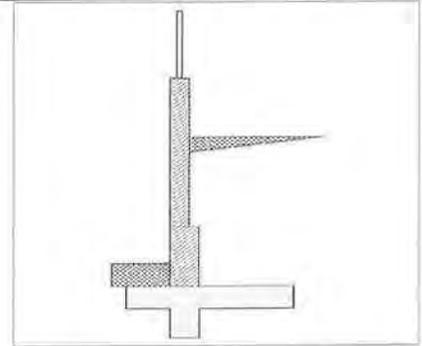
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	6.67 ft
Wall height above soil	=	5.67 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	0.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Earth Pressure Seismic Load

Method : Inverted Triangular

Load at top of Inverted Triangular Distribution (Strength)	=	162.000 psf	Total Strength-Level Seismic Load. ....	=	621.189 lbs
			Total Service-Level Seismic Load. ....	=	434.832 lbs

#### Design Summary

<b>Wall Stability Ratios</b>	
Overturning	= 2.70 OK
Sliding	= 1.36 Ratio < 1.5!
Total Bearing Load	= 6,197 lbs
...resultant ecc.	= 8.72 in
Soil Pressure @ Toe	= 1,895 psf OK
Soil Pressure @ Heel	= 261 psf OK
Allowable	= 2,000 psf
Soil Pressure Less Than Allowable	
ACI Factored @ Toe	= 2,652 psf
ACI Factored @ Heel	= 365 psf
Footing Shear @ Toe	= 24.5 psi OK
Footing Shear @ Heel	= 20.8 psi OK
Allowable	= 75.0 psi
<b>Sliding Calcs</b>	
Lateral Sliding Force	= 2,292.8 lbs
less 100% Passive Force	= - 1,263.9 lbs
less 100% Friction Force	= - 1,859.0 lbs
Added Force Req'd	= 0.0 lbs OK
....for 1.5 Stability	= 316.3 lbs NG

#### Stem Construction

	3rd	2nd	Bottom
Design Height Above Ftg	ft = 9.33	Stem OK 2.67	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry	Masonry
Design Method	=	LRFD	LRFD
Thickness	=	8.00	12.00
Rebar Size	=	# 4	# 4
Rebar Spacing	=	8.00	8.00
Rebar Placed at	=	Edge	Edge
<b>Design Data</b>			
fb/FB + fa/Fa	=	0.452	0.775
<b>Total Force @ Section</b>			
Service Level	lbs =		
Strength Level	lbs =	1,559.4	2,982.3
<b>Moment....Actual</b>			
Service Level	ft-# =		
Strength Level	ft-# =	2,889.6	8,884.8
Moment....Allowable	ft-# =	6,384.4	11,446.9
<b>Shear....Actual</b>			
Service Level	psi =		
Strength Level	psi =	17.0	21.4
Shear....Allowable	=	80.5	80.5
Anet (Masonry)	in <sup>2</sup> =	91.50	139.50
Rebar Depth 'd'	in =	5.25	9.00

#### Masonry Data

f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	124.0
Equiv. Solid Thick.	=	7.60	11.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	

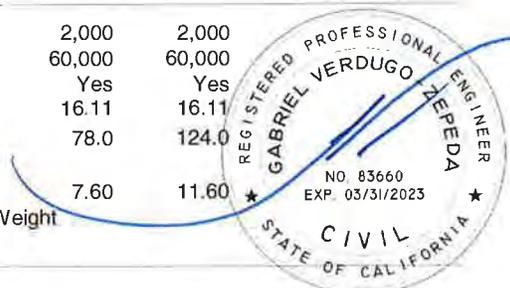
#### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	1.50 ft
Heel Width	=	4.25
Total Footing Width	=	5.75
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	16.00 in
Key Distance from Toe	=	1.50 ft
$f'_c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	=	2.00
@ Btm	=	3.00 in

#### Footing Design Results

	Toe	Heel
Factored Pressure	= 2,652	365 psf
Mu' : Upward	= 2,760	4,204 ft-#
Mu' : Downward	= 513	10,605 ft-#
Mu: Design	= 2,247	6,401 ft-#
Actual 1-Way Shear	= 24.48	20.78 psi
Allow 1-Way Shear	= 40.00	75.00 psi
Toe Reinforcing	=	None Spec'd
Heel Reinforcing	=	None Spec'd
Key Reinforcing	=	None Spec'd

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'_c} * S_m$   
 Heel: #4@ 11.61 in, #5@ 18.00 in, #6@ 25.55 in, #7@ 34.84 in, #8@ 45.88 in, #9@ 5  
 Key: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'_c} * S_m$

Min footing T&S reinf Area 1.16 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup>/ft  
 If one layer of horizontal bars: #4@ 11.90 in, #5@ 18.45 in, #6@ 26.19 in  
 If two layers of horizontal bars: #4@ 23.81 in, #5@ 36.90 in, #6@ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 1,176.3	2.56	3,006.9	Soil Over Heel	= 2,926.0	4.13	12,069.8
Surcharge over Heel	= 681.7	3.83	2,613.9	Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	= 975.0	4.13	4,021.9
Adjacent Footing Load	=			Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	=			* Axial Live Load on Stem	=		
Seismic Earth Load	= 434.8	5.11	2,223.2	Soil Over Toe	= 202.5	0.75	151.9
	=			Surcharge Over Toe	=		
<b>Total</b>	<b>2,292.8</b>	<b>O.T.M.</b>	<b>7,844.0</b>	Stem Weight(s)	= 850.6	1.90	1,614.5
	=	=		Earth @ Stem Transitions	= 180.0	2.33	419.9
<b>Resisting/Overturning Ratio</b>		<b>= 2.70</b>		Footing Weight	= 862.5	2.88	2,479.7
Vertical Loads used for Soil Pressure	=	6,196.5 lbs		Key Weight	= 200.0	2.00	400.0
				Vert. Component	=		
				<b>Total =</b>	<b>6,196.5 lbs</b>	<b>R.M.=</b>	<b>21,157.7</b>

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.113	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

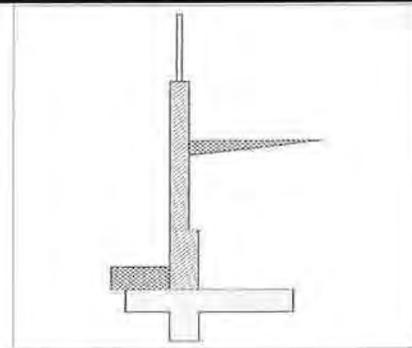
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	6.67 ft
Wall height above soil	=	5.67 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	0.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	1,500.0 lbs
Footing Width	=	2.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	2.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Earth Pressure Seismic Load

Method : Inverted Triangular

Load at top of Inverted Triangular Distribution ..... = 162.000 psf  
 (Strength)

Total Strength-Level Seismic Load. .... = 621.189 lbs  
 Total Service-Level Seismic Load. .... = 434.832 lbs

#### Design Summary

##### Wall Stability Ratios

Overturning	=	3.31 OK
Sliding	=	1.62 OK

Total Bearing Load	=	5,935 lbs
...resultant ecc.	=	6.15 in

Soil Pressure @ Toe	=	1,584 psf OK
Soil Pressure @ Heel	=	480 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		

ACI Factored @ Toe	=	2,218 psf
ACI Factored @ Heel	=	672 psf

Footing Shear @ Toe	=	20.3 psi OK
Footing Shear @ Heel	=	4.3 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	1,882.9 lbs
less 100% Passive Force	= -	1,263.9 lbs
less 100% Friction Force	= -	1,780.4 lbs
Added Force Req'd	=	0.0 lbs OK
...for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	3rd	2nd	Bottom
Design Height Above Ftg	ft= 9.33	Stem OK 2.67	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry	Masonry
Design Method	=	LRFD	LRFD
Thickness	=	8.00	12.00
Rebar Size	=	# 4	# 4
Rebar Spacing	=	8.00	8.00
Rebar Placed at	=	Edge	Edge

##### Design Data

fb/FB + fa/Fa	=	0.289	0.578
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##### Total Force @ Section

Service Level	lbs =		
Strength Level	lbs =	1,153.7	2,432.6

##### Moment....Actual

Service Level	ft-# =		
Strength Level	ft-# =	1,852.4	6,630.4
Moment....Allowable	ft-# =	6,384.4	11,446.9

##### Shear....Actual

Service Level	psi =		
Strength Level	psi =	12.6	17.4

Shear....Allowable	=	80.5	80.5
Anet (Masonry)	in2 =	91.50	139.50
Rebar Depth 'd'	in =	5.25	9.00

##### Masonry Data

f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	124.0

Equiv. Solid Thick.	=	7.60	11.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	

##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	1.50	ft
Heel Width	=	4.25	
Total Footing Width	=	5.75	
Footing Thickness	=	12.00	in
Key Width	=	12.00	in
Key Depth	=	16.00	in
Key Distance from Toe	=	1.50	ft
$f'c$	=	2,500	psi
$F_y$	=	60,000	psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0014	
Cover @ Top	2.00	@ Btm	= 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,218	672 psf
Mu' : Upward	=	2,344	5,087 ft-#
Mu' : Downward	=	513	7,680 ft-#
Mu: Design	=	1,831	2,594 ft-#
Actual 1-Way Shear	=	20.26	4.32 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: #4 @ 11.89 in, #5 @ 18.44 in, #6 @ 26.18 in, #7 @ 35.70 in, #8 @ 47.01 in, #9 @ 5  
 Key: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 1.16 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup>/ft  
 If one layer of horizontal bars: #4 @ 11.90 in, #5 @ 18.45 in, #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in, #5 @ 36.90 in, #6 @ 52.38 in

### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	1,176.3	2.56	3,006.9	Soil Over Heel	=	2,926.0	4.13	12,069.8
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=	271.8	3.05	828.8	Adjacent Footing Load	=	713.3	4.13	2,942.3
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=				* Axial Live Load on Stem	=			
Seismic Earth Load	=	434.8	5.11	2,223.2	Soil Over Toe	=	202.5	0.75	151.9
	=				Surcharge Over Toe	=			
<b>Total</b>		<b>1,882.9</b>	<b>O.T.M.</b>	<b>6,058.9</b>	Stem Weight(s)	=	850.6	1.90	1,614.5
	=				Earth @ Stem Transitions	=	180.0	2.33	419.9
<b>Resisting/Overturning Ratio</b>			=	<b>3.31</b>	Footing Weight	=	862.5	2.88	2,479.7
Vertical Loads used for Soil Pressure =		5,934.8	lbs		Key Weight	=	200.0	2.00	400.0
					Vert. Component	=			
					<b>Total =</b>		<b>5,934.8 lbs</b>	<b>R.M.=</b>	<b>20,078.2</b>

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.094	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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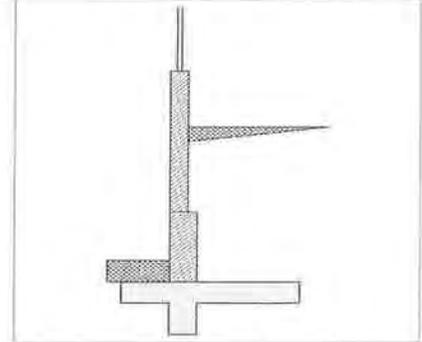
Code: CBC 2019, ACI 318-14, TMS 402-16

#### Criteria

Retained Height	=	7.33 ft
Wall height above soil	=	5.67 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	3.61 OK
Sliding	=	1.63 OK

Total Bearing Load	=	7,387 lbs
...resultant ecc.	=	5.25 in

Soil Pressure @ Toe	=	1,595 psf OK
Soil Pressure @ Heel	=	677 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		

ACI Factored @ Toe	=	2,234 psf
ACI Factored @ Heel	=	948 psf

Footing Shear @ Toe	=	28.6 psi OK
Footing Shear @ Heel	=	17.4 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	2,220.3 lbs
less 100% Passive Force	= -	1,406.3 lbs
less 100% Friction Force	= -	2,216.1 lbs

Added Force Req'd	=	0.0 lbs OK
...for 1.5 Stability	=	0.0 lbs OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	26.7 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Stem Construction

##### Design Height Above Ftg

ft =	10.00	Stem OK	Stem OK
Wall Material Above "Ht"	=	Fence	Masonry
Design Method	=	LRFD	LRFD
Thickness	=	8.00	12.00
Rebar Size	=	# 4	# 4
Rebar Spacing	=	8.00	8.00
Rebar Placed at	=	Edge	Edge

##### Design Data

fb/FB + fa/Fa	=	0.447	0.835
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##### Total Force @ Section

Service Level	lbs =		
Strength Level	lbs =	48.0	1,233.4
2,914.9			

##### Moment...Actual

Service Level	ft-# =		
Strength Level	ft-# =	72.0	2,857.9
9,567.8			
Moment...Allowable	ft-# =	6,384.4	11,446.9

##### Shear...Actual

Service Level	psi =		
Strength Level	psi =	13.5	20.9
80.5			
Shear...Allowable	=	80.5	80.5
Anet (Masonry)	in2 =	91.50	139.50
Rebar Depth 'd'	in =	5.25	9.00

##### Masonry Data

f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	124.0

Equiv. Solid Thick.	=	7.60	11.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	

##### Concrete Data

fc	psi =	
Fy	psi =	



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width = 1.75 ft  
 Heel Width = 4.75  
 Total Footing Width = 6.50  
 Footing Thickness = 12.00 in  
 Key Width = 12.00 in  
 Key Depth = 18.00 in  
 Key Distance from Toe = 1.75 ft  
 f'c = 2,500 psi Fy = 60,000 psi  
 Footing Concrete Density = 150.00 pcf  
 Min. As % = 0.0014  
 Cover @ Top 2.00 @ Btm= 3.00 in

#### Footing Design Results

	Toe	Heel
Factored Pressure =	2,234	948 psf
Mu' : Upward =	3,244	8,407 ft-#
Mu' : Downward =	673	14,726 ft-#
Mu: Design =	2,570	6,319 ft-#
Actual 1-Way Shear =	28.56	17.39 psi
Allow 1-Way Shear =	75.00	75.00 psi
Toe Reinforcing =	None Spec'd	
Heel Reinforcing =	None Spec'd	
Key Reinforcing =	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: #4@ 11.89 in, #5@ 18.44 in, #6@ 26.18 in, #7@ 35.70 in, #8@ 47.01 in, #9@ 5  
 Heel: #4@ 11.76 in, #5@ 18.23 in, #6@ 25.88 in, #7@ 35.30 in, #8@ 46.48 in, #9@ 5  
 Key: Not req'd:  $\mu < \phi \cdot 5 \cdot \lambda \cdot \sqrt{f'c} \cdot S_m$

Min footing T&S reinf Area 1.31 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup>/ft  
 If one layer of horizontal bars: #4@ 11.90 in, #5@ 18.45 in, #6@ 26.19 in  
 If two layers of horizontal bars: #4@ 23.81 in, #5@ 36.90 in, #6@ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure =	1,388.8	2.78	3,857.6	Soil Over Heel =	3,712.3	4.63	17,169.5
Surcharge over Heel =	740.7	4.17	3,086.2	Sloped Soil Over Heel =			
Surcharge Over Toe =				Surcharge Over Heel =	1,125.0	4.63	5,203.1
Adjacent Footing Load =				Adjacent Footing Load =			
Added Lateral Load =				Axial Dead Load on Stem =			
Load @ Stem Above Soil =	90.8	11.17	1,013.5	* Axial Live Load on Stem =			
				Soil Over Toe =	236.3	0.88	206.7
				Surcharge Over Toe =			
				Stem Weight(s) =	933.2	2.16	2,012.9
<b>Total</b>	<b>2,220.3</b>	<b>O.T.M.</b>	<b>7,957.3</b>	Earth @ Stem Transitions =	180.1	2.58	465.3
				Footing Weight =	975.0	3.25	3,168.8
<b>Resisting/Overturning Ratio</b>		=	<b>3.61</b>	Key Weight =	225.0	2.25	506.3
Vertical Loads used for Soil Pressure =		7,386.9 lbs		Vert. Component =			
				<b>Total =</b>	<b>7,386.9 lbs</b>	<b>R.M.=</b>	<b>28,732.7</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.089 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe because the wall would then tend to rotate into the retained soil.



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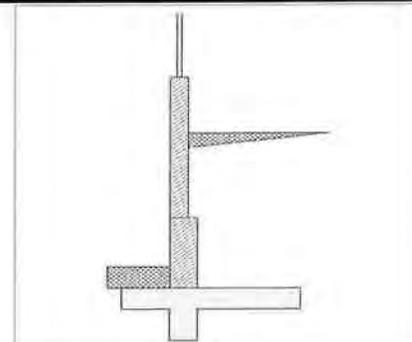
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height = 7.33 ft  
 Wall height above soil = 5.67 ft  
 Slope Behind Wall = 0.00  
 Height of Soil over Toe = 12.00 in  
 Water height over heel = 0.0 ft

#### Soil Data

Allow Soil Bearing = 2,000.0 psf  
 Equivalent Fluid Pressure Method  
 Active Heel Pressure = 40.0 psf/ft  
 Passive Pressure = 250.0 psf/ft  
 Soil Density, Heel = 135.00 pcf  
 Soil Density, Toe = 135.00 pcf  
 Footing||Soil Friction = 0.300  
 Soil height to ignore for passive pressure = 12.00 in



#### Surcharge Loads

Surcharge Over Heel = 300.0 psf  
 Used To Resist Sliding & Overturning  
 Surcharge Over Toe = 0.0 psf  
 Used for Sliding & Overturning

#### Lateral Load Applied to Stem

Lateral Load = 0.0 #/ft  
 ...Height to Top = 0.00 ft  
 ...Height to Bottom = 0.00 ft  
 Load Type = Wind (W)  
 (Strength Level)  
 Wind on Exposed Stem = 0.0 psf  
 (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load = 0.0 lbs  
 Footing Width = 0.00 ft  
 Eccentricity = 0.00 in  
 Wall to Ftg CL Dist = 0.00 ft  
 Footing Type = Line Load  
 Base Above/Below Soil at Back of Wall = 0.0 ft  
 Poisson's Ratio = 0.300

#### Axial Load Applied to Stem

Axial Dead Load = 0.0 lbs  
 Axial Live Load = 0.0 lbs  
 Axial Load Eccentricity = 0.0 in

#### Earth Pressure Seismic Load

Method : Inverted Triangular

Load at top of Inverted Triangular Distribution (Strength) = 178.200 psf

Total Strength-Level Seismic Load. .... = 742.470 lbs  
 Total Service-Level Seismic Load. .... = 519.729 lbs

#### Design Summary

##### Wall Stability Ratios

Overturning = 2.92 OK  
 Sliding = 1.37 Ratio < 1.5!

Total Bearing Load = 7,387 lbs  
 ...resultant ecc. = 8.29 in

Soil Pressure @ Toe = 1,862 psf OK  
 Soil Pressure @ Heel = 411 psf OK  
 Allowable = 2,000 psf  
 Soil Pressure Less Than Allowable

ACI Factored @ Toe = 2,606 psf  
 ACI Factored @ Heel = 576 psf

Footing Shear @ Toe = 33.2 psi OK  
 Footing Shear @ Heel = 22.6 psi OK  
 Allowable = 75.0 psi

##### Sliding Calcs

Lateral Sliding Force = 2,649.2 lbs  
 less 100% Passive Force = - 1,406.3 lbs  
 less 100% Friction Force = - 2,216.1 lbs  
 Added Force Req'd = 0.0 lbs OK  
 ....for 1.5 Stability = 351.5 lbs NG

#### Stem Construction

	3rd	2nd	Bottom
Design Height Above Ftg	ft = 10.00	Stem OK 3.33	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry	Masonry
Design Method	=	LRFD	LRFD
Thickness	=	8.00	12.00
Rebar Size	=	# 4	# 4
Rebar Spacing	=	8.00	8.00
Rebar Placed at	=	Edge	Edge

##### Design Data

fb/FB + fa/Fa = 0.472 0.996

##### Total Force @ Section

Service Level lbs =  
 Strength Level lbs = 1,624.1 3,495.4

##### Moment....Actual

Service Level ft-# =  
 Strength Level ft-# = 3,022.8 11,415.7  
 Moment....Allowable ft-# = 6,384.4 11,446.9

##### Shear.....Actual

Service Level psi =  
 Strength Level psi = 17.7 25.1

##### Shear.....Allowable

= 80.5 80.5  
 Anet (Masonry) in2 = 91.50 139.50  
 Rebar Depth 'd' in = 5.25 9.00

##### Masonry Data

f'm psi = 2,000 2,000  
 Fy psi = 60,000 60,000  
 Solid Grouting = Yes Yes  
 Modular Ratio 'n' = 16.11 16.11  
 Wall Weight psf = 78.0 124.0

Equiv. Solid Thick. = 7.60 11.60  
 Masonry Block Type = Medium Weight  
 Masonry Design Method = LRFD

##### Concrete Data

f'c psi =  
 Fy psi =

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

Building Code CBC 2019,ACI  
 Dead Load 1.200  
 Live Load 1.600  
 Earth, H 1.600  
 Wind, W 1.000  
 Seismic, E 1.000



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**Cantilevered Retaining Wall**

Code: CBC 2019, ACI 318-14, TMS 402-16

**Footing Dimensions & Strengths**

Toe Width	=	1.75	ft
Heel Width	=	4.75	
Total Footing Width	=	6.50	
Footing Thickness	=	12.00	in
Key Width	=	12.00	in
Key Depth	=	18.00	in
Key Distance from Toe	=	1.75	ft
$f'c$	=	2,500	psi
$F_y$	=	60,000	psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0014	
Cover @ Top	=	2.00	@ Btm = 3.00 in

**Footing Design Results**

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	2,606	576 psf
Mu' : Upward	=	3,712	6,795 ft-#
Mu' : Downward	=	673	14,726 ft-#
Mu: Design	=	3,038	7,931 ft-#
Actual 1-Way Shear	=	33.23	22.58 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

**Other Acceptable Sizes & Spacings**

Toe: #4@ 11.89 in, #5@ 18.44 in, #6@ 26.18 in, #7@ 35.70 in, #8@ 47.01 in, #9@ 5  
 Heel: #4@ 9.37 in, #5@ 14.52 in, #6@ 20.62 in, #7@ 28.12 in, #8@ 37.03 in, #9@ 46  
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 1.31 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4@ 11.90 in, #5@ 18.45 in, #6@ 26.19 in  
 If two layers of horizontal bars: #4@ 23.81 in, #5@ 36.90 in, #6@ 52.38 in

**Summary of Overturning & Resisting Forces & Moments**

Item	.....OVERTURNING.....			.....RESISTING.....			Moment ft-#		
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	1,388.8	2.78	3,857.6	Soil Over Heel	=	3,712.3	4.63	17,169.5
Surcharge over Heel	=	740.7	4.17	3,086.2	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	1,125.0	4.63	5,203.1
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=				* Axial Live Load on Stem	=			
Seismic Earth Load	=	519.7	5.56	2,887.3	Soil Over Toe	=	236.3	0.88	206.7
	=				Surcharge Over Toe	=			
<b>Total</b>		<b>2,649.2</b>	<b>O.T.M.</b>	<b>9,831.0</b>	Stem Weight(s)	=	933.2	2.16	2,012.9
	=				Earth @ Stem Transitions	=	180.1	2.58	465.3
<b>Resisting/Overturning Ratio</b>			<b>= 2.92</b>		Footing Weight	=	975.0	3.25	3,168.8
Vertical Loads used for Soil Pressure =			7,386.9 lbs		Key Weight	=	225.0	2.25	506.3
					Vert. Component	=			
					<b>Total =</b>	<b>7,386.9 lbs</b>	<b>R.M.=</b>	<b>28,732.7</b>	

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

**Tilt**

**Horizontal Deflection at Top of Wall due to settlement of soil**

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.103	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

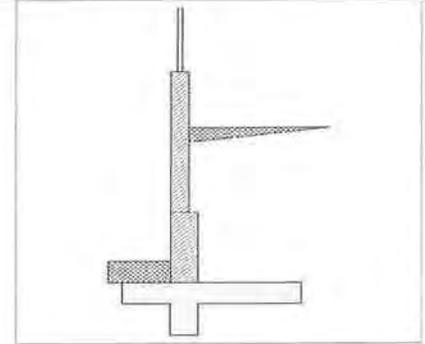
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	7.33 ft
Wall height above soil	=	5.67 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	0.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	1,500.0 lbs
Footing Width	=	2.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	2.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Earth Pressure Seismic Load

Method : Inverted Triangular

Load at top of Inverted Triangular Distribution (Strength)	=	178.200 psf	Total Strength-Level Seismic Load.....	=	742.470 lbs
			Total Service-Level Seismic Load.....	=	519.729 lbs

#### Design Summary

<b>Wall Stability Ratios</b>	
Overturning	= 3.49 OK
Sliding	= 1.60 OK
Total Bearing Load = 7,020 lbs	
...resultant ecc.	= 6.05 in
Soil Pressure @ Toe	= 1,582 psf OK
Soil Pressure @ Heel	= 578 psf OK
Allowable	= 2,000 psf
Soil Pressure Less Than Allowable	
ACI Factored @ Toe	= 2,215 psf
ACI Factored @ Heel	= 809 psf
Footing Shear @ Toe	= 28.0 psi OK
Footing Shear @ Heel	= 5.0 psi OK
Allowable	= 75.0 psi
<b>Sliding Calcs</b>	
Lateral Sliding Force	= 2,190.6 lbs
less 100% Passive Force	= - 1,406.3 lbs
less 100% Friction Force	= - 2,106.1 lbs
Added Force Req'd	= 0.0 lbs OK
....for 1.5 Stability	= 0.0 lbs OK

#### Stem Construction

	3rd	2nd	Bottom
Design Height Above Ftg	ft = 10.00	Stem OK 3.33	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry	Masonry
Design Method	=	LRFD	LRFD
Thickness	=	8.00	12.00
Rebar Size	=	# 4	# 4
Rebar Spacing	=	8.00	8.00
Rebar Placed at	=	Edge	Edge
<b>Design Data</b>			
fb/FB + fa/Fa	=	0.310	0.765
<b>Total Force @ Section</b>			
Service Level	lbs =		
Strength Level	lbs =	1,218.3	2,877.1
<b>Moment....Actual</b>			
Service Level	ft-# =		
Strength Level	ft-# =	1,984.1	8,773.5
Moment....Allowable	ft-# =	6,384.4	11,446.9
<b>Shear....Actual</b>			
Service Level	psi =		
Strength Level	psi =	13.3	20.6
Shear....Allowable	=	80.5	80.5
Anet (Masonry)	in <sup>2</sup> =	91.50	139.50
Rebar Depth 'd'	in =	5.25	9.00

#### Masonry Data

f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	124.0
Equiv. Solid Thick.	=	7.60	11.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	

#### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	1.75	ft
Heel Width	=	4.75	
Total Footing Width	=	6.50	
Footing Thickness	=	12.00	in
Key Width	=	12.00	in
Key Depth	=	18.00	in
Key Distance from Toe	=	1.75	ft
$f_c$	=	2,500	psi
$F_y$	=	60,000	psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0014	
Cover @ Top	2.00	@ Btm	= 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,215	809 psf
Mu' : Upward	=	3,199	7,589 ft-#
Mu' : Downward	=	673	10,901 ft-#
Mu: Design	=	2,526	3,312 ft-#
Actual 1-Way Shear	=	27.96	5.04 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: #4@ 11.89 in, #5@ 18.44 in, #6@ 26.18 in, #7@ 35.70 in, #8@ 47.01 in, #9@ 5  
 Heel: #4@ 11.89 in, #5@ 18.44 in, #6@ 26.18 in, #7@ 35.70 in, #8@ 47.01 in, #9@ 5  
 Key: Not req'd:  $\mu < \phi^5 \lambda \sqrt{f_c} S_m$

Min footing T&S reinf Area 1.31 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup>/ft  
 If one layer of horizontal bars: #4@ 11.90 in, #5@ 18.45 in, #6@ 26.19 in  
 If two layers of horizontal bars: #4@ 23.81 in, #5@ 36.90 in, #6@ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 1,388.8	2.78	3,857.6	Soil Over Heel	= 3,712.3	4.63	17,169.5
Surcharge over Heel	=			Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	=		
Adjacent Footing Load	= 282.1	3.59	1,013.2	Adjacent Footing Load	= 758.4	4.63	3,507.8
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	=			* Axial Live Load on Stem	=		
Seismic Earth Load	= 519.7	5.56	2,887.3	Soil Over Toe	= 236.3	0.88	206.7
	=			Surcharge Over Toe	=		
<b>Total</b>	<b>2,190.6</b>	<b>O.T.M.</b>	<b>7,758.0</b>	Stem Weight(s)	= 933.2	2.16	2,012.9
	=	=		Earth @ Stem Transitions	= 180.1	2.58	465.3
<b>Resisting/Overturning Ratio</b>		=	<b>3.49</b>	Footing Weight	= 975.0	3.25	3,168.8
Vertical Loads used for Soil Pressure =		7,020.3 lbs		Key Weight	= 225.0	2.25	506.3
				Vert. Component	=		
				<b>Total =</b>	<b>7,020.3 lbs</b>	<b>R.M.=</b>	<b>27,037.3</b>

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.088	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

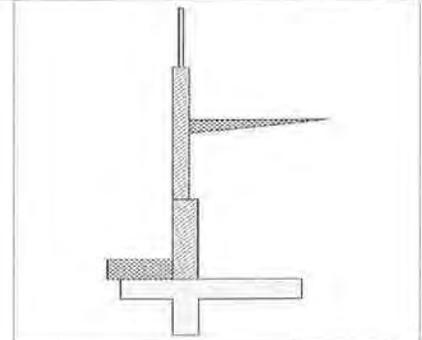
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	8.00 ft
Wall height above soil	=	5.67 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	26.7 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	3.69 OK
Sliding	=	1.67 OK
Total Bearing Load	=	8,311 lbs
...resultant ecc.	=	4.95 in
Soil Pressure @ Toe	=	1,607 psf OK
Soil Pressure @ Heel	=	768 psf OK
Allowable Soil Pressure Less Than Allowable		2,000 psf
ACI Factored @ Toe	=	2,250 psf
ACI Factored @ Heel	=	1,075 psf
Footing Shear @ Toe	=	33.1 psi OK
Footing Shear @ Heel	=	19.1 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	2,510.8 lbs
less 100% Passive Force	= -	1,711.8 lbs
less 100% Friction Force	= -	2,493.4 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	3rd	2nd	Bottom
Design Height Above Ftg	ft = 10.67	Stem OK	Stem OK
Wall Material Above "Ht"	= Fence	Masonry	Masonry
Design Method	=	LRFD	LRFD
Thickness	=	8.00	12.00
Rebar Size	=	# 4	# 5
Rebar Spacing	=	8.00	8.00
Rebar Placed at	=	Edge	Edge

##### Design Data

fb/FB + fa/Fa	=	0.446	0.679
---------------	---	-------	-------

##### Total Force @ Section

Service Level	lbs =			
Strength Level	lbs =	48.0	1,232.2	3,337.1

##### Moment....Actual

Service Level	ft-# =			
Strength Level	ft-# =	71.9	2,854.2	11,651.3
Moment....Allowable	ft-# =		6,384.4	17,143.2

##### Shear.....Actual

Service Level	psi =			
Strength Level	psi =		13.5	23.9
Shear.....Allowable	=		80.5	80.5
Anet (Masonry)	in2 =		91.50	139.50
Rebar Depth 'd'	in =		5.25	9.00

##### Masonry Data

f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	124.0

Equiv. Solid Thick.	=	7.60	11.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	

##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	2.00	ft
Heel Width	=	5.00	
Total Footing Width	=	7.00	
Footing Thickness	=	12.00	in
Key Width	=	12.00	in
Key Depth	=	22.00	in
Key Distance from Toe	=	2.00	ft
$f_c$	=	2,500	psi
$F_y$	=	60,000	psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0014	
Cover @ Top	2.00	@ Btm	= 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,250	1,075 psf
Mu' : Upward	=	4,276	10,389 ft-#
Mu' : Downward	=	855	17,604 ft-#
Mu: Design	=	3,421	7,215 ft-#
Actual 1-Way Shear	=	33.06	19.14 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: #4@ 11.89 in, #5@ 18.44 in, #6@ 26.18 in, #7@ 35.70 in, #8@ 47.01 in, #9@ 5  
 Heel: #4@ 10.30 in, #5@ 15.97 in, #6@ 22.66 in, #7@ 30.91 in, #8@ 40.70 in, #9@ 5  
 Key: #4@ 11.89 in, #5@ 18 in, #6@ 18 in, #7@ 18 in, #8@ 18 i

Min footing T&S reinf Area 1.41 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4@ 11.90 in, #5@ 18.45 in, #6@ 26.19 in  
 If two layers of horizontal bars: #4@ 23.81 in, #5@ 36.90 in, #6@ 52.38 in

### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	1,620.0	3.00	4,860.0	Soil Over Heel	=	4,320.0	5.00	21,600.0
Surcharge over Heel	=	800.0	4.50	3,600.0	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	1,200.0	5.00	6,000.0
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	90.8	11.83	1,074.1	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	270.0	1.00	270.0
					Surcharge Over Toe	=			
<b>Total</b>		<b>2,510.8</b>	<b>O.T.M.</b>	<b>9,534.1</b>	Stem Weight(s)	=	1,016.3	2.41	2,453.9
					Earth @ Stem Transitions	=	180.0	2.83	510.0
<b>Resisting/Overturning Ratio</b>			<b>= 3.69</b>		Footing Weight	=	1,050.0	3.50	3,675.0
Vertical Loads used for Soil Pressure	=		8,311.3 lbs		Key Weight	=	275.0	2.50	687.5
					Vert. Component	=			
					<b>Total =</b>		<b>8,311.3 lbs</b>	<b>R.M.=</b>	<b>35,196.4</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.087 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe because the wall would then tend to rotate into the retained soil.



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**Cantilevered Retaining Wall**

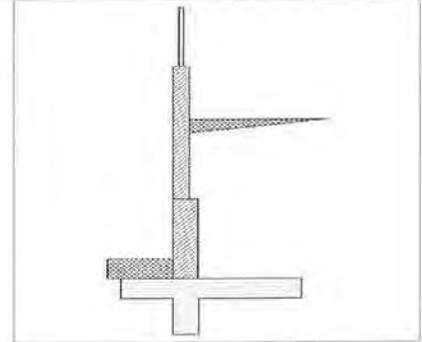
Code: CBC 2019,ACI 318-14,TMS 402-16

**Criteria**

Retained Height = 8.00 ft  
 Wall height above soil = 5.67 ft  
 Slope Behind Wall = 0.00  
 Height of Soil over Toe = 12.00 in  
 Water height over heel = 0.0 ft

**Soil Data**

Allow Soil Bearing = 2,000.0 psf  
 Equivalent Fluid Pressure Method  
 Active Heel Pressure = 40.0 psf/ft  
 Passive Pressure = 250.0 psf/ft  
 Soil Density, Heel = 135.00 pcf  
 Soil Density, Toe = 135.00 pcf  
 Footing||Soil Friction = 0.300  
 Soil height to ignore for passive pressure = 12.00 in



**Surcharge Loads**

Surcharge Over Heel = 300.0 psf  
 Used To Resist Sliding & Overturning  
 Surcharge Over Toe = 0.0 psf  
 Used for Sliding & Overturning

**Lateral Load Applied to Stem**

Lateral Load = 0.0 #/ft  
 ...Height to Top = 0.00 ft  
 ...Height to Bottom = 0.00 ft  
 Load Type = Wind (W)  
 (Strength Level)  
 Wind on Exposed Stem = 0.0 psf  
 (Strength Level)

**Adjacent Footing Load**

Adjacent Footing Load = 0.0 lbs  
 Footing Width = 0.00 ft  
 Eccentricity = 0.00 in  
 Wall to Ftg CL Dist = 0.00 ft  
 Footing Type = Line Load  
 Base Above/Below Soil at Back of Wall = 0.0 ft  
 Poisson's Ratio = 0.300

**Axial Load Applied to Stem**

Axial Dead Load = 0.0 lbs  
 Axial Live Load = 0.0 lbs  
 Axial Load Eccentricity = 0.0 in

**Earth Pressure Seismic Load**

Method : Inverted Triangular

Load at top of Inverted Triangular Distribution (Strength) = 194.400 psf

Total Strength-Level Seismic Load, .... = 874.800 lbs  
 Total Service-Level Seismic Load, .... = 612.360 lbs

**Design Summary**

**Wall Stability Ratios**

Overturning = 2.90 OK  
 Sliding = 1.39 Ratio < 1.5!

Total Bearing Load = 8,311 lbs  
 ...resultant ecc. = 8.70 in

Soil Pressure @ Toe = 1,925 psf OK  
 Soil Pressure @ Heel = 449 psf OK  
 Allowable = 2,000 psf  
 Soil Pressure Less Than Allowable

ACI Factored @ Toe = 2,695 psf  
 ACI Factored @ Heel = 629 psf

Footing Shear @ Toe = 39.3 psi OK  
 Footing Shear @ Heel = 25.8 psi OK  
 Allowable = 75.0 psi

**Sliding Calcs**

Lateral Sliding Force = 3,032.4 lbs  
 less 100% Passive Force = - 1,711.8 lbs  
 less 100% Friction Force = - 2,493.4 lbs  
 Added Force Req'd = 0.0 lbs OK  
 ....for 1.5 Stability = 343.4 lbs NG

**Stem Construction**

	3rd	2nd	Bottom
Design Height Above Ftg	ft = 10.67	Stem OK 4.00	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry	Masonry
Design Method	=	LRFD	LRFD
Thickness	=	8.00	12.00
Rebar Size	=	# 4	# 5
Rebar Spacing	=	8.00	8.00
Rebar Placed at	=	Edge	Edge

**Design Data**

fb/FB + fa/Fa = 0.492 0.838

**Total Force @ Section**

Service Level lbs =  
 Strength Level lbs = 1,685.7 4,049.8

**Moment....Actual**

Service Level ft-# =  
 Strength Level ft-# = 3,145.2 14,390.0  
 Moment....Allowable ft-# = 6,384.4 17,143.2

**Shear.....Actual**

Service Level psi =  
 Strength Level psi = 18.4 29.0

Shear....Allowable = 80.5 80.5  
 Anet (Masonry) in2 = 91.50 139.50  
 Rebar Depth 'd' in = 5.25 9.00

**Masonry Data**

f <sub>m</sub>	psi =	2,000	2,000
F <sub>y</sub>	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	124.0
Equiv. Solid Thick.	=	7.60	11.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	

**Concrete Data**

f'c psi =  
 Fy psi =

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

**Load Factors**

Building Code = CBC 2019,ACI  
 Dead Load = 1.200  
 Live Load = 1.600  
 Earth, H = 1.600  
 Wind, W = 1.000  
 Seismic, E = 1.000



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	2.00	ft
Heel Width	=	5.00	
Total Footing Width	=	7.00	
Footing Thickness	=	12.00	in
Key Width	=	12.00	in
Key Depth	=	22.00	in
Key Distance from Toe	=	2.00	ft
$f'c$	=	2,500	psi
$F_y$	=	60,000	psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0014	
Cover @ Top	=	2.00	@ Btm = 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,695	629 psf
Mu' : Upward	=	4,997	8,181 ft-#
Mu' : Downward	=	855	17,604 ft-#
Mu: Design	=	4,142	9,423 ft-#
Actual 1-Way Shear	=	39.30	25.84 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: #4@ 11.89 in, #5@ 18.44 in, #6@ 26.18 in, #7@ 35.70 in, #8@ 47.01 in, #9@ 5  
 Heel: #4@ 7.88 in, #5@ 12.22 in, #6@ 17.35 in, #7@ 23.67 in, #8@ 31.16 in, #9@ 39  
 Key: #4@ 11.89 in, #5@ 18 in, #6@ 18 in, #7@ 18 in, #8@ 18 i

Min footing T&S reinf Area 1.41 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4@ 11.90 in, #5@ 18.45 in, #6@ 26.19 in  
 If two layers of horizontal bars: #4@ 23.81 in, #5@ 36.90 in, #6@ 52.38 in

### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	1,620.0	3.00	4,860.0	Soil Over Heel	=	4,320.0	5.00	21,600.0
Surcharge over Heel	=	800.0	4.50	3,600.0	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	1,200.0	5.00	6,000.0
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=				* Axial Live Load on Stem	=			
Seismic Earth Load	=	612.4	6.00	3,674.2	Soil Over Toe	=	270.0	1.00	270.0
	=				Surcharge Over Toe	=			
<b>Total</b>		<b>3,032.4</b>	<b>O.T.M.</b>	<b>12,134.2</b>	Stem Weight(s)	=	1,016.3	2.41	2,453.9
	=				Earth @ Stem Transitions	=	180.0	2.83	510.0
<b>Resisting/Overturning Ratio</b>			<b>= 2.90</b>		Footing Weight	=	1,050.0	3.50	3,675.0
Vertical Loads used for Soil Pressure	=	8,311.3	lbs		Key Weight	=	275.0	2.50	687.5
					Vert. Component	=			
					<b>Total =</b>		<b>8,311.3 lbs</b>	<b>R.M.=</b>	<b>35,196.4</b>

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.104	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

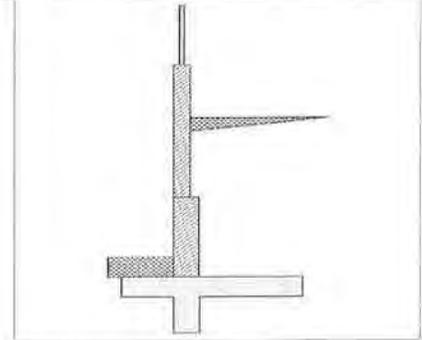
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	8.00 ft
Wall height above soil	=	5.67 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	0.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	1,500.0 lbs
Footing Width	=	2.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	2.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	-2.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Earth Pressure Seismic Load

Method : Inverted Triangular

Load at top of Inverted Triangular Distribution (Strength)	=	194.400 psf	Total Strength-Level Seismic Load. ....	=	874.800 lbs
			Total Service-Level Seismic Load. ....	=	612.360 lbs

#### Design Summary

##### Wall Stability Ratios

Overturning	=	3.38 OK
Sliding	=	1.61 OK

Total Bearing Load	=	7,861 lbs
...resultant ecc.	=	6.57 in

Soil Pressure @ Toe	=	1,650 psf OK
Soil Pressure @ Heel	=	596 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		

ACI Factored @ Toe	=	2,310 psf
ACI Factored @ Heel	=	834 psf

Footing Shear @ Toe	=	33.4 psi OK
Footing Shear @ Heel	=	7.7 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	2,522.1 lbs
less 100% Passive Force	= -	1,711.8 lbs
less 100% Friction Force	= -	2,358.4 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	3rd	2nd	Bottom
Design Height Above Ftg	ft = 10.67	Stem OK 4.00	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry	Masonry
Design Method	=	LRFD	LRFD
Thickness	=	8.00	12.00
Rebar Size	=	# 4	# 5
Rebar Spacing	=	8.00	8.00
Rebar Placed at	=	Edge	Edge

##### Design Data

fb/FB + fa/Fa	=	0.329	0.659
---------------	---	-------	-------

##### Total Force @ Section

Service Level	lbs =		
Strength Level	lbs =	1,280.0	3,355.7

##### Moment....Actual

Service Level	ft-# =		
Strength Level	ft-# =	2,107.7	11,310.7
Moment....Allowable	ft-# =	6,384.4	17,143.2

##### Shear.....Actual

Service Level	psi =		
Strength Level	psi =	14.0	24.1

##### Shear.....Allowable

	=	80.5	80.5
Anet (Masonry)	in2 =	91.50	139.50
Rebar Depth 'd'	in =	5.25	9.00

##### Masonry Data

f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	124.0

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Equiv. Solid Thick.	=	7.60	11.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	

##### Concrete Data

f'c	psi =	
Fy	psi =	



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	2.00	ft
Heel Width	=	5.00	
Total Footing Width	=	7.00	
Footing Thickness	=	12.00	in
Key Width	=	12.00	in
Key Depth	=	22.00	in
Key Distance from Toe	=	2.00	ft
$f'c$	=	2,500	psi
$F_y$	=	60,000	psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0014	
Cover @ Top	=	2.00	
		@ Btm	= 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,310	834 psf
Mu' : Upward	=	4,340	8,922 ft-#
Mu' : Downward	=	855	13,284 ft-#
Mu: Design	=	3,485	4,362 ft-#
Actual 1-Way Shear	=	33.40	7.72 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: #4@ 11.89 in, #5@ 18.44 in, #6@ 26.18 in, #7@ 35.70 in, #8@ 47.01 in, #9@ 5  
 Heel: #4@ 11.89 in, #5@ 18.44 in, #6@ 26.18 in, #7@ 35.70 in, #8@ 47.01 in, #9@ 5  
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 1.41 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars:  
 #4@ 11.90 in  
 #5@ 18.45 in  
 #6@ 26.19 in

If two layers of horizontal bars:  
 #4@ 23.81 in  
 #5@ 36.90 in  
 #6@ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	1,620.0	3.00	4,860.0	Soil Over Heel	=	4,320.0	5.00	21,600.0
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=	289.7	4.16	1,204.0	Adjacent Footing Load	=	750.0	5.00	3,750.0
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=				* Axial Live Load on Stem	=			
Seismic Earth Load	=	612.4	6.00	3,674.2	Soil Over Toe	=	270.0	1.00	270.0
	=				Surcharge Over Toe	=			
<b>Total</b>		<b>2,522.1</b>	<b>O.T.M.</b>	<b>9,738.2</b>	Stem Weight(s)	=	1,016.3	2.41	2,453.9
	=				Earth @ Stem Transitions	=	180.0	2.83	510.0
<b>Resisting/Overturning Ratio</b>				<b>3.38</b>	Footing Weight	=	1,050.0	3.50	3,675.0
Vertical Loads used for Soil Pressure	=			7,861.3 lbs	Key Weight	=	275.0	2.50	687.5
					Vert. Component	=			
					<b>Total =</b>		<b>7,861.3 lbs</b>	<b>R.M.=</b>	<b>32,946.4</b>

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.089 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



# ORCO STANDARD 8'-0" CMU SITE WALLS W/ SPREAD FOOTING FOR 110 MPH 3 SEC. GUST @ EXP C

## REBAR NOTE:

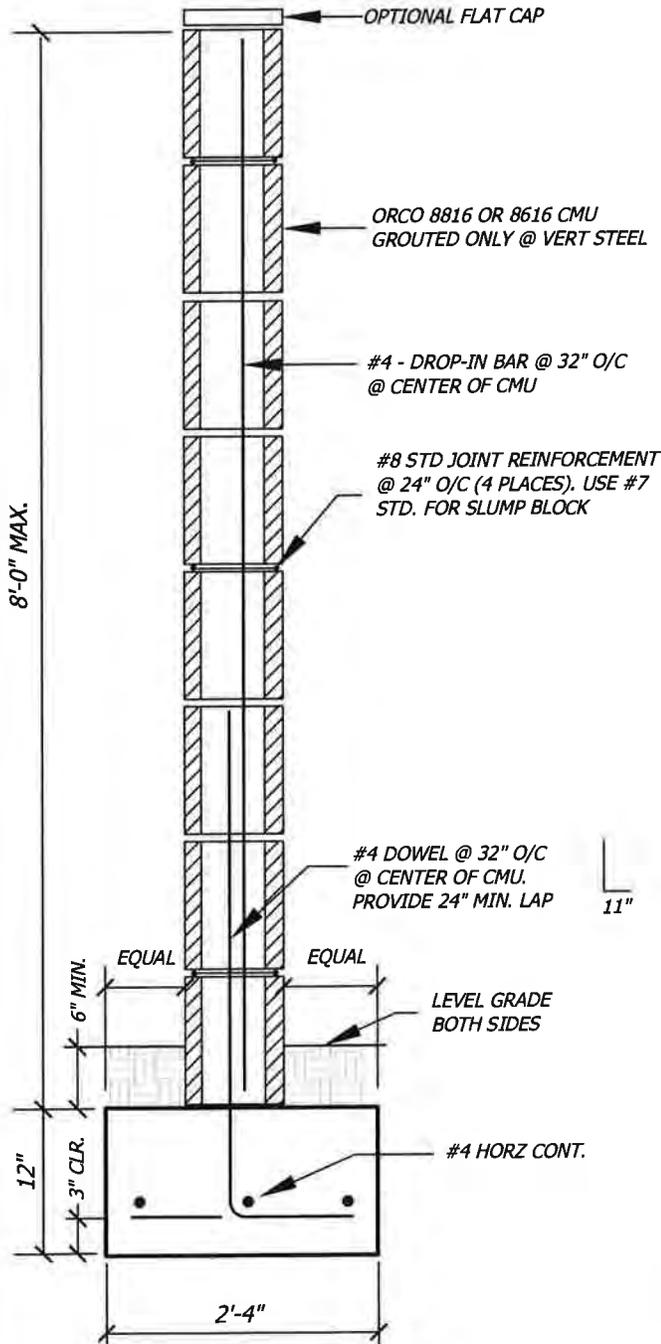
- DO NOT RUN HORIZONTAL REINFORCEMENT THROUGH WALL RETURNS & CONSTRUCTION JOINTS.
- PROVIDE DOWEL & DROP-IN BAR ACCORDING TO DETAIL AT EACH SIDE OF CONTROL JOINTS, ENDS OF WALLS AND @ WALL HEIGHT CHANGES.

## DESIGN CRITERIA PER 2019 CBC:

1. ALLOWABLE SOIL BEARING PRESSURE FOR FOOTINGS = 2000 PSF PER SOILS REP.
2. EQUIVALENT FLUID PRESSURE FOR LEVEL BACKFILL = 40 PCF PER SOILS REPORT.
3. ALLOWABLE LATERAL PASSIVE PRESSURE = 250 PCF PER SOILS REPORT.
4. GROUT STRENGTH = 2000 PSI @ 28 DAYS & REINFORCING STEEL : GRADE 60.
5. EARTH COEFFICIENT OF FRICTION = 0.30.
6. 2000 PSI MASONRY COMPRESSION STRENGTH - SPECIAL INSPECTION REQUIRED.

## NOTES:

1. CONCRETE BLOCK SHALL BE MANUFACTURED BY ORCO ASTM C 90. WEDGELOCK BLOCK, SLUMP BLOCK AND SPLITFACE BLOCK ARE ACCEPTABLE.
2. CONCRETE FOR FOOTING SHALL BE 1 PART CEMENT TO 2-1/2 PARTS SAND TO 3-1/2 PARTS GRAVEL WITH A MAXIMUM OF 1-1/2 GALLONS OF WATER PER SACK. PORTLAND CEMENT SHALL CONFORM TO ASTM C 150 TYPE II/V.  $F_c = 2500$  PSI
3. REINFORCING STEEL SHALL BE DEFORMED AND CONFORM TO ASTM A 615 GRADE 60. PROVIDE 48 BAR DIAMETER LAP.
4. REBAR SHALL BE CENTERED IN THE CONCRETE BLOCK CELL IN WHICH IT IS LOCATED.
5. CONCRETE BLOCK SHALL BE LAID IN A RUNNING BOND PATTERN WITH VERTICAL CONTINUITY OF THE CELLS UNO.
6. ALL BLOCK CELLS CONTAINING VERTICAL REBAR SHALL BE SOLID GROUTED.
7. USE TYPE S MORTAR PROPORTIONED USING ASTM C 270 PART CEMENT TO 1/2 PART LIME TO 4-1/2 PARTS DAMP, LOOSE SAND.
8. GROUT FOR CONCRETE BLOCK PER ASTM C 476 TO BE 1 PART CEMENT TO 3 PARTS SAND (GROUT MAY CONTAIN 2 PARTS 3/8" PEA GRAVEL IF WEATHER CONDITIONS ARE FAVORABLE AND BLOCK UNOBSTRUCTED CELL SIZE IS SUFFICIENT TO ALLOW GOOD GROUT FLOW). WATER SHALL BE ADDED TO PRODUCE GOOD GROUT FLOW WITHOUT SEGREGATION OF THE CONSTITUENTS.
9. BLOCK STEM MAY BE WET-SET 1-1/2" INTO THE FOOTING WHILE THE CONCRETE IS PLASTIC. BLOCK STEM MAY BE PLACED TO EITHER EDGE OF THE TRENCH TYPE FOOTING.
10. FOOTING MUST BE POURED ON OR INTO UNDISTURBED NATURAL SOIL OR ON COMPACTED FILL WITH A MINIMUM COMPACTION OF 90%.
11. FIRST INSPECTION TO BE AFTER FOOTING TRENCHES ARE READY FOR CONCRETE AND ALL REQUIRED STEEL IS TIED IN PLACE. SECOND INSPECTION TO BE WHEN THE REQUIRED VERTICAL IS IN PLACE AND THE BLOCK WALL IS READY TO GROUT.
12. MAXIMUM CONTROL JOINT SPACING: 40' O/C. 20' O/C FOR WALLS TO BE MORTAR WASHED OR STUCCO COATED.



NOTE: DIMENSIONS ARE NOT TO SCALE.

## WALL "E"

**ENGINEERING STAMP APPROVAL IS CONDITIONAL;  
REQUIRING USE OF ORCO MANUFACTURED CMU ON  
ALL ORCO WALL SYSTEM DESIGNS.**

**CITY OF  
HERMOSA BEACH**  
PARKING LOT D  
HERMOSA BEACH, CALIFORNIA



TS-327

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### Cantilevered Retaining Wall

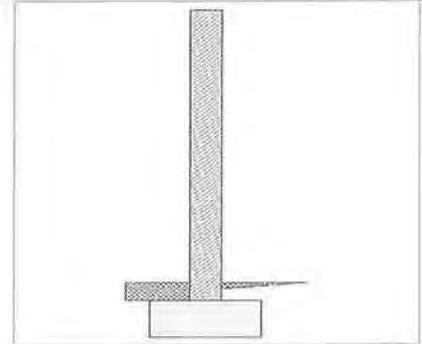
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	0.50 ft
Wall height above soil	=	7.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	26.7 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	1.61 OK
Sliding	=	2.59 OK
Total Bearing Load ...resultant ecc.	=	902 lbs 8.69 in
Soil Pressure @ Toe	=	1,360 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable	=	2,000 psf
ACI Factored @ Toe	=	1,903 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	7.1 psi OK
Footing Shear @ Heel	=	1.8 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	165.2 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	270.7 lbs
Added Force Req'd ...for 1.5 Stability	=	0.0 lbs OK 0.0 lbs OK

#### Stem Construction

Design Height Above Ftg	ft =	Stem OK 0.00
Wall Material Above "Ht"	=	Masonry
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	32.00
Rebar Placed at	=	Center

##### Design Data

fb/FB + fa/Fa	=	0.697
---------------	---	-------

##### Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	208.3

##### Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	852.4
Moment....Allowable	=	1,221.7

##### Shear....Actual

Service Level	psi =	
Strength Level	psi =	8.8
Shear....Allowable	psi =	80.5
Anet (Masonry)	in2 =	23.77
Rebar Depth 'd'	in =	3.75

##### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	No
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	55.0

Equiv. Solid Thick.	in =	4.90
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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**Cantilevered Retaining Wall**

Code: CBC 2019,ACI 318-14,TMS 402-16

**Footing Dimensions & Strengths**

Toe Width = 0.83 ft  
 Heel Width = 1.50  
 Total Footing Width = 2.33  
 Footing Thickness = 12.00 in  
 Key Width = 12.00 in  
 Key Depth = 0.00 in  
 Key Distance from Toe = 0.25 ft  
 f'c = 2,500 psi Fy = 60,000 psi  
 Footing Concrete Density = 150.00 pcf  
 Min. As % = 0.0014  
 Cover @ Top 2.00 @ Btm= 3.00 in

**Footing Design Results**

	Toe	Heel
Factored Pressure =	1,903	0 psf
Mu' : Upward =	522	0 ft-#
Mu' : Downward =	127	127 ft-#
Mu: Design =	395	127 ft-#
Actual 1-Way Shear =	7.07	1.81 psi
Allow 1-Way Shear =	40.00	40.00 psi
Toe Reinforcing =	None Spec'd	
Heel Reinforcing =	None Spec'd	
Key Reinforcing =	None Spec'd	

**Other Acceptable Sizes & Spacings**

Toe: Not req'd: Mu < phi\*5\*lambda\*sqrt(f'c)\*Sm  
 Heel: Not req'd: Mu < phi\*5\*lambda\*sqrt(f'c)\*Sm  
 Key: No key defined

Min footing T&S reinf Area 0.47 in2  
 Min footing T&S reinf Area per foot 0.20 in2 /ft  
 If one layer of horizontal bars: If two layers of horizontal bars:  
 #4 @ 11.90 in #4 @ 23.81 in  
 #5 @ 18.45 in #5 @ 36.90 in  
 #6 @ 26.19 in #6 @ 52.38 in

**Summary of Overturning & Resisting Forces & Moments**

Item	.....OVERTURNING.....			.....RESISTING.....		
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#
Heel Active Pressure =	45.0	0.50	22.5	Soil Over Heel =	56.3	1.92 107.8
Surcharge over Heel =				Sloped Soil Over Heel =		
Surcharge Over Toe =				Surcharge Over Heel =		
Adjacent Footing Load =				Adjacent Footing Load =		
Added Lateral Load =				Axial Dead Load on Stem =		
Load @ Stem Above Soil =	120.2	5.25	630.8	* Axial Live Load on Stem =		
				Soil Over Toe =	56.2	0.42 23.4
				Surcharge Over Toe =		
<b>Total</b>	<b>165.2</b>	<b>O.T.M.</b>	<b>653.3</b>	Stem Weight(s) =	440.0	1.17 513.2
				Earth @ Stem Transitions =		
				Footing Weight =	350.0	1.17 408.2
<b>Resisting/Overturning Ratio</b>		=	<b>1.61</b>	Key Weight =		0.75
Vertical Loads used for Soil Pressure =			902.4 lbs	Vert. Component =		
				<b>Total =</b>	<b>902.4 lbs</b>	<b>R.M.= 1,052.6</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

**Tilt**

**Horizontal Deflection at Top of Wall due to settlement of soil**

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.130 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



# ORCO 2'-0" TO 4'-0" HIGH RETAINING WALL W/ 36" GUARDRAIL FOR 110 MPH 3 SEC. GUST @ EXP C

**SPECIAL INSPECTION NOTE:**

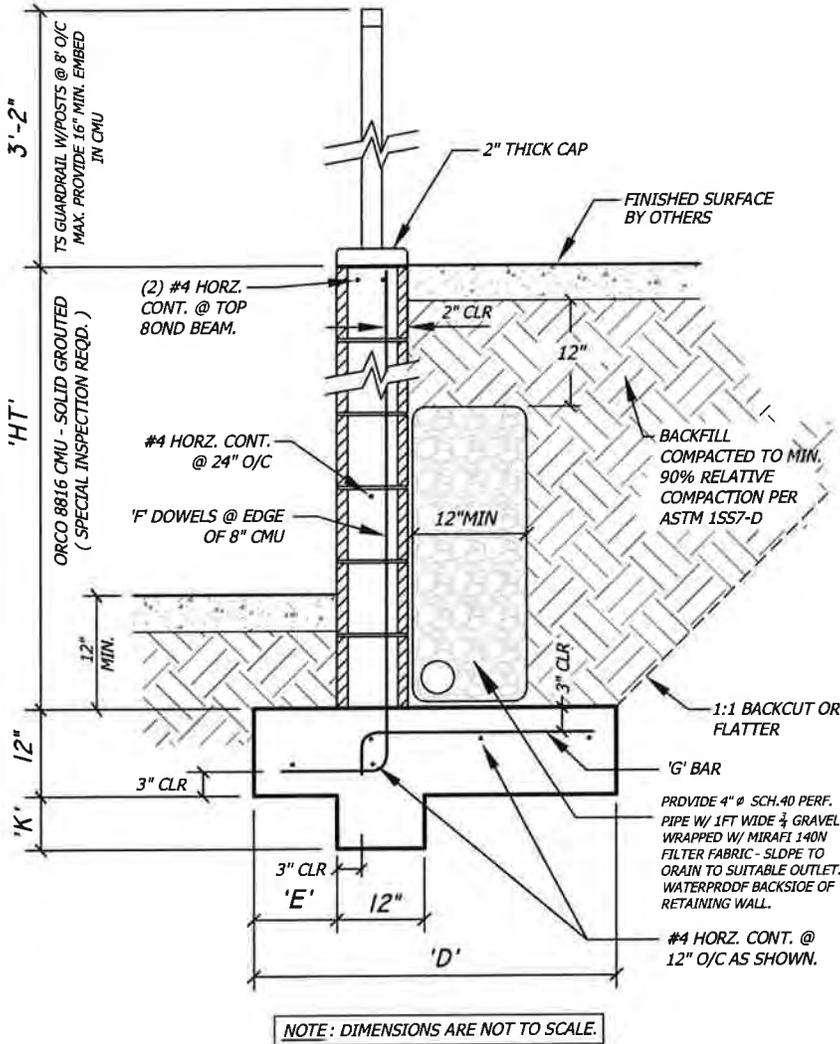
PROVIDE LEVEL 2 SPECIAL INSPECTION PER TMS-602-16 TABLES 3 AND 4 OF THE MASONRY STEM.

**DESIGN CRITERIA PER 2019 CBC:**

1. ALLOWABLE SOIL BEARING PRESSURE FOR FOOTINGS = 2000 PSF PER SOILS REP.
2. EQUIVALENT FLUID PRESSURE FOR LEVEL BACKFILL = 40 PCF PER SOILS REPORT.
3. ALLOWABLE LATERAL PASSIVE PRESSURE = 250 PCF PER SOILS REPORT.
4. GROUT STRENGTH = 2000 PSI @ 28 DAYS & REINFORCING STEEL : GRADE 60.
5. EARTH COEFFICIENT OF FRICTION = 0.30.
6. 2000 PSI MASONRY COMPRESSION STRENGTH - SPECIAL INSPECTION REQUIRED.

**NOTES:**

1. CONCRETE BLOCK SHALL BE MANUFACTURED BY ORCO ASTM C 90. WEDGELock BLOCK, SLUMP BLOCK AND SPLITFACE BLOCK ARE ACCEPTABLE.
2. CONCRETE FOR FOOTING SHALL BE 1 PART CEMENT TO 2-1/2 PARTS SAND TO 3-1/2 PARTS GRAVEL WITH A MAXIMUM OF 1-1/2 GALLONS OF WATER PER SACK. PORTLAND CEMENT SHALL CONFORM TO ASTM C 150 TYPE II/V.  $F_c = 2500$  PSI
3. REINFORCING STEEL SHALL BE DEFORMED AND CONFORM TO ASTM A 615 GRADE 60. PROVIDE 48 BAR DIAMETER LAP.
4. REBAR SHALL BE CENTERED IN THE CONCRETE BLOCK CELL IN WHICH IT IS LOCATED.
5. CONCRETE BLOCK SHALL BE LAID IN A RUNNING BOND PATTERN WITH VERTICAL CONTINUITY OF THE CELLS UNO.
6. ALL BLOCK CELLS SHALL BE SOLID GROUTED.
7. USE TYPE S MORTAR PROPORTIONED USING ASTM C 270 PART CEMENT TO 1/2 PART LIME TO 4-1/2 PARTS DAMP, LOOSE SAND.
8. GROUT FOR CONCRETE BLOCK PER ASTM C 476 TO BE 1 PART CEMENT TO 3 PARTS SAND (GROUT MAY CONTAIN 2 PARTS 3/8" PEA GRAVEL IF WEATHER CONDITIONS ARE FAVORABLE AND BLOCK UNOBSTRUCTED CELL SIZE IS SUFFICIENT TO ALLOW GOOD GROUT FLOW). WATER SHALL BE ADDED TO PRODUCE GOOD GROUT FLOW WITHOUT SEGREGATION OF THE CONSTITUENTS.
9. BLOCK STEM MAY BE WET-SET 1-1/2" INTO THE FOOTING WHILE THE CONCRETE IS PLASTIC. BLOCK STEM MAY BE PLACED TO EITHER EDGE OF THE TRENCH TYPE FOOTING.
10. FOOTING MUST BE POURED ON OR INTO UNDISTURBED NATURAL SOIL OR ON COMPACTED FILL WITH A MINIMUM COMPACTION OF 90%.
11. FIRST INSPECTION TO BE AFTER FOOTING TRENCHES ARE READY FOR CONCRETE AND ALL REQUIRED STEEL IS TIED IN PLACE. SECOND INSPECTION TO BE WHEN THE REQUIRED VERTICAL IS IN PLACE AND THE BLOCK WALL IS READY TO GROUT.
12. MAXIMUM CONTROL JOINT SPACING: 40' O/C. 20' O/C FOR WALLS TO BE MORTAR WASHED OR STUCCO COATED.



NOTE: DIMENSIONS ARE NOT TO SCALE.

## WALL "F1"

**ENGINEERING STAMP APPROVAL IS CONDITIONAL;  
REQUIRING USE OF ORCO MANUFACTURED CMU ON  
ALL ORCO WALL SYSTEM DESIGNS.**

'HT'	'D'	'E'	'F' DOWEL	'G' BAR	'K'
2'-0"	2'-6"	6"	#4@16" O/C 8" ┘ 33"	#4@16" O/C 8" ┘ 18"	4"
2'-8"	2'-9"	6"	#4@16" O/C 8" ┘ 41"	#4@16" O/C 8" ┘ 21"	4"
3'-4"	3'-0"	6"	#4@16" O/C 8" ┘ 49"	#4@16" O/C 8" ┘ 24"	6"
4'-0"	3'-6"	6"	#4@8" O/C 8" ┘ 57"	#4@8" O/C 8" ┘ 30"	7"

**CITY OF  
HERMOSA BEACH**  
PARKING LOT D  
HERMOSA BEACH, CALIFORNIA



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### Cantilevered Retaining Wall

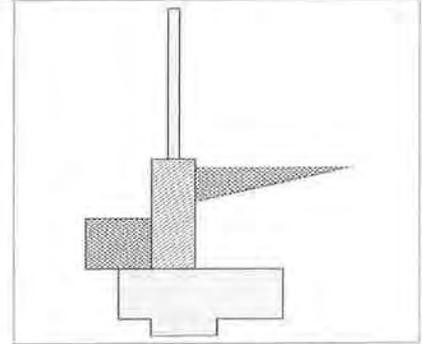
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	2.00 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

<b>Wall Stability Ratios</b>	
Overturning	= 2.04 OK
Sliding	= 1.81 OK
Total Bearing Load	= 1,422 lbs
...resultant ecc.	= 6.10 in
Soil Pressure @ Toe	= 1,278 psf OK
Soil Pressure @ Heel	= 0 psf OK
Allowable Soil Pressure Less Than Allowable	= 2,000 psf
ACI Factored @ Toe	= 1,789 psf
ACI Factored @ Heel	= 0 psf
Footing Shear @ Toe	= 5.0 psi OK
Footing Shear @ Heel	= 7.2 psi OK
Allowable	= 75.0 psi
<b>Sliding Calcs</b>	
Lateral Sliding Force	= 541.6 lbs
less 100% Passive Force	= - 555.6 lbs
less 100% Friction Force	= - 426.5 lbs
Added Force Req'd	= 0.0 lbs OK
...for 1.5 Stability	= 0.0 lbs OK

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Stem Construction

	2nd	Bottom
Design Height Above Ftg	ft = 2.17	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry
Design Method	= LRFD	LRFD LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	16.00
Rebar Placed at	=	Edge

#### Design Data

fb/FB + fa/Fa	=	0.277
<b>Total Force @ Section</b>		
Service Level	lbs =	
Strength Level	lbs =	89.9 570.7
<b>Moment....Actual</b>		
Service Level	ft-# =	
Strength Level	ft-# =	134.6 937.0
Moment....Allowable	ft-# =	3,368.0
<b>Shear.....Actual</b>		
Service Level	psi =	
Strength Level	psi =	6.2
Shear....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25

#### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

#### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.50 ft
Heel Width	=	2.00
Total Footing Width	=	2.50
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	4.00 in
Key Distance from Toe	=	0.50 ft
$f_c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	=	2.00
@ Btm	=	3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	1,789	0 psf
Mu' : Upward	=	207	159 ft-#
Mu' : Downward	=	71	1,093 ft-#
Mu: Design	=	136	934 ft-#
Actual 1-Way Shear	=	4.97	7.18 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.50 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup>/ft  
 If one layer of horizontal bars: #4 @ 11.90 in  
 #5 @ 18.45 in  
 #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in  
 #5 @ 36.90 in  
 #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....		
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	180.0	1.00	180.0		
Surcharge over Heel	=	266.7	1.50	400.0		
Surcharge Over Toe	=					
Adjacent Footing Load	=					
Added Lateral Load	=					
Load @ Stem Above Soil	=	95.0	4.58	435.3		
	=					
<b>Total</b>	=	<b>541.6</b>	<b>O.T.M.</b>			<b>1,015.3</b>
	=					
<b>Resisting/Overturning Ratio</b>	=					<b>2.04</b>
Vertical Loads used for Soil Pressure =		1,421.8	lbs			
Soil Over Heel	=	360.0	1.83	660.0		
Sloped Soil Over Heel	=					
Surcharge Over Heel	=	400.0	1.83	733.3		
Adjacent Footing Load	=					
Axial Dead Load on Stem	=					
* Axial Live Load on Stem	=					
Soil Over Toe	=	67.5	0.25	16.9		
Surcharge Over Toe	=					
Stem Weight(s)	=	169.3	0.83	141.1		
Earth @ Stem Transitions	=					
Footing Weight	=	375.0	1.25	468.8		
Key Weight	=	50.0	1.00	50.0		
Vert. Component	=					
<b>Total =</b>		<b>1,421.8</b>	<b>lbs</b>	<b>R.M.=</b>		<b>2,070.0</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.073 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

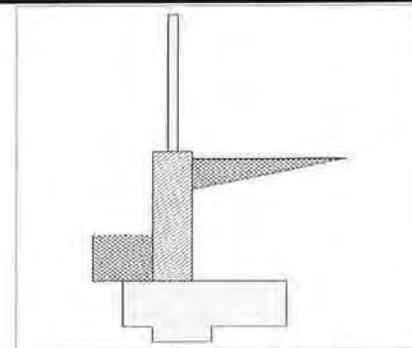
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	2.67 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	2.01 OK
Sliding	=	1.58 OK
Total Bearing Load	=	1,796 lbs
...resultant ecc.	=	6.89 in
Soil Pressure @ Toe	=	1,495 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable	=	2,000 psf
ACI Factored @ Toe	=	2,094 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	6.2 psi OK
Footing Shear @ Heel	=	8.9 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	690.6 lbs
less 100% Passive Force	= -	555.6 lbs
less 100% Friction Force	= -	538.9 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Stem Construction

	2nd	Bottom
Design Height Above Ftg	ft = 2.83	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry
Design Method	= LRFD	LRFD LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	16.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	0.410
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	90.2 766.2
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	135.5 1,383.2
Moment....Allowable	ft-# =	3,368.0
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	8.4
Shear.....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25
Masonry Data		
f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

#### Concrete Data

f'c	psi =
Fy	psi =



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**Cantilevered Retaining Wall**

Code: CBC 2019, ACI 318-14, TMS 402-16

**Footing Dimensions & Strengths**

Toe Width = 0.50 ft  
 Heel Width = 2.25  
 Total Footing Width = 2.75  
 Footing Thickness = 12.00 in  
 Key Width = 12.00 in  
 Key Depth = 4.00 in  
 Key Distance from Toe = 0.50 ft  
 f'c = 2,500 psi Fy = 60,000 psi  
 Footing Concrete Density = 150.00 pcf  
 Min. As % = 0.0014  
 Cover @ Top 2.00 @ Btm = 3.00 in

**Footing Design Results**

	Toe	Heel
Factored Pressure =	2,094	0 psf
Mu' : Upward =	244	274 ft-#
Mu' : Downward =	71	1,658 ft-#
Mu: Design =	172	1,384 ft-#
Actual 1-Way Shear =	6.17	8.87 psi
Allow 1-Way Shear =	40.00	40.00 psi
Toe Reinforcing =	None Spec'd	
Heel Reinforcing =	None Spec'd	
Key Reinforcing =	None Spec'd	

**Other Acceptable Sizes & Spacings**

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.55 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup>/ft  
 If one layer of horizontal bars: #4 @ 11.90 in  
 #5 @ 18.45 in  
 #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in  
 #5 @ 36.90 in  
 #6 @ 52.38 in

**Summary of Overturning & Resisting Forces & Moments**

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure =	269.4	1.22	329.5	Soil Over Heel =	570.7	1.96	1,117.6
Surcharge over Heel =	326.2	1.84	598.6	Sloped Soil Over Heel =			
Surcharge Over Toe =				Surcharge Over Heel =	475.0	1.96	930.2
Adjacent Footing Load =				Adjacent Footing Load =			
Added Lateral Load =				Axial Dead Load on Stem =			
Load @ Stem Above Soil =	95.0	5.25	498.9	* Axial Live Load on Stem =			
				Soil Over Toe =	67.5	0.25	16.9
				Surcharge Over Toe =			
				Stem Weight(s) =	220.7	0.83	184.0
<b>Total</b>	<b>690.6</b>	<b>O.T.M.</b>	<b>1,427.1</b>	Earth @ Stem Transitions =			
				Footing Weight =	412.5	1.38	567.2
<b>Resisting/Overturning Ratio</b>		<b>= 2.01</b>		Key Weight =	50.0	1.00	50.0
Vertical Loads used for Soil Pressure =		1,796.5 lbs		Vert. Component =			
				<b>Total =</b>	<b>1,796.5 lbs</b>	<b>R.M.=</b>	<b>2,865.9</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

**Tilt**

**Horizontal Deflection at Top of Wall due to settlement of soil**

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.088 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

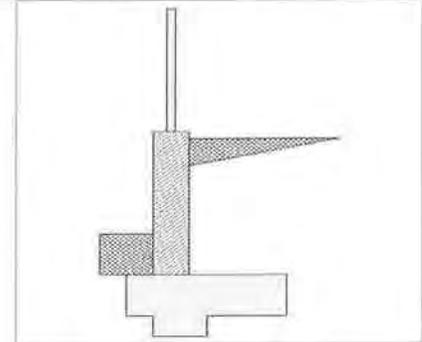
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	3.33 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing\Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Design Summary

<b>Wall Stability Ratios</b>	
Overturning	= 1.99 OK
Sliding	= 1.55 OK
Total Bearing Load	= 2,240 lbs
...resultant ecc.	= 7.71 in
Soil Pressure @ Toe	= 1,741 psf OK
Soil Pressure @ Heel	= 0 psf OK
Allowable Soil Pressure Less Than Allowable	= 2,000 psf
ACI Factored @ Toe	= 2,437 psf
ACI Factored @ Heel	= 0 psf
Footing Shear @ Toe	= 7.5 psi OK
Footing Shear @ Heel	= 10.5 psi OK
Allowable	= 75.0 psi
<b>Sliding Calcs</b>	
Lateral Sliding Force	= 854.8 lbs
less 100% Passive Force	= - 656.3 lbs
less 100% Friction Force	= - 671.9 lbs
Added Force Req'd	= 0.0 lbs OK
....for 1.5 Stability	= 0.0 lbs OK

#### Stem Construction

	2nd	Bottom
Design Height Above Ftg	ft = 3.50	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry
Design Method	= LRFD	LRFD LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	16.00
Rebar Placed at	=	Edge

#### Design Data

fb/FB + fa/Fa	=	0.581
<b>Total Force @ Section</b>		
Service Level	lbs =	
Strength Level	lbs =	89.9 986.7
<b>Moment....Actual</b>		
Service Level	ft-# =	
Strength Level	ft-# =	134.6 1,960.1
Moment.....Allowable	ft-# =	3,368.0
<b>Shear.....Actual</b>		
Service Level	psi =	
Strength Level	psi =	10.8
Shear.....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25

#### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

#### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.50 ft
Heel Width	=	2.50
Total Footing Width	=	3.00
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	6.00 in
Key Distance from Toe	=	0.50 ft
f'c =	2,500 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm = 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,437	0 psf
Mu' : Upward	=	285	439 ft-#
Mu' : Downward	=	71	2,382 ft-#
Mu: Design	=	214	1,943 ft-#
Actual 1-Way Shear	=	7.52	10.52 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.60 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup>/ft  
 If one layer of horizontal bars: If two layers of horizontal bars:  
 #4@ 11.90 in #4@ 23.81 in  
 #5@ 18.45 in #5@ 36.90 in  
 #6@ 26.19 in #6@ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	375.0	1.44	541.2	Soil Over Heel	=	824.2	2.08	1,717.0
Surcharge over Heel	=	384.9	2.17	833.3	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	550.0	2.08	1,145.8
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	95.0	5.91	561.6	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	67.5	0.25	16.9
					Surcharge Over Toe	=			
<b>Total</b>		<b>854.8</b>	<b>O.T.M.</b>	<b>1,936.1</b>	Stem Weight(s)	=	273.0	0.83	227.5
					Earth @ Stem Transitions	=			
					Footing Weight	=	450.0	1.50	675.0
<b>Resisting/Overturning Ratio</b>			=	<b>1.99</b>	Key Weight	=	75.0	1.00	75.0
Vertical Loads used for Soil Pressure	=			2,239.7 lbs	Vert. Component	=			
					<b>Total =</b>		<b>2,239.7 lbs</b>	<b>R.M.=</b>	<b>3,857.2</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0 pcf
Horizontal Defl @ Top of Wall (approximate only)	0.105 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

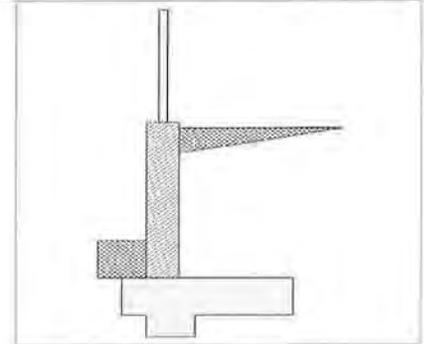
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	2.28 OK
Sliding	=	1.54 OK
Total Bearing Load	=	2,964 lbs
...resultant ecc.	=	7.65 in
Soil Pressure @ Toe	=	1,777 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable		2,000 psf
ACI Factored @ Toe	=	2,488 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	7.9 psi OK
Footing Shear @ Heel	=	11.4 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	1,039.4 lbs
less 100% Passive Force	= -	709.2 lbs
less 100% Friction Force	= -	889.3 lbs
Added Force Req'd	=	0.0 lbs OK
...for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	2nd	Bottom
Design Height Above Ftg	ft = 4.16	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry
Design Method	= LRFD	LRFD LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	8.00
Rebar Placed at	=	Edge

##### Design Data

fb/FB + fa/Fa	=	0.423
---------------	---	-------

##### Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	90.2 1,239.2

##### Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	135.5 2,704.2
Moment....Allowable	ft-# =	6,384.4

##### Shear....Actual

Service Level	psi =	
Strength Level	psi =	13.5
Shear....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25

##### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.50 ft
Heel Width	=	3.00
Total Footing Width	=	3.50
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	7.00 in
Key Distance from Toe	=	0.50 ft
$f'c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm= 3.00 in

#### Footing Design Results

	Toe	Heel
Factored Pressure	= 2,488	0 psf
Mu' : Upward	= 295	1,270 ft-#
Mu' : Downward	= 71	4,069 ft-#
Mu: Design	= 224	2,800 ft-#
Actual 1-Way Shear	= 7.94	11.37 psi
Allow 1-Way Shear	= 40.00	75.00 psi
Toe Reinforcing	= None Spec'd	
Heel Reinforcing	= None Spec'd	
Key Reinforcing	= None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: #4 @ 11.89 in, #5 @ 18.44 in, #6 @ 26.18 in, #7 @ 35.70 in, #8 @ 47.01 in, #9 @ 5  
 Key: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.71 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup>/ft  
 If one layer of horizontal bars: #4 @ 11.90 in, #5 @ 18.45 in, #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in, #5 @ 36.90 in, #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 500.0	1.67	833.3	Soil Over Heel	= 1,260.0	2.33	2,940.0
Surcharge over Heel	= 444.4	2.50	1,111.1	Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	= 700.0	2.33	1,633.3
Adjacent Footing Load	=			Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	= 95.0	6.58	625.3	* Axial Live Load on Stem	=		
	=			Soil Over Toe	= 67.5	0.25	16.9
				Surcharge Over Toe	=		
				Stem Weight(s)	= 324.5	0.83	270.4
				Earth @ Stem Transitions	=		
<b>Total</b>	<b>1,039.4</b>	<b>O.T.M.</b>	<b>2,569.7</b>	Footing Weight	= 525.0	1.75	918.8
				Key Weight	= 87.5	1.00	87.5
				Vert. Component	=		
<b>Resisting/Overturning Ratio</b>		=	<b>2.28</b>	<b>Total =</b>	<b>2,964.5 lbs</b>	<b>R.M.=</b>	<b>5,866.9</b>
Vertical Loads used for Soil Pressure =		2,964.5 lbs		* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.			

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0 pci
Horizontal Defl @ Top of Wall (approximate only)	0.101 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



# ORCO 3'-4" TO 4'-0" HIGH RETAINING WALL W/ 4'-8" CMU WALL ON TOP FOR 110 MPH 3 SEC. GUST @ EXP C

## SPECIAL INSPECTION NOTE:

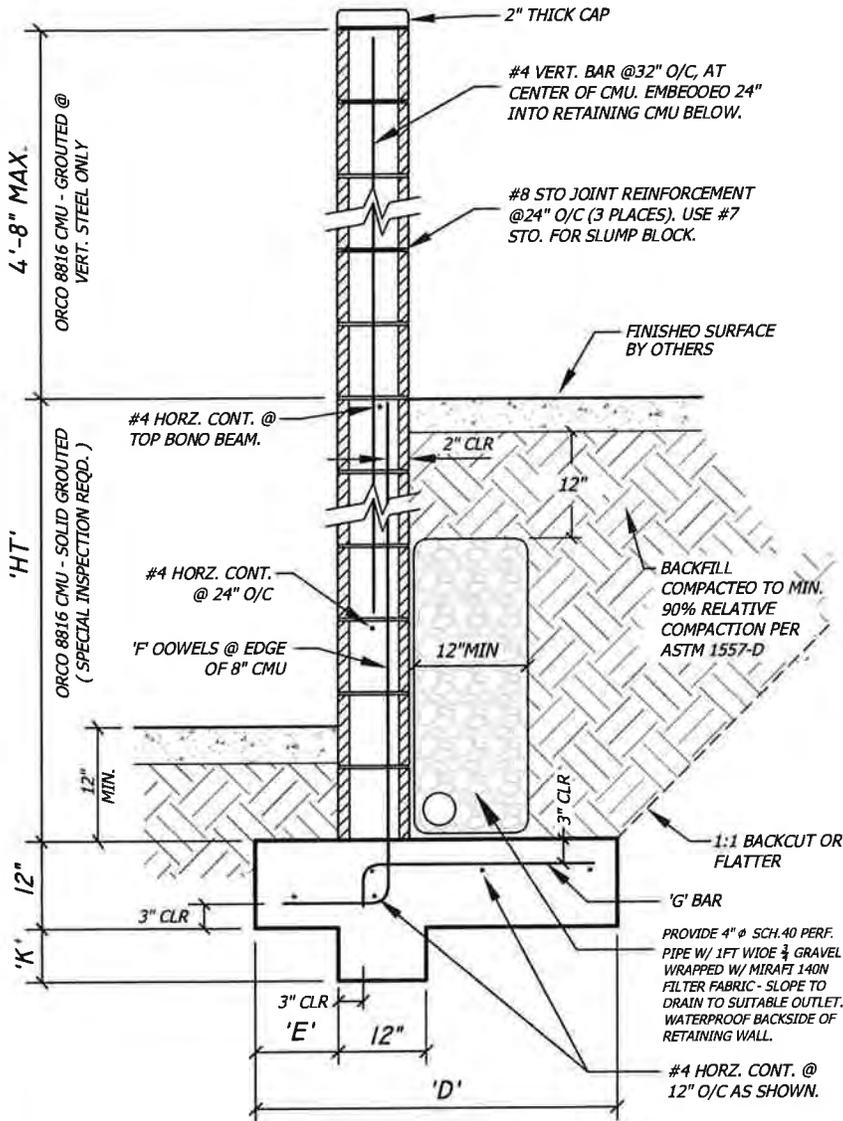
PROVIDE LEVEL 2 SPECIAL INSPECTION PER TMS-602-16 TABLES 3 AND 4 OF THE MASONRY STEM.

## DESIGN CRITERIA PER 2019 CBC:

1. ALLOWABLE SOIL BEARING PRESSURE FOR FOOTINGS = 2000 PSF PER SOILS REP.
2. EQUIVALENT FLUID PRESSURE FOR LEVEL BACKFILL = 40 PCF PER SOILS REPORT.
3. ALLOWABLE LATERAL PASSIVE PRESSURE = 250 PCF PER SOILS REPORT.
4. GROUT STRENGTH = 2000 PSI @ 28 DAYS & REINFORCING STEEL : GRADE 60.
5. EARTH COEFFICIENT OF FRICTION = 0.30.
6. 2000 PSI MASONRY COMPRESSION STRENGTH - SPECIAL INSPECTION REQUIRED.

## NOTES:

1. CONCRETE BLOCK SHALL BE MANUFACTURED BY ORCO ASTM C 90. WEOGLOCK BLOCK, SLUMP BLOCK AND SPLITFACE BLOCK ARE ACCEPTABLE.
2. CONCRETE FOR FOOTING SHALL BE 1 PART CEMENT TO 2-1/2 PARTS SAND TO 3-1/2 PARTS GRAVEL WITH A MAXIMUM OF 1-1/2 GALLONS OF WATER PER SACK. PORTLAND CEMENT SHALL CONFORM TO ASTM C 150 TYPE II/V.  $F_c = 2500$  PSI
3. REINFORCING STEEL SHALL BE DEFORMED AND CONFORM TO ASTM A 615 GRADE 60. PROVIDE 48 BAR DIAMETER LAP.
4. REBAR SHALL BE CENTERED IN THE CONCRETE BLOCK CELL IN WHICH IT IS LOCATED.
5. CONCRETE BLOCK SHALL BE LAID IN A RUNNING BOND PATTERN WITH VERTICAL CONTINUITY OF THE CELLS UNO.
6. ALL BLOCK CELLS SHALL BE SOLID GROUTED.
7. USE TYPE S MORTAR PROPORTIONED USING ASTM C 270 PART CEMENT TO 1/2 PART LIME TO 4-1/2 PARTS SAND, LOOSE SAND.
8. GROUT FOR CONCRETE BLOCK PER ASTM C 476 TO BE 1 PART CEMENT TO 3 PARTS SAND (GROUT MAY CONTAIN 2 PARTS 3/8" PEA GRAVEL IF WEATHER CONDITIONS ARE FAVORABLE AND BLOCK UNOBSTRUCTED CELL SIZE IS SUFFICIENT TO ALLOW GOOD GROUT FLOW). WATER SHALL BE ADDED TO PRODUCE GOOD GROUT FLOW WITHOUT SEGREGATION OF THE CONSTITUENTS.
9. BLOCK STEM MAY BE WET-SET 1-1/2" INTO THE FOOTING WHILE THE CONCRETE IS PLASTIC. BLOCK STEM MAY BE PLACED TO EITHER EDGE OF THE TRENCH TYPE FOOTING.
10. FOOTING MUST BE POURED ON OR INTO UNOBTURBED NATURAL SOIL OR ON COMPACTED FILL WITH A MINIMUM COMPACTION OF 90%.
11. FIRST INSPECTION TO BE AFTER FOOTING TRENCHES ARE READY FOR CONCRETE AND ALL REQUIRED STEEL IS TIED IN PLACE. SECOND INSPECTION TO BE WHEN THE REQUIRED VERTICAL IS IN PLACE AND THE BLOCK WALL IS READY TO GROUT.
12. MAXIMUM CONTROL JOINT SPACING: 40' O/C. 20' O/C FOR WALLS TO BE MORTAR WASHED OR STUCCO COATED.



NOTE: DIMENSIONS ARE NOT TO SCALE.

## WALL "F2"

**ENGINEERING STAMP APPROVAL IS CONDITIONAL; REQUIRING USE OF ORCO MANUFACTURED CMU ON ALL ORCO WALL SYSTEM DESIGNS.**

'HT'	'D'	'E'	'F' DOWEL	'G' BAR	'K'
3'-4"	3'-0"	6"	#4@16" O/C 8"   49"	#4@16" O/C 8"   24"	5"
4'-0"	3'-6"	6"	#4@8" O/C 8"   57"	#4@8" O/C 8"   30"	6"

**CITY OF HERMOSA BEACH**  
PARKING LOT D  
HERMOSA BEACH, CALIFORNIA



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### Cantilevered Retaining Wall

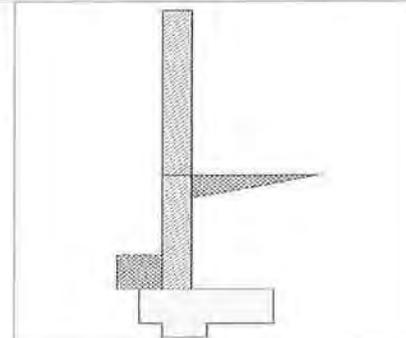
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	3.33 ft
Wall height above soil	=	4.83 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	26.7 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Design Summary

##### Wall Stability Ratios

Overturning	=	2.14 OK
Sliding	=	1.61 OK
Total Bearing Load	=	2,480 lbs
...resultant ecc.	=	7.56 in
Soil Pressure @ Toe	=	1,899 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable		2,000 psf
ACI Factored @ Toe	=	2,659 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	8.4 psi OK
Footing Shear @ Heel	=	9.5 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	837.3 lbs
less 100% Passive Force	= -	605.0 lbs
less 100% Friction Force	= -	743.9 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

#### Stem Construction

##### Design Height Above Ftg

ft =	3.33	0.00
Wall Material Above "Ht"	=	Masonry
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	32.00
Rebar Placed at	=	Center

##### Design Data

fb/FB + fa/Fa	=	0.254	0.570
---------------	---	-------	-------

##### Total Force @ Section

Service Level	lbs =		
Strength Level	lbs =	129.0	957.5

##### Moment....Actual

Service Level	ft-# =		
Strength Level	ft-# =	311.8	1,924.0
Moment....Allowable	ft-# =	1,221.7	3,368.0

##### Shear....Actual

Service Level	psi =		
Strength Level	psi =	5.4	10.5
Shear....Allowable	psi =	80.5	80.5
Anet (Masonry)	in2 =	23.77	91.50
Rebar Depth 'd'	in =	3.75	5.25

##### Masonry Data

f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	No	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	55.0	78.0

Equiv. Solid Thick.	in =	4.90	7.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	

##### Concrete Data

f'c	psi =	
Fy	psi =	



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**Cantilevered Retaining Wall**

Code: CBC 2019,ACI 318-14,TMS 402-16

**Footing Dimensions & Strengths**

Toe Width = 0.50 ft  
 Heel Width = 2.50  
 Total Footing Width = 3.00  
 Footing Thickness = 12.00 in  
 Key Width = 12.00 in  
 Key Depth = 5.00 in  
 Key Distance from Toe = 0.50 ft  
 f'c = 2,500 psi Fy = 60,000 psi  
 Footing Concrete Density = 150.00 pcf  
 Min. As % = 0.0014  
 Cover @ Top 2.00 @ Btm = 3.00 in

**Footing Design Results**

	Toe	Heel
Factored Pressure =	2,659	0 psf
Mu' : Upward =	311	512 ft-#
Mu' : Downward =	71	2,382 ft-#
Mu: Design =	240	1,871 ft-#
Actual 1-Way Shear =	8.37	9.47 psi
Allow 1-Way Shear =	40.00	40.00 psi
Toe Reinforcing =	None Spec'd	
Heel Reinforcing =	None Spec'd	
Key Reinforcing =	None Spec'd	

**Other Acceptable Sizes & Spacings**

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.60 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4 @ 11.90 in  
 #5 @ 18.45 in  
 #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in  
 #5 @ 36.90 in  
 #6 @ 52.38 in

**Summary of Overturning & Resisting Forces & Moments**

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure =	375.0	1.44	541.2	Soil Over Heel =	824.2	2.08	1,717.0
Surcharge over Heel =	384.9	2.17	833.3	Sloped Soil Over Heel =			
Surcharge Over Toe =				Surcharge Over Heel =	550.0	2.08	1,145.8
Adjacent Footing Load =				Adjacent Footing Load =			
Added Lateral Load =				Axial Dead Load on Stem =			
Load @ Stem Above Soil =	77.4	6.75	522.3	* Axial Live Load on Stem =			
				Soil Over Toe =	67.5	0.25	16.9
				Surcharge Over Toe =			
<b>Total</b>	<b>837.3</b>	<b>O.T.M.</b>	<b>1,896.8</b>	Stem Weight(s) =	525.6	0.83	438.0
				Earth @ Stem Transitions =			
				Footing Weight =	450.0	1.50	675.0
<b>Resisting/Overturning Ratio</b>		<b>= 2.14</b>		Key Weight =	62.5	1.00	62.5
Vertical Loads used for Soil Pressure =		2,479.7 lbs		Vert. Component =			
				<b>Total =</b>	<b>2,479.7 lbs</b>	<b>R.M.=</b>	<b>4,055.2</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

**Tilt**

**Horizontal Deflection at Top of Wall due to settlement of soil**

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.144 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

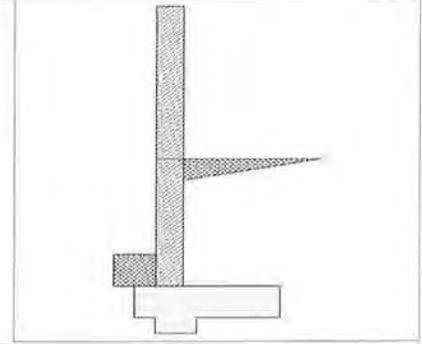
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	4.83 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	26.7 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Design Summary

<b>Wall Stability Ratios</b>	
Overturning	= 2.41 OK
Sliding	= 1.58 OK
Total Bearing Load	= 3,205 lbs
...resultant ecc.	= 7.72 in
Soil Pressure @ Toe	= 1,931 psf OK
Soil Pressure @ Heel	= 0 psf OK
Allowable Soil Pressure Less Than Allowable	= 2,000 psf
ACI Factored @ Toe	= 2,704 psf
ACI Factored @ Heel	= 0 psf
Footing Shear @ Toe	= 8.8 psi OK
Footing Shear @ Heel	= 10.2 psi OK
Allowable	= 75.0 psi
<b>Sliding Calcs</b>	
Lateral Sliding Force	= 1,021.9 lbs
less 100% Passive Force	= - 656.3 lbs
less 100% Friction Force	= - 961.6 lbs
Added Force Req'd	= 0.0 lbs OK
....for 1.5 Stability	= 0.0 lbs OK

#### Stem Construction

	2nd	Bottom	
Design Height Above Ftg	ft = 4.00	Stem OK 0.00	
Wall Material Above "Ht"	= Masonry	Masonry	
Design Method	= LRFD	LRFD	LRFD
Thickness	= 8.00	8.00	
Rebar Size	= # 4	# 4	
Rebar Spacing	= 32.00	8.00	
Rebar Placed at	= Center	Edge	
<b>Design Data</b>			
fb/FB + fa/Fa	= 0.254	0.414	
<b>Total Force @ Section</b>			
Service Level	lbs =		
Strength Level	lbs =	129.0	1,209.9
<b>Moment.....Actual</b>			
Service Level	ft-# =		
Strength Level	ft-# =	311.8	2,648.4
Moment.....Allowable	ft-# =	1,221.7	6,384.4
<b>Shear.....Actual</b>			
Service Level	psi =		
Strength Level	psi =	5.4	13.2
Shear.....Allowable	psi =	80.5	80.5
Anet (Masonry)	in2 =	23.77	91.50
Rebar Depth 'd'	in =	3.75	5.25
<b>Masonry Data</b>			
f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	No	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	55.0	78.0

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

#### Concrete Data

f'c	psi =		
Fy	psi =		
Equiv. Solid Thick.	in =	4.90	7.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	



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**Cantilevered Retaining Wall**

Code: CBC 2019,ACI 318-14,TMS 402-16

**Footing Dimensions & Strengths**

Toe Width	=	0.50 ft
Heel Width	=	3.00
Total Footing Width	=	3.50
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	6.00 in
Key Distance from Toe	=	0.50 ft
f'c =	2,500 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm = 3.00 in

**Footing Design Results**

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	2,704	0 psf
Mu' : Upward	=	321	1,355 ft-#
Mu' : Downward	=	71	4,069 ft-#
Mu: Design	=	250	2,715 ft-#
Actual 1-Way Shear	=	8.77	10.21 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

**Other Acceptable Sizes & Spacings**

Toe: Not req'd: Mu < phi\*5\*lambda\*sqrt(f'c)\*Sm  
 Heel: #4@ 11.89 in, #5@ 18.44 in, #6@ 26.18 in, #7@ 35.70 in, #8@ 47.01 in, #9@ 5  
 Key: Not req'd: Mu < phi\*5\*lambda\*sqrt(f'c)\*Sm

Min footing T&S reinf Area 0.71 in2  
 Min footing T&S reinf Area per foot 0.20 in2 /ft  
 If one layer of horizontal bars: If two layers of horizontal bars:  
 #4@ 11.90 in #4@ 23.81 in  
 #5@ 18.45 in #5@ 36.90 in  
 #6@ 26.19 in #6@ 52.38 in

**Summary of Overturning & Resisting Forces & Moments**

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	500.0	1.67	833.3	Soil Over Heel	=	1,260.0	2.33	2,940.0
Surcharge over Heel	=	444.4	2.50	1,111.1	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	700.0	2.33	1,633.3
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	77.4	7.42	574.2	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	67.5	0.25	16.9
					Surcharge Over Toe	=			
<b>Total</b>		<b>1,021.9</b>	<b>O.T.M.</b>	<b>2,518.7</b>	Stem Weight(s)	=	577.8	0.83	481.5
					Earth @ Stem Transitions	=			
<b>Resisting/Overturning Ratio</b>				<b>= 2.41</b>	Footing Weight	=	525.0	1.75	918.8
Vertical Loads used for Soil Pressure	=	3,205.3	lbs		Key Weight	=	75.0	1.00	75.0
					Vert. Component	=			
					<b>Total =</b>	<b>3,205.3 lbs</b>	<b>R.M.=</b>	<b>6,065.5</b>	

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

**Tilt**

**Horizontal Deflection at Top of Wall due to settlement of soil**

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.135	in

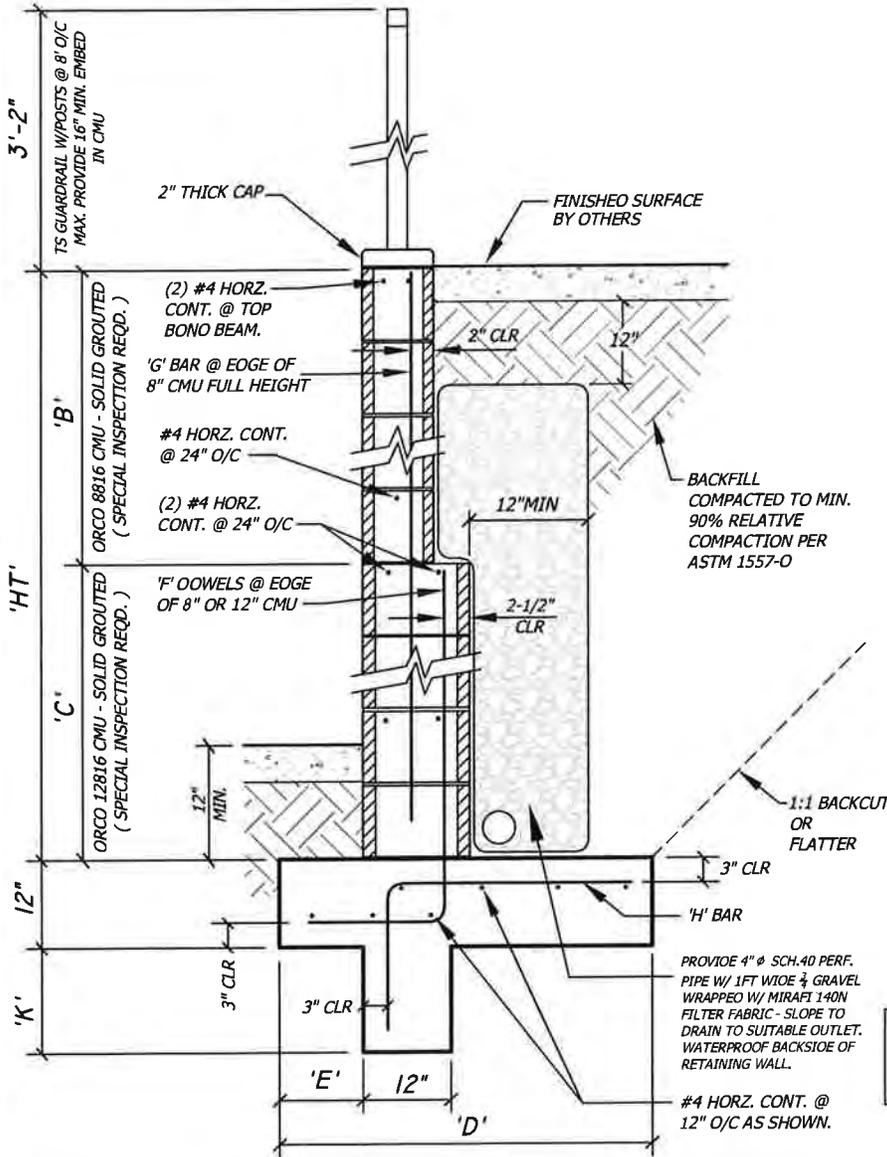
The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



# ORCO 2'-8" TO 6'-8" HIGH RETAINING WALL W/ 36" GUARDRAIL FOR 110 MPH 3 SEC. GUST @ EXP C

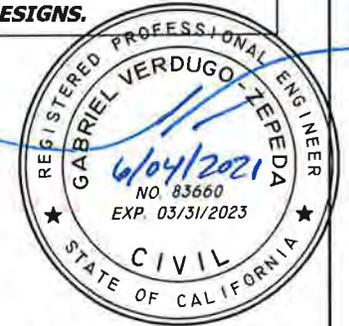
**SPECIAL INSPECTION NOTE:**  
PROVIDE LEVEL 2 SPECIAL INSPECTION PER TMS-602-16 TABLES 3 AND 4 OF THE MASONRY STEM.

- DESIGN CRITERIA PER 2019 CBC:**
1. ALLOWABLE SOIL BEARING PRESSURE FOR FOOTINGS = 2000 PSF PER SOILS REP.
  2. EQUIVALENT FLUID PRESSURE FOR LEVEL BACKFILL = 40 PCF PER SOILS REPORT.
  3. ALLOWABLE LATERAL PASSIVE PRESSURE = 250 PCF PER SOILS REPORT.
  4. GROUT STRENGTH = 2000 PSI @ 28 DAYS & REINFORCING STEEL : GRADE 60.
  5. EARTH COEFFICIENT OF FRICTION = 0.30.
  6. 2000 PSI MASONRY COMPRESSION STRENGTH - SPECIAL INSPECTION REQUIRED.



- NOTES:**
1. CONCRETE BLOCK SHALL BE MANUFACTURED BY ORCO ASTM C 90. WEDGELOCK BLOCK, SLUMP BLOCK AND SPLITFACE BLOCK ARE ACCEPTABLE.
  2. CONCRETE FOR FOOTING SHALL BE 1 PART CEMENT TO 2-1/2 PARTS SAND TO 3-1/2 PARTS GRAVEL WITH A MAXIMUM OF 1-1/2 GALLONS OF WATER PER SACK. PORTLAND CEMENT SHALL CONFORM TO ASTM C 150 TYPE II/V.  $F_c = 2500$  PSI
  3. REINFORCING STEEL SHALL BE DEFORMED AND CONFORM TO ASTM A 615 GRADE 60. PROVIDE 48 BAR DIAMETER LAP.
  4. REBAR SHALL BE CENTERED IN THE CONCRETE BLOCK CELL IN WHICH IT IS LOCATED.
  5. CONCRETE BLOCK SHALL BE LAID IN A RUNNING BOND PATTERN WITH VERTICAL CONTINUITY OF THE CELLS UNO.
  6. ALL BLOCK CELLS SHALL BE SOLID GROUTED.
  7. USE TYPE S MORTAR PROPORTIONED USING ASTM C 270 PART CEMENT TO 1/2 PART LIME TO 4-1/2 PARTS OAMP, LOOSE SAND.
  8. GROUT FOR CONCRETE BLOCK PER ASTM C 476 TO BE 1 PART CEMENT TO 3 PARTS SAND (GROUT MAY CONTAIN 2 PARTS 3/8" PEA GRAVEL IF WEATHER CONDITIONS ARE FAVORABLE AND BLOCK UNOBSTRUCTED CELL SIZE IS SUFFICIENT TO ALLOW GOOD GROUT FLOW). WATER SHALL BE ADDED TO PRODUCE GOOD GROUT FLOW WITHOUT SEGREGATION OF THE CONSTITUENTS.
  9. BLOCK STEM MAY BE WET-SET 1-1/2" INTO THE FOOTING WHILE THE CONCRETE IS PLASTIC. BLOCK STEM MAY BE PLACED TO EITHER EDGE OF THE TRENCH TYPE FOOTING.
  10. FOOTING MUST BE POURED ON OR INTO UNDISTURBED NATURAL SOIL OR ON COMPACTED FILL WITH A MINIMUM COMPACTION OF 90%.
  11. FIRST INSPECTION TO BE AFTER FOOTING TRENCHES ARE READY FOR CONCRETE AND ALL REQUIRED STEEL IS TIED IN PLACE. SECOND INSPECTION TO BE WHEN THE REQUIRED VERTICAL IS IN PLACE AND THE BLOCK WALL IS READY TO GROUT.
  12. MAXIMUM CONTROL JOINT SPACING: 40' O/C. 20' O/C FOR WALLS TO BE MORTAR WASHED OR STUCCO COATED.

**ENGINEERING STAMP APPROVAL IS CONDITIONAL;  
REQUIRING USE OF ORCO MANUFACTURED CMU ON  
ALL ORCO WALL SYSTEM DESIGNS.**



'HT'	'B'	'C'	'D'	'E'	'F' DOWEL	'G' VERT	'H' BAR	'K'
2'-8"	2'-8"	N/A	2'-9"	6"	#4@16" O/C 8"   41"	N/A	#4@16" O/C 8"   21"	4"
3'-4"	3'-4"	N/A	3'-0"	6"	#4@16" O/C 8"   49"	N/A	#4@16" O/C 8"   24"	6"
4'-0"	4'-0"	N/A	3'-6"	6"	#4@8" O/C 8"   57"	N/A	#4@8" O/C 8"   30"	7"
4'-8"	4'-8"	N/A	3'-9"	9"	#4@8" O/C 11"   65"	N/A	#4@8" O/C 8"   30"	10"
5'-4"	3'-4"	2'-0"	4'-3"	9"	#4@8" O/C 15"   33"	#4@16" O/C	#4@8" O/C 18"   36"	1'-0"
6'-0"	3'-4"	2'-8"	4'-9"	1'-0"	#4@8" O/C 18"   41"	#4@16" O/C	#4@8" O/C 20"   39"	1'-2"
6'-8"	4'-0"	2'-8"	6'-0"	1'-0"	#4@8" O/C 18"   41"	#4@8" O/C	#4@8" O/C 20"   54"	1'-2"

## WALL "F3"

**CITY OF  
HERMOSA BEACH**  
PARKING LOT D  
HERMOSA BEACH, CALIFORNIA

**NOTE: DIMENSIONS ARE NOT TO SCALE.**

TS-344

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### Cantilevered Retaining Wall

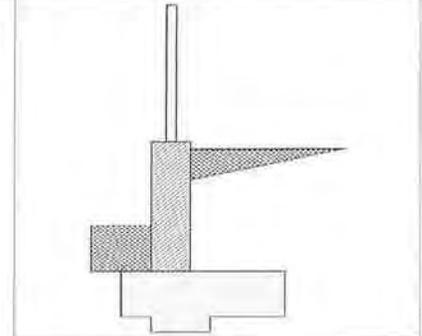
Code: CBC 2019, ACI 318-14, TMS 402-16

#### Criteria

Retained Height	=	2.67 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	2.01 OK
Sliding	=	1.58 OK
Total Bearing Load ...resultant ecc.	=	1,796 lbs 6.89 in
Soil Pressure @ Toe	=	1,495 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable	=	2,000 psf
ACI Factored @ Toe	=	2,094 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	6.2 psi OK
Footing Shear @ Heel	=	8.9 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	690.6 lbs
less 100% Passive Force	= -	555.6 lbs
less 100% Friction Force	= -	538.9 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	2nd	Bottom
Design Height Above Ftg	ft= 2.83	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry
Design Method	= LRFD	LRFD LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	16.00
Rebar Placed at	=	Edge

##### Design Data

fb/FB + fa/Fa	=	0.410
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	90.2 766.2
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	135.5 1,383.2
Moment....Allowable	ft-# =	3,368.0

##### Shear.....Actual

Service Level	psi =	
Strength Level	psi =	8.4
Shear.....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25

##### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

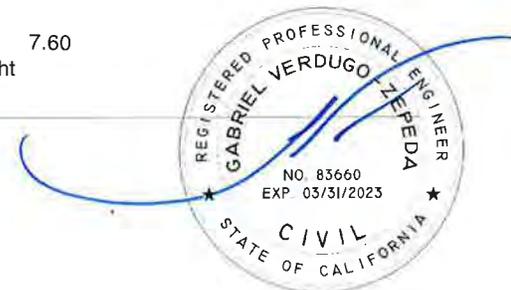
##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.50 ft
Heel Width	=	2.25
Total Footing Width	=	2.75
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	4.00 in
Key Distance from Toe	=	0.50 ft
$f'c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	=	2.00
	@ Btm.=	3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,094	0 psf
Mu' : Upward	=	244	274 ft-#
Mu' : Downward	=	71	1,658 ft-#
Mu: Design	=	172	1,384 ft-#
Actual 1-Way Shear	=	6.17	8.87 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.55 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4 @ 11.90 in  
 #5 @ 18.45 in  
 #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in  
 #5 @ 36.90 in  
 #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	269.4	1.22	329.5	Soil Over Heel	=	570.7	1.96	1,117.6
Surcharge over Heel	=	326.2	1.84	598.6	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	475.0	1.96	930.2
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	95.0	5.25	498.9	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	67.5	0.25	16.9
					Surcharge Over Toe	=			
<b>Total</b>		<b>690.6</b>	<b>O.T.M.</b>	<b>1,427.1</b>	Stem Weight(s)	=	220.7	0.83	184.0
					Earth @ Stem Transitions	=			
					Footing Weight	=	412.5	1.38	567.2
<b>Resisting/Overturning Ratio</b>			=	<b>2.01</b>	Key Weight	=	50.0	1.00	50.0
Vertical Loads used for Soil Pressure	=			1,796.5 lbs	Vert. Component	=			
					<b>Total =</b>		<b>1,796.5 lbs</b>	<b>R.M.=</b>	<b>2,865.9</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.088 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

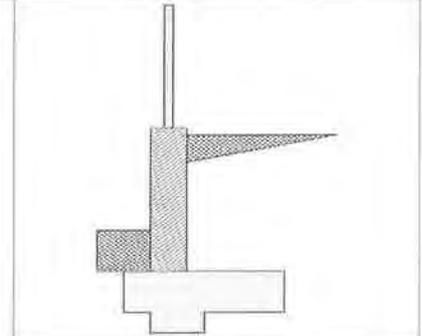
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	3.33 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	1.99 OK
Sliding	=	1.55 OK
Total Bearing Load	=	2,240 lbs
...resultant ecc.	=	7.71 in
Soil Pressure @ Toe	=	1,741 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable		2,000 psf
ACI Factored @ Toe	=	2,437 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	7.5 psi OK
Footing Shear @ Heel	=	10.5 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	854.8 lbs
less 100% Passive Force	= -	656.3 lbs
less 100% Friction Force	= -	671.9 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	2nd	Bottom
Design Height Above Ftg	ft = 3.50	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry
Design Method	= LRFD	LRFD LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	16.00
Rebar Placed at	=	Edge

##### Design Data

fb/FB + fa/Fa	=	0.581
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	89.9 986.7
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	134.6 1,960.1
Moment....Allowable	ft-# =	3,368.0

##### Shear.....Actual

Service Level	psi =	
Strength Level	psi =	10.8
Shear.....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25

##### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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**Cantilevered Retaining Wall**

Code: CBC 2019,ACI 318-14,TMS 402-16

**Footing Dimensions & Strengths**

Toe Width	=	0.50 ft
Heel Width	=	2.50
Total Footing Width	=	3.00
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	6.00 in
Key Distance from Toe	=	0.50 ft
f'c	=	2,500 psi
Fy	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	=	2.00
@ Btm	=	3.00 in

**Footing Design Results**

		<b>Toe</b>	<b>Heel</b>
Factored Pressure	=	2,437	0 psf
Mu' : Upward	=	285	439 ft-#
Mu' : Downward	=	71	2,382 ft-#
Mu: Design	=	214	1,943 ft-#
Actual 1-Way Shear	=	7.52	10.52 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

**Other Acceptable Sizes & Spacings**

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.60 in2  
 Min footing T&S reinf Area per foot 0.20 in2 /ft  
 If one layer of horizontal bars: #4 @ 11.90 in  
   #5 @ 18.45 in  
   #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in  
   #5 @ 36.90 in  
   #6 @ 52.38 in

**Summary of Overturning & Resisting Forces & Moments**

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	375.0	1.44	541.2	Soil Over Heel	=	824.2	2.08	1,717.0
Surcharge over Heel	=	384.9	2.17	833.3	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	550.0	2.08	1,145.8
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=	95.0	5.91	561.6	* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	67.5	0.25	16.9
					Surcharge Over Toe	=			
<b>Total</b>		<b>854.8</b>	<b>O.T.M.</b>	<b>1,936.1</b>	Stem Weight(s)	=	273.0	0.83	227.5
					Earth @ Stem Transitions	=			
<b>Resisting/Overturning Ratio</b>			<b>= 1.99</b>		Footing Weight	=	450.0	1.50	675.0
Vertical Loads used for Soil Pressure	=	2,239.7	lbs		Key Weight	=	75.0	1.00	75.0
					Vert. Component	=			
					<b>Total =</b>	<b>2,239.7 lbs</b>	<b>R.M.=</b>	<b>3,857.2</b>	

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

**Tilt**

**Horizontal Deflection at Top of Wall due to settlement of soil**

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.105	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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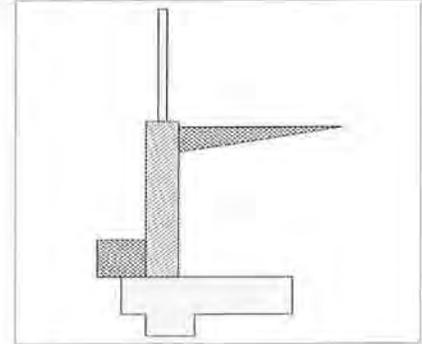
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

<b>Wall Stability Ratios</b>		
Overturning	=	2.28 OK
Sliding	=	1.54 OK
Total Bearing Load	=	2,964 lbs
...resultant ecc.	=	7.65 in
Soil Pressure @ Toe	=	1,777 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable	=	2,000 psf
ACI Factored @ Toe	=	2,488 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	7.9 psi OK
Footing Shear @ Heel	=	11.4 psi OK
Allowable	=	75.0 psi
<b>Sliding Calcs</b>		
Lateral Sliding Force	=	1,039.4 lbs
less 100% Passive Force	= -	709.2 lbs
less 100% Friction Force	= -	889.3 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	2nd	Bottom
Design Height Above Ftg	ft = 4.16	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry
Design Method	= LRFD	LRFD LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	8.00
Rebar Placed at	=	Edge

#### Design Data

fb/FB + fa/Fa	=	0.423
---------------	---	-------

#### Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	90.2 1,239.2

#### Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	135.5 2,704.2
Moment....Allowable	ft-# =	6,384.4

#### Shear.....Actual

Service Level	psi =	
Strength Level	psi =	13.5
Shear.....Allowable	=	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	5.25

#### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

#### Concrete Data

f'c	psi =	
Fy	psi =	



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.50 ft
Heel Width	=	3.00
Total Footing Width	=	3.50
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	7.00 in
Key Distance from Toe	=	0.50 ft
$f'c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm.= 3.00 in

#### Footing Design Results

	Toe	Heel
Factored Pressure	= 2,488	0 psf
Mu' : Upward	= 295	1,270 ft-#
Mu' : Downward	= 71	4,069 ft-#
Mu: Design	= 224	2,800 ft-#
Actual 1-Way Shear	= 7.94	11.37 psi
Allow 1-Way Shear	= 40.00	75.00 psi
Toe Reinforcing	= None Spec'd	
Heel Reinforcing	= None Spec'd	
Key Reinforcing	= None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: #4@ 11.89 in, #5@ 18.44 in, #6@ 26.18 in, #7@ 35.70 in, #8@ 47.01 in, #9@ 5  
 Key: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.71 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4@ 11.90 in, #5@ 18.45 in, #6@ 26.19 in  
 If two layers of horizontal bars: #4@ 23.81 in, #5@ 36.90 in, #6@ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 500.0	1.67	833.3	Soil Over Heel	= 1,260.0	2.33	2,940.0
Surcharge over Heel	= 444.4	2.50	1,111.1	Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	= 700.0	2.33	1,633.3
Adjacent Footing Load	=			Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	= 95.0	6.58	625.3	* Axial Live Load on Stem	=		
	=			Soil Over Toe	= 67.5	0.25	16.9
				Surcharge Over Toe	=		
				Stem Weight(s)	= 324.5	0.83	270.4
				Earth @ Stem Transitions	=		
<b>Total</b>	<b>1,039.4</b>	<b>O.T.M.</b>	<b>2,569.7</b>	Footing Weight	= 525.0	1.75	918.8
	=	=		Key Weight	= 87.5	1.00	87.5
				Vert. Component	=		
<b>Resisting/Overturning Ratio</b>		=	<b>2.28</b>	<b>Total =</b>	<b>2,964.5 lbs</b>	<b>R.M.=</b>	<b>5,866.9</b>
Vertical Loads used for Soil Pressure =			2,964.5 lbs	* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.			

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0 pcf
Horizontal Defl @ Top of Wall (approximate only)	0.101 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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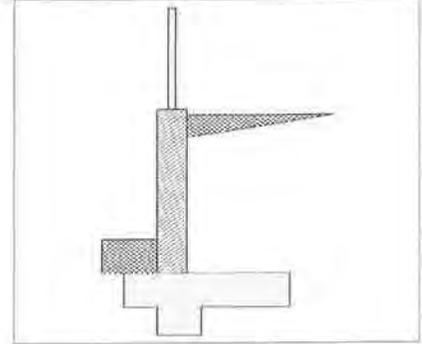
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	4.67 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	2.18 OK
Sliding	=	1.51 OK
Total Bearing Load	=	3,337 lbs
...resultant ecc.	=	8.36 in
Soil Pressure @ Toe	=	1,887 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable	=	2,000 psf
ACI Factored @ Toe	=	2,642 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	12.3 psi OK
Footing Shear @ Heel	=	14.3 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	1,242.0 lbs
less 100% Passive Force	= -	878.5 lbs
less 100% Friction Force	= -	1,001.0 lbs
Added Force Req'd	=	0.0 lbs OK
...for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

##### Design Height Above Ftg

ft =	4.83	2nd	Bottom
Wall Material Above "Ht"	=	Fence	Masonry
Design Method	=	LRFD	LRFD
Thickness	=		8.00
Rebar Size	=		# 4
Rebar Spacing	=		8.00
Rebar Placed at	=		Edge

##### Design Data

fb/FB + fa/Fa	=	0.567
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##### Total Force @ Section

Service Level	lbs =		
Strength Level	lbs =	90.2	1,520.4

##### Moment....Actual

Service Level	ft-# =		
Strength Level	ft-# =	135.5	3,627.1
Moment....Allowable	ft-# =		6,384.4

##### Shear.....Actual

Service Level	psi =		
Strength Level	psi =		16.6
Shear....Allowable	=		80.5
Anet (Masonry)	in2 =		91.50
Rebar Depth 'd'	in =		5.25

##### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Equiv. Solid Thick.	=	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

##### Concrete Data

fc	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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**Cantilevered Retaining Wall**

Code: CBC 2019,ACI 318-14,TMS 402-16

**Footing Dimensions & Strengths**

Toe Width = 0.75 ft  
 Heel Width = 3.00  
 Total Footing Width = 3.75  
 Footing Thickness = 12.00 in  
 Key Width = 12.00 in  
 Key Depth = 10.00 in  
 Key Distance from Toe = 0.75 ft  
 f'c = 2,500 psi Fy = 60,000 psi  
 Footing Concrete Density = 150.00 pcf  
 Min. As % = 0.0014  
 Cover @ Top 2.00 @ Btm = 3.00 in

**Footing Design Results**

	Toe	Heel
Factored Pressure =	2,642	0 psf
Mu' : Upward =	691	1,185 ft-#
Mu' : Downward =	139	4,407 ft-#
Mu: Design =	552	3,222 ft-#
Actual 1-Way Shear =	12.29	14.27 psi
Allow 1-Way Shear =	40.00	75.00 psi
Toe Reinforcing =	None Spec'd	
Heel Reinforcing =	None Spec'd	
Key Reinforcing =	None Spec'd	

**Other Acceptable Sizes & Spacings**

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: #4@ 11.89 in, #5@ 18.44 in, #6@ 26.18 in, #7@ 35.70 in, #8@ 47.01 in, #9@ 5  
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.76 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: If two layers of horizontal bars:  
 #4@ 11.90 in #4@ 23.81 in  
 #5@ 18.45 in #5@ 36.90 in  
 #6@ 26.19 in #6@ 52.38 in

**Summary of Overturning & Resisting Forces & Moments**

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure =	643.0	1.89	1,215.2	Soil Over Heel =	1,471.1	2.58	3,800.2
Surcharge over Heel =	504.0	2.84	1,428.8	Sloped Soil Over Heel =			
Surcharge Over Toe =				Surcharge Over Heel =	700.0	2.58	1,808.3
Adjacent Footing Load =				Adjacent Footing Load =			
Added Lateral Load =				Axial Dead Load on Stem =			
Load @ Stem Above Soil =	95.0	7.25	688.9	* Axial Live Load on Stem =			
				Soil Over Toe =	101.3	0.38	38.0
				Surcharge Over Toe =			
<b>Total</b>	<b>1,242.0</b>	<b>O.T.M.</b>	<b>3,333.0</b>	Stem Weight(s) =	376.7	1.08	408.1
				Earth @ Stem Transitions =			
				Footing Weight =	562.5	1.88	1,054.7
<b>Resisting/Overturning Ratio</b>		=	<b>2.18</b>	Key Weight =	125.0	1.25	156.3
Vertical Loads used for Soil Pressure =		3,336.5 lbs		Vert. Component =			
				<b>Total =</b>	<b>3,336.5 lbs</b>	<b>R.M.=</b>	<b>7,265.6</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

**Tilt**

**Horizontal Deflection at Top of Wall due to settlement of soil**

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.110 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

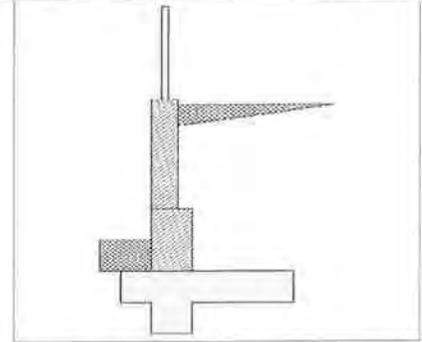
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	5.33 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	2.38 OK
Sliding	=	1.53 OK
Total Bearing Load ...resultant ecc.	=	4,108 lbs 8.42 in
Soil Pressure @ Toe	=	1,925 psf OK
Soil Pressure @ Heel	=	9 psf OK
Allowable Soil Pressure Less Than Allowable	=	2,000 psf
ACI Factored @ Toe	=	2,695 psf
ACI Factored @ Heel	=	12 psf
Footing Shear @ Toe	=	12.9 psi OK
Footing Shear @ Heel	=	15.8 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	1,459.0 lbs
less 100% Passive Force	= -	1,000.0 lbs
less 100% Friction Force	= -	1,232.5 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	3rd	2nd	Bottom
Design Height Above Ftg	ft = 5.50	Stem OK	Stem OK
Wall Material Above "Ht"	= Fence	Masonry	Masonry
Design Method	= LRFD	LRFD	LRFD
Thickness	=	8.00	12.00
Rebar Size	=	# 4	# 4
Rebar Spacing	=	16.00	8.00
Rebar Placed at	=	Edge	Edge

##### Design Data

fb/FB + fa/Fa	=	0.581	0.412
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##### Total Force @ Section

Service Level	lbs =			
Strength Level	lbs =	89.9	986.7	1,825.4

##### Moment....Actual

Service Level	ft-# =			
Strength Level	ft-# =	134.6	1,960.1	4,729.7
Moment....Allowable	ft-# =		3,368.0	11,446.9

##### Shear.....Actual

Service Level	psi =			
Strength Level	psi =		10.8	13.1

Shear....Allowable	=	80.5	80.5
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Anet (Masonry)	in2 =	91.50	139.50
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Rebar Depth 'd'	in =	5.25	9.00
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##### Masonry Data

f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	124.0

Equiv. Solid Thick.	=	7.60	11.60
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Masonry Block Type	=	Medium Weight
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Masonry Design Method	=	LRFD
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##### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	0.75 ft
Heel Width	=	3.50
Total Footing Width	=	4.25
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	12.00 in
Key Distance from Toe	=	0.75 ft
$f'c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm= 3.00 in

#### Footing Design Results

	Toe	Heel
Factored Pressure	= 2,695	12 psf
Mu' : Upward	= 713	1,682 ft-#
Mu' : Downward	= 160	5,713 ft-#
Mu: Design	= 553	4,031 ft-#
Actual 1-Way Shear	= 12.89	15.84 psi
Allow 1-Way Shear	= 40.00	75.00 psi
Toe Reinforcing	= None Spec'd	
Heel Reinforcing	= None Spec'd	
Key Reinforcing	= None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: #4 @ 11.89 in, #5 @ 18.44 in, #6 @ 26.18 in, #7 @ 35.70 in, #8 @ 47.01 in, #9 @ 5  
 Key: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.86 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4 @ 11.90 in, #5 @ 18.45 in, #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in, #5 @ 36.90 in, #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 801.4	2.11	1,690.9	Soil Over Heel	= 1,798.9	3.00	5,396.6
Surcharge over Heel	= 562.7	3.17	1,780.8	Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	= 750.0	3.00	2,250.0
Adjacent Footing Load	=			Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	= 95.0	7.91	751.6	* Axial Live Load on Stem	=		
	=			Soil Over Toe	= 101.3	0.38	38.0
				Surcharge Over Toe	=		
<b>Total</b>	<b>1,459.0</b>	<b>O.T.M.</b>	<b>4,223.3</b>	Stem Weight(s)	= 521.0	1.16	605.8
				Earth @ Stem Transitions	= 149.9	1.58	237.3
				Footing Weight	= 637.5	2.13	1,354.7
<b>Resisting/Overturning Ratio</b>		=	<b>2.38</b>	Key Weight	= 150.0	1.25	187.5
Vertical Loads used for Soil Pressure =		4,108.5 lbs		Vert. Component	=		
				<b>Total =</b>	<b>4,108.5 lbs</b>	<b>R.M.=</b>	<b>10,069.8</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.107 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

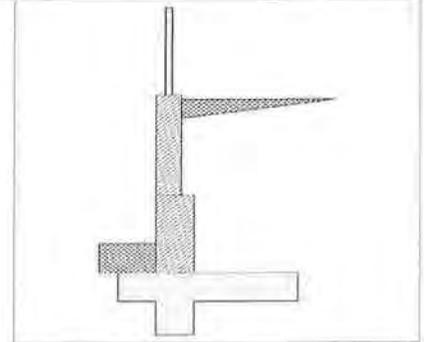
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	2.55 OK
Sliding	=	1.52 OK
Total Bearing Load	=	4,828 lbs
...resultant ecc.	=	8.17 in
Soil Pressure @ Toe	=	1,891 psf OK
Soil Pressure @ Heel	=	142 psf OK
Allowable Soil Pressure Less Than Allowable		2,000 psf
ACI Factored @ Toe	=	2,647 psf
ACI Factored @ Heel	=	199 psf
Footing Shear @ Toe	=	16.6 psi OK
Footing Shear @ Heel	=	17.5 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	1,697.2 lbs
less 100% Passive Force	=	- 1,128.5 lbs
less 100% Friction Force	=	- 1,448.4 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

	3rd	2nd	Bottom
Design Height Above Ftg	ft= 6.16	Stem OK 2.67	Stem OK 0.00
Wall Material Above "Ht"	= Fence	Masonry	Masonry
Design Method	= LRFD	LRFD	LRFD
Thickness	=	8.00	12.00
Rebar Size	=	# 4	# 4
Rebar Spacing	=	16.00	8.00
Rebar Placed at	=	Edge	Edge

##### Design Data

fb/FB + fa/Fa	=	0.581	0.529
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##### Total Force @ Section

Service Level	lbs =		
Strength Level	lbs =	90.2	986.7 2,163.6

##### Moment....Actual

Service Level	ft-# =		
Strength Level	ft-# =	135.5	1,960.1 6,064.4
Moment....Allowable	ft-# =		3,368.0 11,446.9

##### Shear.....Actual

Service Level	psi =		
Strength Level	psi =		10.8 15.5

Shear.....Allowable	=	80.5	80.5
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Anet (Masonry)	in2 =	91.50	139.50
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Rebar Depth 'd'	in =	5.25	9.00
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##### Masonry Data

f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	124.0

Equiv. Solid Thick.	=	7.60	11.60
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Masonry Block Type	=	Medium Weight	
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Masonry Design Method	=	LRFD	
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##### Concrete Data

f'c	psi =		
Fy	psi =		

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	3.75
Total Footing Width	=	4.75
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	14.00 in
Key Distance from Toe	=	1.00 ft
$f'c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm = 3.00 in

#### Footing Design Results

	Toe	Heel
Factored Pressure	= 2,647	199 psf
Mu' : Upward	= 1,238	2,539 ft-#
Mu' : Downward	= 257	7,293 ft-#
Mu: Design	= 981	4,754 ft-#
Actual 1-Way Shear	= 16.61	17.47 psi
Allow 1-Way Shear	= 40.00	75.00 psi
Toe Reinforcing	=	None Spec'd
Heel Reinforcing	=	None Spec'd
Key Reinforcing	=	None Spec'd

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: #4 @ 11.89 in, #5 @ 18.44 in, #6 @ 26.18 in, #7 @ 35.70 in, #8 @ 47.01 in, #9 @ 5  
 Key: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.96 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4 @ 11.90 in, #5 @ 18.45 in, #6 @ 26.19 in  
 If two layers of horizontal bars: #4 @ 23.81 in, #5 @ 36.90 in, #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 980.0	2.33	2,286.7	Soil Over Heel	= 2,227.5	3.38	7,517.8
Surcharge over Heel	= 622.2	3.50	2,177.8	Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	= 825.0	3.38	2,784.4
Adjacent Footing Load	=			Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	= 95.0	8.58	815.2	* Axial Live Load on Stem	=		
	=			Soil Over Toe	= 135.0	0.50	67.5
				Surcharge Over Toe	=		
				Stem Weight(s)	= 603.3	1.42	859.6
				Earth @ Stem Transitions	= 149.9	1.83	274.7
				Footing Weight	= 712.5	2.38	1,692.2
				Key Weight	= 175.0	1.50	262.5
				Vert. Component	=		
<b>Total</b>	<b>1,697.2</b>	<b>O.T.M.</b>	<b>5,279.7</b>	<b>Total =</b>	<b>4,828.2 lbs</b>	<b>R.M.=</b>	<b>13,458.7</b>
<b>Resisting/Overturning Ratio</b>		<b>= 2.55</b>					
Vertical Loads used for Soil Pressure =		4,828.2 lbs					

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0 pcf
Horizontal Defl @ Top of Wall (approximate only)	0.101 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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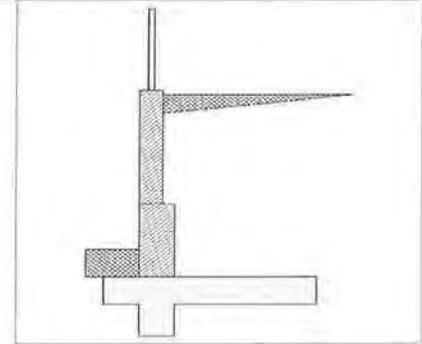
Code: CBC 2019, ACI 318-14, TMS 402-16

#### Criteria

Retained Height	=	6.67 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	50.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

<b>Wall Stability Ratios</b>	
Overturning	= 3.62 OK
Sliding	= 1.63 OK
Total Bearing Load	= 6,845 lbs
...resultant ecc.	= 6.21 in
Soil Pressure @ Toe	= 1,731 psf OK
Soil Pressure @ Heel	= 551 psf OK
Allowable	= 2,000 psf
Soil Pressure Less Than Allowable	
ACI Factored @ Toe	= 2,423 psf
ACI Factored @ Heel	= 771 psf
Footing Shear @ Toe	= 15.7 psi OK
Footing Shear @ Heel	= 14.7 psi OK
Allowable	= 75.0 psi
<b>Sliding Calcs</b>	
Lateral Sliding Force	= 1,951.8 lbs
less 100% Passive Force	= - 1,128.5 lbs
less 100% Friction Force	= - 2,053.5 lbs
Added Force Req'd	= 0.0 lbs OK
...for 1.5 Stability	= 0.0 lbs OK

#### Stem Construction

	3rd	2nd	Bottom	
<b>Design Height Above Ftg</b>	ft = 6.83	Stem OK	Stem OK	
Wall Material Above "Ht"	= Fence	2.67	0.00	
Design Method	= LRFD	Masonry	Masonry	
Thickness	=	8.00	12.00	
Rebar Size	=	# 4	# 4	
Rebar Spacing	=	8.00	8.00	
Rebar Placed at	=	Edge	Edge	
<b>Design Data</b>				
fb/FB + fa/Fa	=	0.422	0.665	
<b>Total Force @ Section</b>				
Service Level	lbs =			
Strength Level	lbs =	90.1	1,237.6	2,528.3
<b>Moment....Actual</b>				
Service Level	ft-# =			
Strength Level	ft-# =	135.2	2,699.3	7,625.2
Moment....Allowable	ft-# =		6,384.4	11,446.9
<b>Shear.....Actual</b>				
Service Level	psi =			
Strength Level	psi =		13.5	18.1
Shear....Allowable	=		80.5	80.5
Anet (Masonry)	in2 =		91.50	139.50
Rebar Depth 'd'	in =		5.25	9.00
<b>Masonry Data</b>				
f'm	psi =		2,000	2,000
Fy	psi =		60,000	60,000
Solid Grouting	=		Yes	Yes
Modular Ratio 'n'	=		16.11	16.11
Wall Weight	psf =		78.0	124.0

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

Building Code	CBC 2019, ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

#### Concrete Data

f'c	psi =		
Fy	psi =		
Equiv. Solid Thick.	=	7.60	11.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	5.00
Total Footing Width	=	6.00
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	14.00 in
Key Distance from Toe	=	1.00 ft
$f'c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm = 3.00 in

#### Footing Design Results

	Toe	Heel
Factored Pressure	= 2,423	771 psf
Mu' : Upward	= 1,166	9,105 ft-#
Mu' : Downward	= 257	15,659 ft-#
Mu: Design	= 909	6,554 ft-#
Actual 1-Way Shear	= 15.75	14.67 psi
Allow 1-Way Shear	= 40.00	75.00 psi
Toe Reinforcing	=	None Spec'd
Heel Reinforcing	=	None Spec'd
Key Reinforcing	=	None Spec'd

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: #4 @ 11.34 in, #5 @ 17.58 in, #6 @ 24.95 in, #7 @ 34.03 in, #8 @ 44.81 in, #9 @ 5  
 Key: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area	1.21	in <sup>2</sup>
Min footing T&S reinf Area per foot	0.20	in <sup>2</sup> /ft
If one layer of horizontal bars:		If two layers of horizontal bars:
#4 @ 11.90 in		#4 @ 23.81 in
#5 @ 18.45 in		#5 @ 36.90 in
#6 @ 26.19 in		#6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 1,175.4	2.56	3,003.4	Soil Over Heel	= 3,599.6	4.00	14,398.6
Surcharge over Heel	= 681.4	3.83	2,611.9	Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	= 1,200.0	4.00	4,800.0
Adjacent Footing Load	=			Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	= 95.0	9.25	878.5	* Axial Live Load on Stem	=		
	=			Soil Over Toe	= 135.0	0.50	67.5
				Surcharge Over Toe	=		
<b>Total</b>	<b>1,951.8</b>	<b>O.T.M.</b>	<b>6,493.8</b>	Stem Weight(s)	= 655.6	1.42	929.3
				Earth @ Stem Transitions	= 179.8	1.83	329.7
<b>Resisting/Overturning Ratio</b>		=	<b>3.62</b>	Footing Weight	= 900.0	3.00	2,700.0
Vertical Loads used for Soil Pressure	=	6,845.0 lbs		Key Weight	= 175.0	1.50	262.5
				Vert. Component	=		
				<b>Total</b>	<b>= 6,845.0 lbs</b>	<b>R.M.=</b>	<b>23,487.5</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.079	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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### Cantilevered Retaining Wall

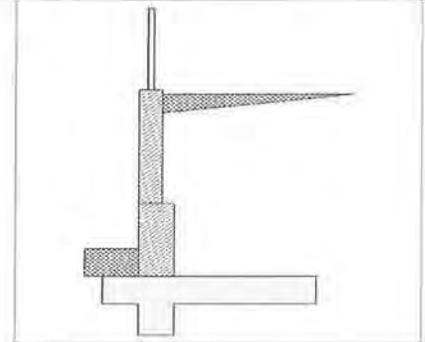
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	6.67 ft
Wall height above soil	=	3.17 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	0.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Earth Pressure Seismic Load

Method : Inverted Triangular

Load at top of Inverted Triangular Distribution ..... = 162.000 psf  
 (Strength)

Total Strength-Level Seismic Load. .... = 620.946 lbs  
 Total Service-Level Seismic Load. .... = 434.662 lbs

#### Design Summary

##### Wall Stability Ratios

Overturning	=	3.00 OK
Sliding	=	1.39 Ratio < 1.5!
Total Bearing Load	=	6,845 lbs
...resultant ecc.	=	8.56 in
Soil Pressure @ Toe	=	1,955 psf OK
Soil Pressure @ Heel	=	327 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,737 psf
ACI Factored @ Heel	=	458 psf
Footing Shear @ Toe	=	17.9 psi OK
Footing Shear @ Heel	=	18.3 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	2,291.4 lbs
less 100% Passive Force	= -	1,128.5 lbs
less 100% Friction Force	= -	2,053.5 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	255.2 lbs NG

#### Stem Construction

##### Design Height Above Ftg

ft=	6.83	Stem OK	2.67	Stem OK	0.00
Wall Material Above "Ht"	=	Fence	Masonry	Masonry	
Design Method	=	LRFD	LRFD	LRFD	
Thickness	=		8.00	12.00	
Rebar Size	=		# 4	# 4	
Rebar Spacing	=		8.00	8.00	
Rebar Placed at	=		Edge	Edge	

##### Design Data

fb/FB + fa/Fa = 0.451 0.774

##### Total Force @ Section

Service Level	lbs =			
Strength Level	lbs =		1,557.9	2,980.4

##### Moment....Actual

Service Level	ft-# =			
Strength Level	ft-# =		2,884.8	8,875.4
Moment....Allowable	ft-# =		6,384.4	11,446.9

##### Shear....Actual

Service Level	psi =			
Strength Level	psi =		17.0	21.4

##### Shear....Allowable

=		80.5	80.5
Anet (Masonry)	in2 =	91.50	139.50
Rebar Depth 'd'	in =	5.25	9.00

##### Masonry Data

f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	124.0

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

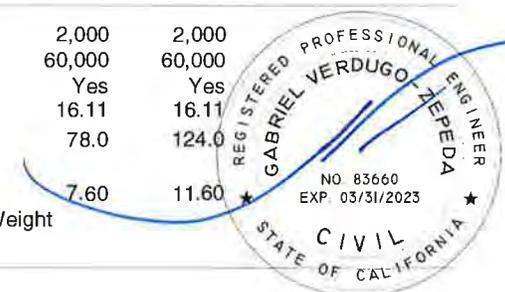
#### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Equiv. Solid Thick. = 7.60 11.60  
 Masonry Block Type = Medium Weight  
 Masonry Design Method = LRFD

#### Concrete Data

f'c	psi =	
Fy	psi =	



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### Cantilevered Retaining Wall

Code: CBC 2019, ACI 318-14, TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	5.00
Total Footing Width	=	6.00
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	14.00 in
Key Distance from Toe	=	1.00 ft
$f'c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	=	2.00
	@ Btm	= 3.00 in

#### Footing Design Results

	Toe	Heel
Factored Pressure	= 2,737	458 psf
Mu' : Upward	= 1,305	7,712 ft-#
Mu' : Downward	= 257	15,659 ft-#
Mu: Design	= 1,049	7,947 ft-#
Actual 1-Way Shear	= 17.92	18.34 psi
Allow 1-Way Shear	= 40.00	75.00 psi
Toe Reinforcing	=	None Spec'd
Heel Reinforcing	=	None Spec'd
Key Reinforcing	=	None Spec'd

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: #4@ 9.35 in, #5@ 14.50 in, #6@ 20.58 in, #7@ 28.06 in, #8@ 36.95 in, #9@ 46  
 Key: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area	1.21	in <sup>2</sup>
Min footing T&S reinf Area per foot	0.20	in <sup>2</sup> /ft
If one layer of horizontal bars:		If two layers of horizontal bars:
#4@ 11.90 in		#4@ 23.81 in
#5@ 18.45 in		#5@ 36.90 in
#6@ 26.19 in		#6@ 52.38 in

### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			=	.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#		Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 1,175.4	2.56	3,003.4		Soil Over Heel	= 3,599.6	4.00	14,398.6
Surcharge over Heel	= 681.4	3.83	2,611.9		Sloped Soil Over Heel	=		
Surcharge Over Toe	=				Surcharge Over Heel	= 1,200.0	4.00	4,800.0
Adjacent Footing Load	=				Adjacent Footing Load	=		
Added Lateral Load	=				Axial Dead Load on Stem	=		
Load @ Stem Above Soil	=				* Axial Live Load on Stem	=		
Seismic Earth Load	= 434.7	5.11	2,221.4		Soil Over Toe	= 135.0	0.50	67.5
	=				Surcharge Over Toe	=		
<b>Total</b>	<b>2,291.4</b>	<b>O.T.M.</b>	<b>7,836.7</b>		Stem Weight(s)	= 655.6	1.42	929.3
	=				Earth @ Stem Transitions	= 179.8	1.83	329.7
<b>Resisting/Overturning Ratio</b>		=	<b>3.00</b>		Footing Weight	= 900.0	3.00	2,700.0
Vertical Loads used for Soil Pressure	=	6,845.0 lbs			Key Weight	= 175.0	1.50	262.5
					Vert. Component	=		
					<b>Total =</b>	<b>6,845.0 lbs</b>	<b>R.M.=</b>	<b>23,487.5</b>

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

#### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.089	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



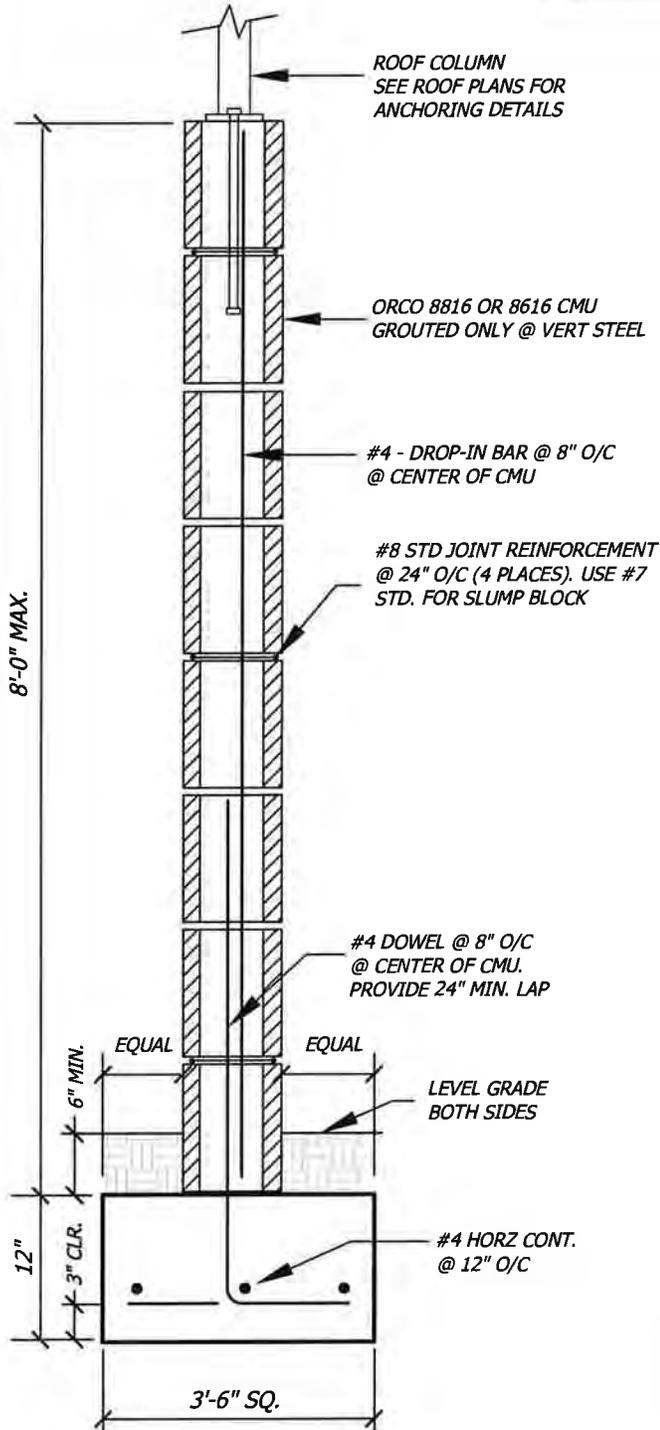
# ORCO WALLS AT TRASH ENCLOSURE ROOF SUPPORTS FOR 110 MPH 3 SEC. GUST @ EXP C

**REBAR NOTE:**

- DO NOT RUN HORIZONTAL REINFORCEMENT THROUGH WALL RETURNS & CONSTRUCTION JOINTS.
- PROVIDE DOWEL & DROP-IN BAR ACCORDING TO DETAIL AT EACH SIDE OF CONTROL JOINTS, ENDS OF WALLS AND @ WALL HEIGHT CHANGES.

**DESIGN CRITERIA PER 2019 CBC:**

1. ALLOWABLE SOIL BEARING PRESSURE FOR FOOTINGS = 2000 PSF PER SOILS REP.
2. EQUIVALENT FLUID PRESSURE FOR LEVEL BACKFILL = 40 PCF PER SOILS REPORT.
3. ALLOWABLE LATERAL PASSIVE PRESSURE = 250 PCF PER SOILS REPORT.
4. GROUT STRENGTH = 2000 PSI @ 28 DAYS & REINFORCING STEEL : GRADE 60.
5. EARTH COEFFICIENT OF FRICTION = 0.30.
6. 2000 PSI MASONRY COMPRESSION STRENGTH - SPECIAL INSPECTION REQUIRED.



**NOTES:**

1. CONCRETE BLOCK SHALL BE MANUFACTURED BY ORCO ASTM C 90. WEDGELOCK BLOCK, SLUMP BLOCK AND SPLITFACE BLOCK ARE ACCEPTABLE.
2. CONCRETE FOR FOOTING SHALL BE 1 PART CEMENT TO 2-1/2 PARTS SAND TO 3-1/2 PARTS GRAVEL WITH A MAXIMUM OF 1-1/2 GALLONS OF WATER PER SACK. PORTLAND CEMENT SHALL CONFORM TO ASTM C 150 TYPE II/V.  $f_c = 2500$  PSI
3. REINFORCING STEEL SHALL BE DEFORMED AND CONFORM TO ASTM A 615 GRADE 60. PROVIDE 48 BAR DIAMETER LAP.
4. REBAR SHALL BE CENTERED IN THE CONCRETE BLOCK CELL IN WHICH IT IS LOCATED.
5. CONCRETE BLOCK SHALL BE LAID IN A RUNNING BOND PATTERN WITH VERTICAL CONTINUITY OF THE CELLS UNO.
6. ALL BLOCK CELLS CONTAINING VERTICAL REBAR SHALL BE SOLID GROUTED.
7. USE TYPE S MORTAR PROPORTIONED USING ASTM C 270 PART CEMENT TO 1/2 PART LIME TO 4-1/2 PARTS DAMP, LOOSE SAND.
8. GROUT FOR CONCRETE BLOCK PER ASTM C 476 TO BE 1 PART CEMENT TO 3 PARTS SAND (GROUT MAY CONTAIN 2 PARTS 3/8" PEA GRAVEL IF WEATHER CONDITIONS ARE FAVORABLE AND BLOCK UNOBSTRUCTED CELL SIZE IS SUFFICIENT TO ALLOW GOOD GROUT FLOW). WATER SHALL BE ADDED TO PRODUCE GOOD GROUT FLOW WITHOUT SEGREGATION OF THE CONSTITUENTS.
9. BLOCK STEM MAY BE WET-SET 1-1/2" INTO THE FOOTING WHILE THE CONCRETE IS PLASTIC. BLOCK STEM MAY BE PLACED TO EITHER EDGE OF THE TRENCH TYPE FOOTING.
10. FOOTING MUST BE POURED ON OR INTO UNDISTURBED NATURAL SOIL OR ON COMPACTED FILL WITH A MINIMUM COMPACTION OF 90%.
11. FIRST INSPECTION TO BE AFTER FOOTING TRENCHES ARE READY FOR CONCRETE AND ALL REQUIRED STEEL IS TIED IN PLACE. SECOND INSPECTION TO BE WHEN THE REQUIRED VERTICAL IS IN PLACE AND THE BLOCK WALL IS READY TO GROUT.
12. MAXIMUM CONTROL JOINT SPACING: 40' O/C. 20' O/C FOR WALLS TO BE MORTAR WASHED OR STUCCO COATED.

## WALL "E.1"

**ENGINEERING STAMP APPROVAL IS CONDITIONAL;  
REQUIRING USE OF ORCO MANUFACTURED CMU ON  
ALL ORCO WALL SYSTEM DESIGNS.**

**NOTE: DIMENSIONS ARE NOT TO SCALE.**

**CITY OF  
HERMOSA BEACH**  
PARKING LOT D  
HERMOSA BEACH, CALIFORNIA  
TS-361



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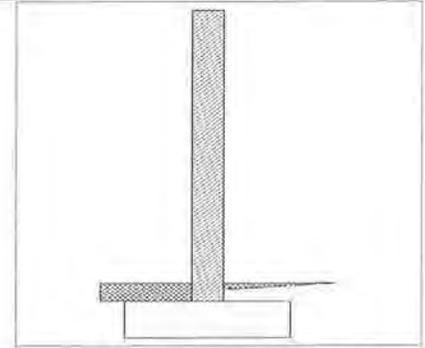
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	0.50 ft
Wall height above soil	=	7.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	337.5 #/ft
...Height to Top	=	8.00 ft
...Height to Bottom	=	7.00 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	0.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

<b>Wall Stability Ratios</b>	
Overturning	= 1.34 Ratio < 1.5!
Sliding	= 2.26 OK
Total Bearing Load	= 1,340 lbs
...resultant ecc.	= 15.62 in
Soil Pressure @ Toe	= 1,993 psf OK
Soil Pressure @ Heel	= 0 psf OK
Allowable Soil Pressure Less Than Allowable	= 2,000 psf
ACI Factored @ Toe	= 2,791 psf
ACI Factored @ Heel	= 0 psf
Footing Shear @ Toe	= 12.2 psi OK
Footing Shear @ Heel	= 3.1 psi OK
Allowable	= 75.0 psi
<b>Sliding Calcs</b>	
Lateral Sliding Force	= 247.5 lbs
less 100% Passive Force	= - 156.3 lbs
less 100% Friction Force	= - 402.0 lbs
Added Force Req'd	= 0.0 lbs OK
....for 1.5 Stability	= 0.0 lbs OK

#### Stem Construction

Design Height Above Ftg	ft =	Stem OK
Wall Material Above "Ht"	=	Masonry
Design Method	=	LRFD
Thickness	=	8.00
Rebar Size	=	# 4
Rebar Spacing	=	8.00
Rebar Placed at	=	Center

#### Design Data

fb/FB + fa/Fa	=	0.580
---------------	---	-------

#### Total Force @ Section

Service Level	lbs =	
Strength Level	lbs =	345.5

#### Moment....Actual

Service Level	ft-# =	
Strength Level	ft-# =	2,532.6
Moment....Allowable	=	4,359.4

#### Shear....Actual

Service Level	psi =	
Strength Level	psi =	3.8
Shear....Allowable	psi =	80.5
Anet (Masonry)	in2 =	91.50
Rebar Depth 'd'	in =	3.75

#### Masonry Data

f'm	psi =	2,000
Fy	psi =	60,000
Solid Grouting	=	Yes
Modular Ratio 'n'	=	16.11
Wall Weight	psf =	78.0

Equiv. Solid Thick.	in =	7.60
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	LRFD

#### Concrete Data

f'c	psi =	
Fy	psi =	

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	1.42 ft
Heel Width	=	2.08
Total Footing Width	=	3.50
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.25 ft
$f'c$	=	2,500 psi
$F_y$	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm = 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,791	0 psf
Mu' : Upward	=	1,816	0 ft-#
Mu' : Downward	=	323	323 ft-#
Mu: Design	=	1,492	323 ft-#
Actual 1-Way Shear	=	12.24	3.08 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $Mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: No key defined

Min footing T&S reinf Area 0.71 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft  
 If one layer of horizontal bars: #4 @ 11.90 in #4 @ 23.81 in  
 #5 @ 18.45 in #5 @ 36.90 in  
 #6 @ 26.19 in #6 @ 52.38 in

### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	45.0	0.50	22.5	Soil Over Heel	=	95.6	2.79	266.8
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=	202.5	8.50	1,721.3	Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=				* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	95.6	0.71	67.7
	=				Surcharge Over Toe	=			
<b>Total</b>		<b>247.5</b>	<b>O.T.M.</b>	<b>1,743.8</b>	Stem Weight(s)	=	624.0	1.75	1,091.6
	=				Earth @ Stem Transitions	=			
<b>Resisting/Overturning Ratio</b>			=	<b>1.34</b>	Footing Weight	=	524.9	1.75	918.2
Vertical Loads used for Soil Pressure	=			1,340.0 lbs	Key Weight	=		0.75	
					Vert. Component	=			
					<b>Total =</b>	<b>1,340.0 lbs</b>	<b>R.M.=</b>	<b>2,344.3</b>	

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.127	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



# ORCO COMBO RETAINING WALL AT TRASH ENCLOSURE ROOF SUPPORT FOR 110 MPH 3 SEC. GUST @ EXP C

**SPECIAL INSPECTION NOTE:**

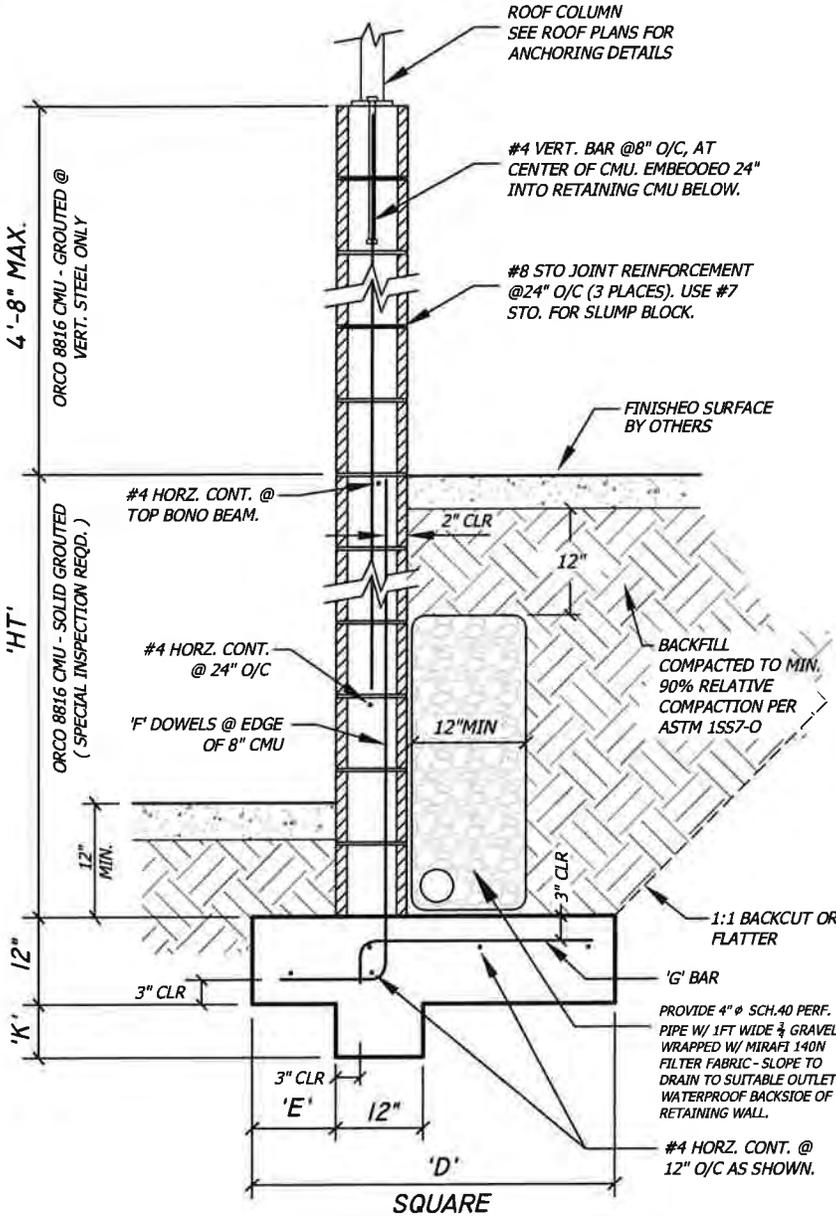
PROVIDE LEVEL 2 SPECIAL INSPECTION PER TMS-602-16 TABLES 3 AND 4 OF THE MASONRY STEM.

**DESIGN CRITERIA PER 2019 CBC:**

1. ALLOWABLE SOIL BEARING PRESSURE FOR FOOTINGS = 2000 PSF PER SOILS REP.
2. EQUIVALENT FLUID PRESSURE FOR LEVEL BACKFILL = 40 PCF PER SOILS REPORT.
3. ALLOWABLE LATERAL PASSIVE PRESSURE = 250 PCF PER SOILS REPORT.
4. GROUT STRENGTH = 2000 PSI @ 28 DAYS & REINFORCING STEEL : GRAOE 60.
5. EARTH COEFFICIENT OF FRICTION = 0.30.
6. 2000 PSI MASONRY COMPRESSION STRENGTH - SPECIAL INSPECTION REQUIRED.

**NOTES:**

1. CONCRETE BLOCK SHALL BE MANUFACTURED BY ORCO ASTM C 90. WEDGELock BLOCK, SLUMP BLOCK AND SPLITFACE BLOCK ARE ACCEPTABLE.
2. CONCRETE FOR FOOTING SHALL BE 1 PART CEMENT TO 2-1/2 PARTS SAND TO 3-1/2 PARTS GRAVEL WITH A MAXIMUM OF 1-1/2 GALLONS OF WATER PER SACK. PORTLAND CEMENT SHALL CONFORM TO ASTM C 150 TYPE II/V.  $F_c = 2500$  PSI
3. REINFORCING STEEL SHALL BE DEFORMED AND CONFORM TO ASTM A 615 GRAOE 60. PROVIDE 48 BAR DIAMETER LAP.
4. REBAR SHALL BE CENTERED IN THE CONCRETE BLOCK CELL IN WHICH IT IS LOCATED.
5. CONCRETE BLOCK SHALL BE LAID IN A RUNNING BONO PATTERN WITH VERTICAL CONTINUITY OF THE CELLS UNO.
6. ALL BLOCK CELLS SHALL BE SOLID GROUTED.
7. USE TYPE S MORTAR PROPORTIONEED USING ASTM C 270 PART CEMENT TO 1/2 PART LIME TO 4-1/2 PARTS OAMP, LOOSE SAND.
8. GROUT FOR CONCRETE BLOCK PER ASTM C 476 TO BE 1 PART CEMENT TO 3 PARTS SAND (GROUT MAY CONTAIN 2 PARTS 3/8" PEA GRAVEL IF WEATHER CONOITIONS ARE FAVORABLE AND BLOCK UNOBSERVED CELL SIZE IS SUFFICIENT TO ALLOW GOOD GROUT FLOW). WATER SHALL BE ADDED TO PRODUCE GOOD GROUT FLOW WITHOUT SEGREGATION OF THE CONSTITUENTS.
9. BLOCK STEM MAY BE WET-SET 1-1/2" INTO THE FOOTING WHILE THE CONCRETE IS PLASTIC. BLOCK STEM MAY BE PLACED TO EITHER EDGE OF THE TRENCH TYPE FOOTING.
10. FOOTING MUST BE POURED ON OR INTO UNOISTURBED NATURAL SOIL OR ON COMPACTED FILL WITH A MINIMUM COMPACTION OF 90%.
11. FIRST INSPECTION TO BE AFTER FOOTING TRENCHES ARE READY FOR CONCRETE AND ALL REQUIRED STEEL IS TIED IN PLACE. SECONO INSPECTION TO BE WHEN THE REQUIRED VERTICAL IS IN PLACE AND THE BLOCK WALL IS READY TO GROUT.
12. MAXIMUM CONTROL JOINT SPACING: 40' O/C. 20' O/C FOR WALLS TO BE MORTAR WASHED OR STUCCO COATED.



NOTE: DIMENSIONS ARE NOT TO SCALE.

'HT'	'D'	'E'	'F' DOWEL	'G' BAR	'K'
3'-4"	3'-6"	1'-0"	#4@8" O/C 14"   49"	#4@8" O/C 8"   24"	5"
4'-0"	4'-0"	1'-0"	#4@8" O/C 14"   57"	#4@8" O/C 8"   30"	6"

**WALL "F2.1"**

**ENGINEERING STAMP APPROVAL IS CONDITIONAL;  
REQUIRING USE OF ORCO MANUFACTURED CMU ON  
ALL ORCO WALL SYSTEM DESIGNS.**

**CITY OF  
HERMOSA BEACH**  
PARKING LOT D  
HERMOSA BEACH, CALIFORNIA



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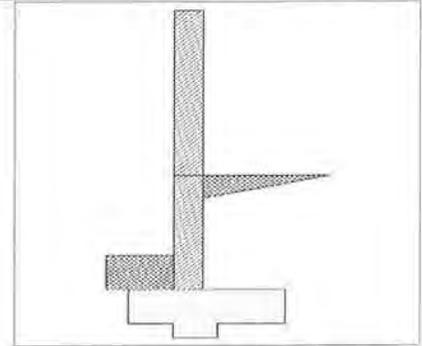
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	3.33 ft
Wall height above soil	=	4.83 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	337.5 #/ft
...Height to Top	=	8.16 ft
...Height to Bottom	=	7.16 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	0.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

<b>Wall Stability Ratios</b>	
Overturning	= 1.77 OK
Sliding	= 2.18 OK
Total Bearing Load	= 2,183 lbs
...resultant ecc.	= 11.31 in
Soil Pressure @ Toe	= 1,802 psf OK
Soil Pressure @ Heel	= 0 psf OK
Allowable Soil Pressure Less Than Allowable	= 2,000 psf
ACI Factored @ Toe	= 2,523 psf
ACI Factored @ Heel	= 0 psf
Footing Shear @ Toe	= 13.4 psi OK
Footing Shear @ Heel	= 8.5 psi OK
Allowable	= 75.0 psi
<b>Sliding Calcs</b>	
Lateral Sliding Force	= 577.5 lbs
less 100% Passive Force	= - 605.0 lbs
less 100% Friction Force	= - 655.0 lbs
Added Force Req'd	= 0.0 lbs OK
....for 1.5 Stability	= 0.0 lbs OK

#### Stem Construction

	2nd	Bottom	
Design Height Above Ftg	ft = 3.33	Stem OK	Stem OK
Wall Material Above "Ht"	= Masonry	Masonry	
Design Method	= LRFD	LRFD	LRFD
Thickness	= 8.00	8.00	
Rebar Size	= # 4	# 4	
Rebar Spacing	= 8.00	8.00	
Rebar Placed at	= Center	Edge	
<b>Design Data</b>			
fb/FB + fa/Fa	= 0.334	0.466	
<b>Total Force @ Section</b>			
Service Level	lbs =		
Strength Level	lbs =	337.5	692.3
<b>Moment....Actual</b>			
Service Level	ft-# =		
Strength Level	ft-# =	1,461.4	2,979.1
Moment....Allowable	ft-# =	4,359.4	6,384.4
<b>Shear.....Actual</b>			
Service Level	psi =		
Strength Level	psi =	3.7	7.6
Shear.....Allowable	psi =	80.5	80.5
Anet (Masonry)	in2 =	91.50	91.50
Rebar Depth 'd'	in =	3.75	5.25
<b>Masonry Data</b>			
f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	78.0

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

#### Concrete Data

f'c	psi =		
Fy	psi =		
Equiv. Solid Thick.	in =	7.60	7.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	2.50
Total Footing Width	=	3.50
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	5.00 in
Key Distance from Toe	=	1.00 ft
f'c =	2,500 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm = 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,523	0 psf
Mu' : Upward	=	1,088	75 ft-#
Mu' : Downward	=	228	1,429 ft-#
Mu: Design	=	860	1,354 ft-#
Actual 1-Way Shear	=	13.39	8.51 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.71 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft

If one layer of horizontal bars: If two layers of horizontal bars:

#4 @ 11.90 in #4 @ 23.81 in  
 #5 @ 18.45 in #5 @ 36.90 in  
 #6 @ 26.19 in #6 @ 52.38 in

### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	375.0	1.44	541.2	Soil Over Heel	=	824.2	2.58	2,129.1
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=	202.5	8.66	1,753.7	Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=				* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	135.0	0.50	67.5
	=				Surcharge Over Toe	=			
<b>Total</b>		<b>577.5</b>	<b>O.T.M.</b>	<b>2,294.9</b>	Stem Weight(s)	=	636.7	1.33	849.0
	=				Earth @ Stem Transitions	=			
<b>Resisting/Overturning Ratio</b>			<b>= 1.77</b>		Footing Weight	=	525.0	1.75	918.8
Vertical Loads used for Soil Pressure	=	2,183.4	lbs		Key Weight	=	62.5	1.50	93.8
					Vert. Component	=			
					<b>Total =</b>	<b>2,183.4 lbs</b>	<b>R.M.=</b>	<b>4,058.1</b>	

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.117	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



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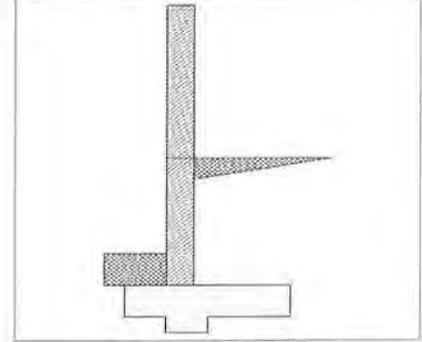
Code: CBC 2019,ACI 318-14,TMS 402-16

#### Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	4.83 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	135.00 pcf
Soil Density, Toe	=	135.00 pcf
Footing  Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	12.00 in



#### Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

#### Lateral Load Applied to Stem

Lateral Load	=	337.5 #/ft
...Height to Top	=	8.83 ft
...Height to Bottom	=	7.83 ft
Load Type	=	Wind (W) (Strength Level)
Wind on Exposed Stem	=	0.0 psf (Strength Level)

#### Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

#### Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	2.16 OK
Sliding	=	2.11 OK
Total Bearing Load ...resultant ecc.	=	2,759 lbs 10.32 in
Soil Pressure @ Toe	=	1,613 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable Soil Pressure Less Than Allowable	=	2,000 psf
ACI Factored @ Toe	=	2,258 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	12.8 psi OK
Footing Shear @ Heel	=	7.6 psi OK
Allowable	=	75.0 psi

##### Sliding Calcs

Lateral Sliding Force	=	702.5 lbs
less 100% Passive Force	= -	656.3 lbs
less 100% Friction Force	= -	827.7 lbs
Added Force Req'd	=	0.0 lbs OK
...for 1.5 Stability	=	0.0 lbs OK

#### Stem Construction

##### Design Height Above Ftg

	2nd	Bottom
Stem OK	Stem OK	
ft = 4.00	ft = 0.00	
Wall Material Above "Ht"	= Masonry	Masonry
Design Method	= LRFD	LRFD LRFD
Thickness	= 8.00	8.00
Rebar Size	= # 4	# 4
Rebar Spacing	= 8.00	8.00
Rebar Placed at	= Center	Edge

##### Design Data

fb/FB + fa/Fa	=	0.334	0.546
<b>Total Force @ Section</b>			
Service Level	lbs =		
Strength Level	lbs =	337.5	849.5
<b>Moment....Actual</b>			
Service Level	ft-# =		
Strength Level	ft-# =	1,461.4	3,494.0
<b>Moment....Allowable</b>	ft-# =	4,359.4	6,384.4

##### Shear.....Actual

Service Level	psi =		
Strength Level	psi =	3.7	9.3
Shear....Allowable	psi =	80.5	80.5
Anet (Masonry)	in <sup>2</sup> =	91.50	91.50
Rebar Depth 'd'	in =	3.75	5.25

##### Masonry Data

f'm	psi =	2,000	2,000
Fy	psi =	60,000	60,000
Solid Grouting	=	Yes	Yes
Modular Ratio 'n'	=	16.11	16.11
Wall Weight	psf =	78.0	78.0

Equiv. Solid Thick.	in =	7.60	7.60
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	LRFD	

##### Concrete Data

f'c	psi =		
Fy	psi =		

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

##### Load Factors

Building Code	CBC 2019,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000



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### Cantilevered Retaining Wall

Code: CBC 2019,ACI 318-14,TMS 402-16

#### Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	3.00
Total Footing Width	=	4.00
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	6.00 in
Key Distance from Toe	=	1.00 ft
f'c =	2,500 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0014
Cover @ Top	2.00	@ Btm = 3.00 in

#### Footing Design Results

		Toe	Heel
Factored Pressure	=	2,258	0 psf
Mu' : Upward	=	1,019	594 ft-#
Mu' : Downward	=	228	2,576 ft-#
Mu: Design	=	791	1,982 ft-#
Actual 1-Way Shear	=	12.77	7.64 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

#### Other Acceptable Sizes & Spacings

Toe: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Heel: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$   
 Key: Not req'd:  $\mu < \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Min footing T&S reinf Area 0.81 in<sup>2</sup>  
 Min footing T&S reinf Area per foot 0.20 in<sup>2</sup> /ft

If one layer of horizontal bars: If two layers of horizontal bars:

#4 @ 11.90 in #4 @ 23.81 in  
 #5 @ 18.45 in #5 @ 36.90 in  
 #6 @ 26.19 in #6 @ 52.38 in

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....					
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#			
Heel Active Pressure	=	500.0	1.67	833.3	Soil Over Heel	=	1,260.0	2.83	3,570.0
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=	202.5	9.33	1,889.3	Axial Dead Load on Stem	=			
Load @ Stem Above Soil	=				* Axial Live Load on Stem	=			
	=				Soil Over Toe	=	135.0	0.50	67.5
	=				Surcharge Over Toe	=			
<b>Total</b>	=	<b>702.5</b>	<b>O.T.M.</b>	<b>2,722.7</b>	Stem Weight(s)	=	689.0	1.33	918.6
	=				Earth @ Stem Transitions	=			
<b>Resisting/Overturning Ratio</b>	=			<b>2.16</b>	Footing Weight	=	600.0	2.00	1,200.0
Vertical Loads used for Soil Pressure	=			2,759.0 lbs	Key Weight	=	75.0	1.50	112.5
	=				Vert. Component	=			
	=				<b>Total =</b>	<b>2,759.0 lbs</b>	<b>R.M.=</b>	<b>5,868.6</b>	

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

#### Tilt

##### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci  
 Horizontal Defl @ Top of Wall (approximate only) 0.099 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.



# GATE POLE AT TRASH ENCLOSURE

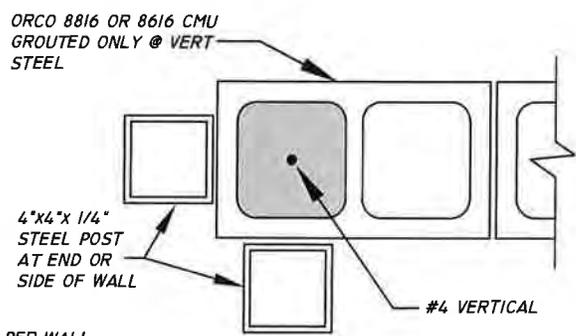
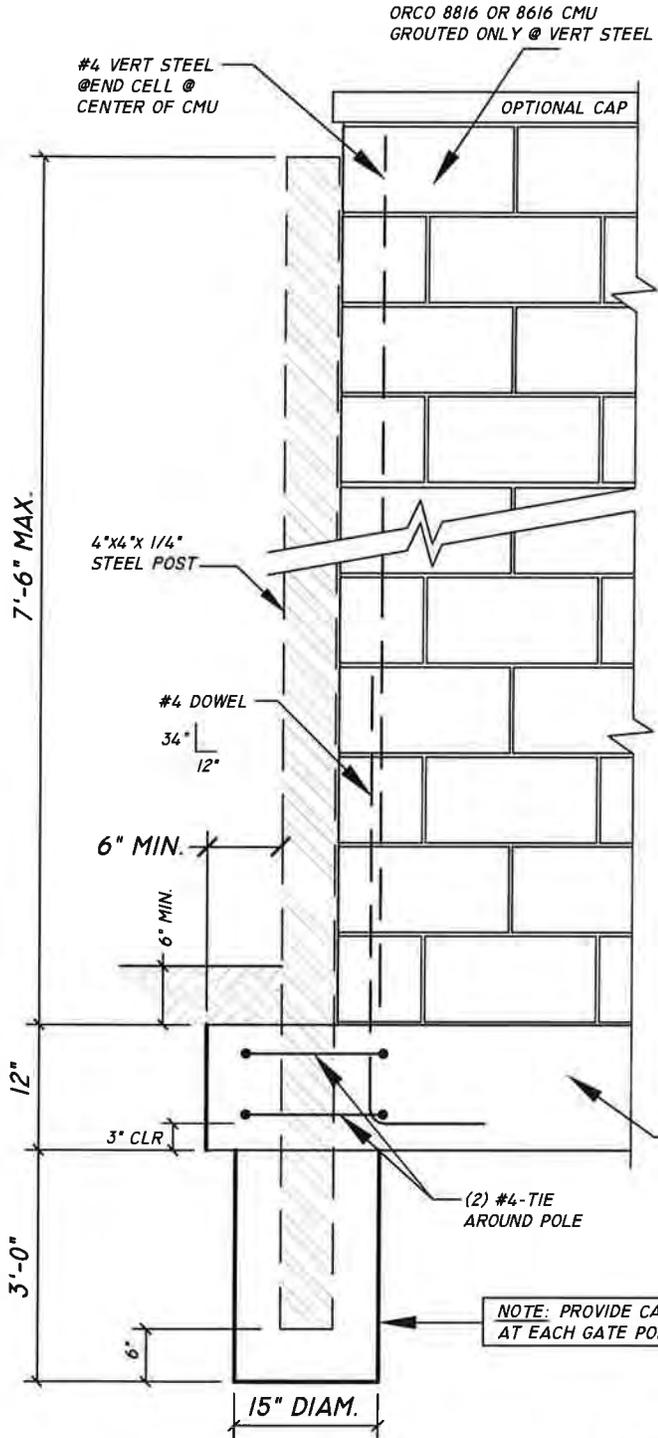
## FOR 110 MPH EXPOSURE C WIND

**DESIGN CRITERIA PER 2019 CBC:**

1. ALLOWABLE SOIL BEARING PRESSURE FOR FOOTINGS = 2000 PSF PER SOILS REP.
2. EQUIVALENT FLUID PRESSURE FOR LEVEL BACKFILL = 40 PCF PER SOILS REPORT.
3. ALLOWABLE LATERAL PASSIVE PRESSURE = 250 PCF PER SOILS REPORT.
4. GROUT STRENGTH = 2000 PSI @ 28 DAYS & REINFORCING STEEL : GRADE 60.
5. EARTH COEFFICIENT OF FRICTION = 0.30.
6. 2000 PSI MASONRY COMPRESSION STRENGTH - SPECIAL INSPECTION REQUIRED.

**NOTES :**

1. CONCRETE BLOCK SHALL BE MANUFACTURED BY ORCO ASTM C 90. WEDGELOCK BLOCK, SLUMP BLOCK AND SPLITFACE BLOCK ARE ACCEPTABLE.
2. CONCRETE FOR FOOTING SHALL BE 1 PART CEMENT TO 2-1/2 PARTS SAND TO 3-1/2 PARTS GRAVEL WITH A MAXIMUM OF 1-1/2 GALLONS OF WATER PER SACK. PORTLAND CEMENT SHALL CONFORM TO ASTM C 150 TYPE II/V.  $F_c = 2500$  PSI
3. REINFORCING STEEL SHALL BE DEFORMED AND CONFORM TO ASTM A 615 GRADE 60. PROVIDE 48 BAR DIAMETER LAP.
4. REBAR SHALL BE CENTERED IN THE CONCRETE BLOCK CELL IN WHICH IT IS LOCATED.
5. CONCRETE BLOCK SHALL BE LAID IN A RUNNING BOND PATTERN WITH VERTICAL CONTINUITY OF THE CELLS UNO.
6. ALL BLOCK CELLS CONTAINING VERTICAL REBAR SHALL BE SOLID GROUTED.
7. USE TYPE S MORTAR PROPORTIONED USING ASTM C 270 PART CEMENT TO 1/2 PART LIME TO 4-1/2 PARTS DAMP, LOOSE SAND.
8. GROUT FOR CONCRETE BLOCK PER ASTM C 476 TO BE 1 PART CEMENT TO 3 PARTS SAND (GROUT MAY CONTAIN 2 PARTS 3/8" PEA GRAVEL IF WEATHER CONDITIONS ARE FAVORABLE AND BLOCK UNOBSTRUCTED CELL SIZE IS SUFFICIENT TO ALLOW GOOD GROUT FLOW). WATER SHALL BE ADDED TO PRODUCE GOOD GROUT FLOW WITHOUT SEGREGATION OF THE CONSTITUENTS.
9. BLOCK STEM MAY BE WET-SET 1-1/2" INTO THE FOOTING WHILE THE CONCRETE IS PLASTIC. BLOCK STEM MAY BE PLACED TO EITHER EDGE OF THE TRENCH TYPE FOOTING.
10. FOOTING MUST BE POURED ON OR INTO UNDISTURBED NATURAL SOIL OR ON COMPACTED FILL WITH A MINIMUM COMPACTION OF 90%.
11. FIRST INSPECTION TO BE AFTER FOOTING TRENCHES ARE READY FOR CONCRETE AND ALL REQUIRED STEEL IS TIED IN PLACE. SECOND INSPECTION TO BE WHEN THE REQUIRED VERTICAL IS IN PLACE AND THE BLOCK WALL IS READY TO GROUT.
12. MAXIMUM CONTROL JOINT SPACING: 40' O/C. 20' O/C FOR WALLS TO BE MORTAR WASHED OR STUCCO COATED.



**PLAN DETAIL**  
NOT TO SCALE

NOTE: PROVIDE CAISSON AT EACH GATE POST.

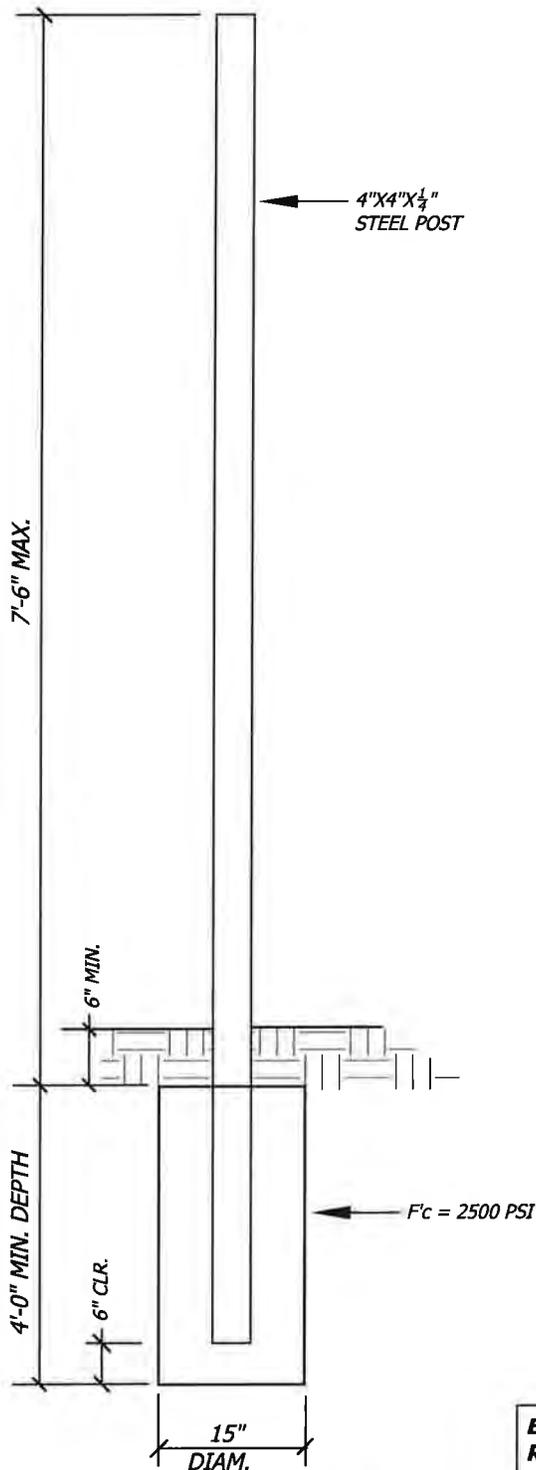
**ENGINEERING STAMP APPROVAL IS CONDITIONAL;  
REQUIRING USE OF ORCO MANUFACTURED CMU ON  
ALL ORCO WALL SYSTEM DESIGNS.**

NOTE: DIMENSIONS ARE NOT TO SCALE.

**CITY OF  
HERMOSA BEACH**  
PARKING LOT D  
HERMOSA BEACH, CALIFORNIA



# GATE POLE FOOTING FOR 110 MPH 3 SEC. GUST @ EXP C



**NOTE:** DIMENSIONS ARE NOT TO SCALE.

**ENGINEERING STAMP APPROVAL IS CONDITIONAL;  
REQUIRING USE OF ORCO MANUFACTURED CMU ON  
ALL ORCO WALL SYSTEM DESIGNS.**

**CITY OF  
HERMOSA BEACH**  
PARKING LOT D  
HERMOSA BEACH, CALIFORNIA



## Pole Footing Embedded in Soil

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 Software copyright ENERCALC, INC. 1983-2018, Build:10.18.11.27  
 Licensee : ORCO BLOCK COMPANY INC

Lic. # : KW-06003522

Licensee : ORCO BLOCK COMPANY INC

Description : gate pole

### Code References

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16  
 Load Combinations Used : ASCE 7-16

### General Information

Pole Footing Shape Rectangular  
 Pole Footing Width 15.0 in  
 Calculate Min. Depth for Allowable Pressures  
 Lateral Restraint at Ground Surface  
 Allow Passive 250.0 pcf  
 Max Passive 1,500.0 psf

### Controlling Values

Governing Load Combination : +D+0.70E+0.60H  
 Lateral Load 1.381 k  
 Moment 5.930 k-ft

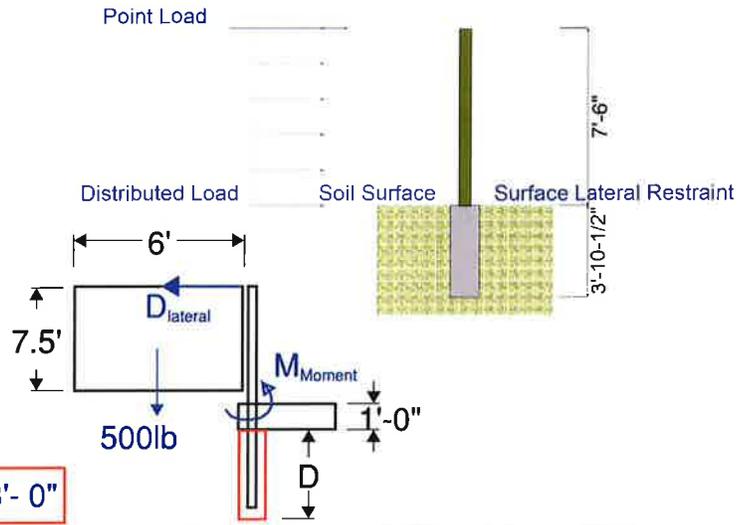
Restraint @ Ground Surface

### Pressure at Depth

Actual 952.24 psf  
 Allowable 968.75 psf  
 Surface Restraint Force 4,633.01 lbs

**Minimum Required Depth 3.875 ft**

Footing Base Area 1.563 ft<sup>2</sup>  
 Maximum Soil Pressure 0.0 ksf



$D = 3.87 \text{ ft} - 1 \text{ ft} = 2.87 \text{ ft} \rightarrow \boxed{3' - 0''}$

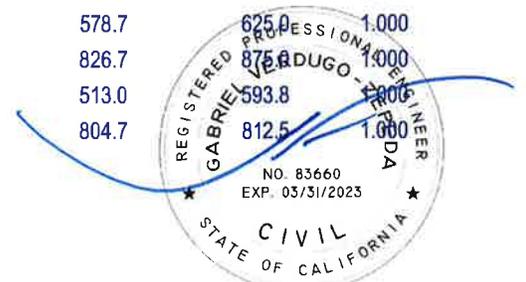
### Applied Loads

Lateral Concentrated Load (k)	Lateral Distributed Loads (klf)	Applied Moment (kft)	Vertical Load (k)
D : Dead Load <b>0.20 k</b>			
Lr : Roof Live			
L : Live			
S : Snow			
W : Wind <b>0.160</b>	<b>0.2250</b>		
E : Earthquake			
H : Lateral Earth			
Load distance above ground surface <b>7.50 ft</b>	TOP of Load above ground surface 7.50 ft	$M_{\text{Moment}} = [(500\text{lb})(6\text{ft}/2)] = 1.5 \text{ kip-ft}$ $D_{\text{Lateral}} = 1.5 \text{ kip-ft} / 7.5\text{ft} = 0.2 \text{ kips}$ $W_{\text{Wind Load}} = 26.7\text{psf}(6\text{ft}) = 0.16 \text{ kip/ft}$ $E_{\text{Seismic Load}} = (0.45)(500\text{lb}) = 0.22 \text{ kip/ft}$	
	BOTTOM of Load above ground surface ft		

Lateral Dead Load was applied @ 7.5' height

### Load Combination Results

Load Combination	Forces @ Ground Surface		Required Depth - (ft)	Pressure at Depth		Soil Increase Factor
	Loads - (k)	Moments - (ft-k)		Actual - (psf)	Allow - (psf)	
+D+H	0.200	1.500	2.50	578.7	625.0	1.000
+D+L+H	0.200	1.500	2.50	578.7	625.0	1.000
+D+Lr+H	0.200	1.500	2.50	578.7	625.0	1.000
+D+S+H	0.200	1.500	2.50	578.7	625.0	1.000
+D+0.750Lr+0.750L+H	0.200	1.500	2.50	578.7	625.0	1.000
+D+0.750L+0.750S+H	0.200	1.500	2.50	578.7	625.0	1.000
+D+0.60W+H	0.920	4.200	3.50	826.7	875.0	1.000
+D-0.60W+H	0.520	1.200	2.38	513.0	593.8	1.000
+D+0.750Lr+0.450W+H	0.740	3.525	3.25	804.7	812.5	1.000



ORCO Block & Hardscape  
 11100 Beach Blvd  
 Stanton, CA 90680  
 Tel. (714) 527-2239

Project Title:  
 Engineer:  
 Project ID:  
 Project Descr:

**Pole Footing Embedded in Soil**

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Lic. # : KW-06003522

Licensee : ORCO BLOCK COMPANY INC

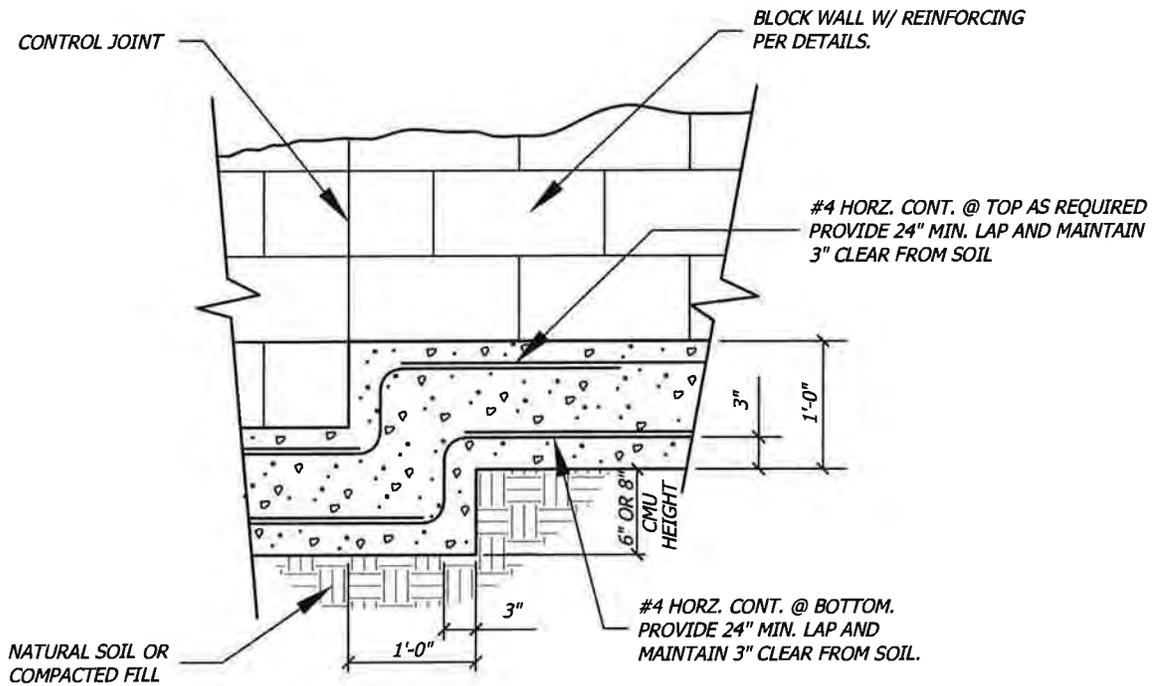
Description : gate pole

+D+0.750Lr-0.450W+H	0.340	0.525	1.75	413.4	437.5	1.000
+D+0.750S+0.450W+H	0.740	3.525	3.25	804.7	812.5	1.000
+D+0.750S-0.450W+H	0.340	0.525	1.75	413.4	437.5	1.000
+0.60D+0.60W+0.60H	0.840	3.600	3.38	762.1	843.8	1.000
+0.60D-0.60W+0.60H	0.600	1.800	2.63	629.9	656.3	1.000
+D+0.70E+0.60H	1.381	5.930	3.88	952.2	968.8	1.000
+D-0.70E+0.60H	0.981	2.930	3.13	723.4	781.3	1.000
+D+0.750L+0.750S+0.5250E+H	1.086	4.822	3.63	884.9	906.3	1.000
+D+0.750L+0.750S-0.5250E+H	0.686	1.822	2.63	637.7	656.3	1.000
+0.60D+0.70E+H	1.301	5.330	3.75	913.9	937.5	1.000
+0.60D-0.70E+H	1.061	3.530	3.25	805.8	812.5	1.000

TS-372



# FOOTING STEP DETAIL



**ENGINEERING STAMP APPROVAL IS CONDITIONAL;  
REQUIRING USE OF ORCO MANUFACTURED CMU ON  
ALL ORCO WALL SYSTEM DESIGNS.**

**NOTE: DIMENSIONS ARE NOT TO SCALE.**

**CITY OF  
HERMOSA BEACH**  
PARKING LOT D  
HERMOSA BEACH, CALIFORNIA



# ORCO CMU WALLS - LEVEL 2 QUALITY ASSURANCE OF MASONRY STEM

MINIMUM QUALITY ASSURANCE LEVEL TABLE 3.1, TMS 402-16		
DESIGNED IN ACCORDANCE WITH	RISK CATEGORY I, II OR III	RISK CATEGORY IV
PART 3 OR APPENDIX B OR APPENDIX C	LEVEL 2	LEVEL 3
PART 4	LEVEL 1	LEVEL 2
APPENDIX A	LEVEL 1	NOT PERMITTED

MINIMUM VERIFICATION REQUIREMENTS TABLE 3, TMS 602-16	
MINIMUM VERIFICATION	REQUIRED
PRIOR TO CONSTRUCTION, VERIFICATION OF COMPLIANCE OF SUBMITTALS.	X
PRIOR TO CONSTRUCTION, VERIFICATION OF $f'_m$ , EXCEPT WHERE SPECIFICALLY EXEMPTED BY THE CODE.	X
DURING CONSTRUCTION, VERIFICATION OF SLUMP FLOW AND VISUAL STABILITY INDEX (VSI) WHEN SELF-CONSOLIDATING GROUT IS DELIVERED TO THE PROJECT SITE.	X

MINIMUM SPECIAL INSPECTION REQUIREMENTS TABLE 4, TMS 602-16		
INSPECTION TASK	FREQUENCY OF INSPECTION	
	CONTINUOUS DURING TASK	PERIODIC DURING TASK
1. AS MASONRY CONSTRUCTION BEGINS, VERIFY THAT THE FOLLOWING ARE IN COMPLIANCE:		
PROPORTIONS OF SITE-PREPARED MORTAR.		X
GRADE, TYPE AND SIZE OF REINFORCEMENT.		X
SAMPLE PANEL CONSTRUCTION.		X
2. PRIOR TO GROUTING, VERIFY THAT THE FOLLOWING ARE IN COMPLIANCE:		
GROUT SPACE		X
PLACEMENT OF REINFORCEMENT.		X
PROPORTIONS OF SITE-PREPARED GROUT.		X
3. VERIFY COMPLIANCE OF THE FOLLOWING DURING CONSTRUCTION:		
MATERIALS AND PROCEDURES WITH THE APPROVED SUBMITTALS.		X
PLACEMENT OF MASONRY UNITS AND MORTAR JOINT CONSTRUCTION.		X
SIZE AND LOCATION OF STRUCTURAL ELEMENTS.		X
PREPARATION, CONSTRUCTION, AND PROTECTION OF MASONRY DURING COLD WEATHER (TEMP. < 40°F) OR HOT WEATHER (TEMP. > 90°F).		X
GROUT PLACEMENT IS IN COMPLIANCE WITH CODE AND CONSTRUCTION DOCUMENT PROVISIONS.	X	
4. OBSERVE PREPARATION OF GROUT SPECIMENS AND MORTAR SPECIMENS.	TS-374	X



**ATTACHMENT “C”**

**TRASH ENCLOSURE ROOF  
STRUCTURAL CALCULATIONS**



## STRUCTURAL CALCULATIONS

**PROJECT:** PARKING LOT "D" – Trash Enclosure Roof  
1331 Manhattan Avenue  
Hermosa Beach, CA 90254

**CRITERIA:** 2019 CALIFORNIA AND/OR LOCAL BLDG CODE LATEST EDITION  
OR 2018 INTERNATIONAL AND/OR LOCAL BLDG. CODE, LATEST EDITION  
OR 2020 L.A. CITY AND/OR LOCAL BLDG CODE, LATEST EDITION

**MATERIALS:** EXCEPT AS OTHERWISE SPECIFIED HEREIN

CONCRETE:	3,000 PSI AT 28 DAYS
CONCRETE BLOCK:	GRADE N, MED. WT. UNITS, ASTM C-90
REINFORCING STEEL:	(ASTM A615, GRADE 60)
STRUCTURAL STEEL:	(COMPACT) (ASTM A992)
STRUCTURAL PIPE:	(ASTM A-53, GRADE "B")
PLYWOOD SHEATHING:	DOUGLAS FIR, STRUCTURAL 1, P.S. 2-09 or 2-10
GLUE LAM. BEAMS:	2,400 PSI (D.F. COMB. "24F")
LUMBER:	GRADE MARKED D.F. PER W.C.L.B. GRDG. RULE 17
SOIL PRESSURE	SEE FOUNDATION PLAN FOR COMPLETE DATA

**DESIGN REFERENCES:** INCLUDING CHARTS AND TABLES FROM

GENERAL DESIGN:	ASCE 7-16
LUMBER & TIMBER:	NATIONAL DESIGN SPECIFICATION FOR WOOD CONSTRUCTION
STEEL:	MANUAL OF STEEL CONSTRUCTION, AISC.
CONCRETE BLOCK:	MSJC PUBLICATION
CONCRETE:	ACI DESIGN HANDBOOK

BY: \_\_\_\_\_



DATE: 5/29/2021

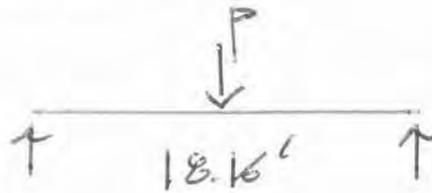
# TRUSS ENCLOSURE ROOF

$$\text{Roof DL} = 10 \text{ psf}$$

$$\text{Roof LL} = 20 \text{ psf}$$

HSS 6x4 BEAMS (WORST CASE)

$$P = (9.00) \left( \frac{8}{2} \right) (10 + 20) \\ = 1090 \text{ lbs}$$



$$M_f = \frac{(16)(18.16)^2}{8} + \frac{(1090)(18.16)}{4} \\ = 5608 \text{ l}\# < 17,609 \text{ l}\# \checkmark \text{ ok}$$

$$EI = \left[ \frac{(9)(16)(18.16)^4}{384} + \frac{(1090)(18.16)^3}{48} \right] \frac{1}{\frac{(18.16)(12)}{240}} \\ = 301.9 \text{ E6 l}\#_{\text{IN}}^2 < 606.1 \text{ l}\#_{\text{IN}}^2 \checkmark \text{ ok}$$

USE HSS 6x4x1/4  
FOR ALL BEAMS

## METAL DECK

2-SPAN, 9.08' PER SPAN,  $w = (10 + 20) = 30$  PSF

VERCO 1 1/2" x 20 GA. TYPE B (PLB-36)

METAL DECK:

2-SPAN, 10' PER SPAN,  $w_{all} = 36$  PSF ✓ OK

USE 1 1/2" x 20 GA TYPE-B  
METAL DECK

---

$S_+$	=	0.230	IN <sup>3</sup> /FT
$S_-$	=	0.237	IN <sup>3</sup> /FT
$I_+$	=	0.219	IN <sup>4</sup> /FT
$I_-$	=	0.231	IN <sup>4</sup> /FT

OR EQUAL

## **CIP NO. 682 PARKING LOT “D” IMPROVEMENTS PROJECT**

### **VII. SPECIAL PROVISIONS**

The following Special Provisions supplement and amend the 2021 Standard Specifications for Public Works Construction (SSPWC). These Special Provisions have been arranged into a format and sequence that parallels the Standard Specifications for Public Works Construction.

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## **PART 1 – GENERAL PROVISIONS**

### **PREFACE: STANDARD SPECIFICATIONS AND STANDARD DRAWINGS**

The Standard Specifications for Public Works Construction (SSPWC), written and promulgated by the Southern California Chapter of the American Public Works Association and the Southern California Districts of the Associated General Contractors of California, shall be the Standard Specifications of the City. All work shall conform to the edition indicated in this document and in the bid proposal documents, including supplements, of the SSPWC, these Special Provisions which supplement or modify the SSPWC, the Standard Plans for Public Works Construction (SPPWC) of the same edition as the SSPWC, and the Standard Drawings as issued by the City available at the time bids are opened unless otherwise specified in the Contract documents.

The above referenced Standard Specifications, Special Provisions and Standard Drawings are hereby made a part of the Contract documents.

### **SECTION 1 – GENERAL.**

#### **1-2 TERMS AND DEFINITIONS.**

Whenever the following terms are used in the SSPWC, they shall be understood to mean and refer to the following:

- a) Board – The City Council of the City of Hermosa Beach
- b) Contract documents – Documents including but not limited to the proposal forms, Special Provisions, Bonds, Insurance, Contract, and all Addenda setting forth any modifications to the documents.
- c) Engineer – The Director of Public Works/City Engineer or their authorized representative
- d) Bidder – An individual, co-partnership, association, or corporation submitting a proposal for the work contemplated, acting directly or through a duly authorized representative.
- e) Legal Address of Contractor – The address given on the Contractor’s bid and is hereby designated as the place to which all notices, letters or other communications to the Contractor shall be mailed or delivered.

### **SECTION 2 – SCOPE OF THE WORK.**

#### **2-2 PERMITS.**

Add the following:

Prior to beginning work, the Contractor shall obtain authorization and permits from the City of Hermosa Beach. The Contractor will be responsible to protect and preserve all property and improvements in accordance with the Contract documents.

The Contractor must have or obtain a valid City of Hermosa Beach Business License in accordance with the provisions of the Hermosa Beach Municipal Code.

### City Right of Way Permit

A City Right of Way Permit is required to work within public right-of-way and will be issued at no cost to the Contractor.

### Right of Way Permits

When work occurs in the right-of-way of other entities, the Contractor shall obtain a no fee right of way permit as required for an encroachment from that entity.

## **2-5 THE CONTRACTOR'S EQUIPMENT AND FACILITIES.**

### **2-5.4 Haul Routes.**

Replace the entire subsection with the following:

Haul Routes shall be per the City of Hermosa Beach Truck Routes map. See Exhibit "D" of the Contract Documents.

Add the following subsections:

### **2-5.5 Contractor's Responsibility for Work.**

Until the formal acceptance of the work by the City, the Contractor shall have the charge and care thereof and shall, subject to the insurance protection furnished, bear the risk of accident, loss or damage to any part thereof by action of the elements or from any other cause, whether arising from the execution or from the non-execution of the work. The Contractor shall rebuild, repair, restore and otherwise correct damages to any portion of the work occasioned by any of the above causes before its acceptance.

In case of suspension of work from any cause whatever, the Contractor shall be responsible for all materials and the proper temporary storage thereof.

### **2-5.6 Notice and Service Thereof.**

Any notice required or given by one party to the other under the Contract shall be in writing and shall be dated and signed by the party giving such notice or by a duly authorized representative of such party. Any such notice shall not be effective for any purpose whatever unless served in the following manner:

Notice shall be given to the City by personal delivery thereof to the City's Engineer or by depositing the same in the United States mail enclosed in a sealed envelope, registered and with postage prepaid, addressed to:

Public Works Department  
City of Hermosa Beach  
1315 Valley Dr.  
Hermosa Beach, CA 90254

Notice shall be given to the Contractor by personal delivery thereof to said Contractor or to his authorized representative at the site of the project, or by depositing the same in the United States mail, enclosed in a sealed envelope addressed to said Contractor at the address established for the conduct of the work under this Contract, postage prepaid and registered.

Notice shall be given to the Surety, or any other person, by personal delivery to said Surety or other person, or by depositing the same in the United States Mail, enclosed in a sealed envelope addressed to such Surety or persons at the address of said Surety or persons last communicated to the party giving the notice, postage prepaid and registered.

**2-5.7           Warranty of Title.**

No materials, supplies, or equipment for the work under this Contract shall be purchased subject to any chattel mortgage or under a conditional sale Contract or other agreement by which an interest therein or any part thereof is retained by the seller or supplier. The Contractor warrants clear and good title to all materials, supplies, and equipment installed and incorporated in the work, and agrees upon completion of all work to deliver the premises, together with all improvements and appurtenances constructed or placed thereon by them to the City free from any claims, liens, encumbrances, or charges, and further agrees that neither they nor any person, firm, or corporation furnishing any material or labor for work covered by the Contract shall have any right to a lien upon the premises or any improvement or appurtenance thereon; provided, that this shall not preclude the Contractor from installing metering devices or other equipment of utility companies the title of which is commonly retained by the utility company.

Nothing contained in this section, however, shall defeat or impair the right of such persons furnishing materials or labor under any bond given by the Contractor for their protection, or any right under any law permitting such persons to look to funds due the Contractor, which are in the hands of the City.

**2-11           RETENTION OF IMPERFECT WORK.**

If any portion of the work done or materials furnished under the Contract proves defective or not in accordance with the specifications and Contract drawings, and if the imperfection in the same is not of sufficient magnitude or importance to make the work dangerous or undesirable, or if the removal of such work is impracticable or will create conditions which are dangerous or undesirable in the opinion of the Engineer, the Engineer shall have the right and authority to retain the work instead of requiring it to be removed and reconstructed, but he shall make such deductions therefor in the payment due the Contractor as may be just and reasonable.

**SECTION 3 – CONTROL OF THE WORK.**

**3-6           THE CONTRACTOR’S REPRESENTATIVE.**

Add the following:

The Contractor shall provide the Engineer with the name, address, and business and home telephone numbers of the person responsible for the maintenance of barricades, traffic control signs, lights and other safety devices.

**3-7 CONTRACT DOCUMENT.**

**3-7.2 Precedence of Contract documents.**

Replace the entire subsection with the following:

If there is a conflict between any of the Contract documents, the document highest in the order of precedence shall control. The order of precedence, from highest to lowest, shall be as follows:

1. Requirements of law, including the Code and Ordinances of the City of Hermosa Beach.
2. Permits from other agencies as may be required by law.
3. Permits from City of Hermosa Beach Departments as may be required by law or ordinance.
4. The Contract.
5. The Bid Proposal.
6. Addenda.
7. Notice Inviting Bids.
8. Instructions to Bidders.
9. Special and General Provisions.
10. Plans.
11. City of Hermosa Beach Standard Plans.
12. Other Standard Plans.
13. Standard Specifications for Public Works Construction.
14. Reference Specifications.

Change orders, supplemental agreements, and approved revisions to Plans and Specifications will take precedence over documents listed above, except those listed as FIRST, SECOND, and THIRD. Detailed plans shall have precedence over general plans.

**3-8 SUBMITTALS.**

**3-8.1 General.**

Add the following:

The Contractor shall submit the following submittals within ten (10) days of notification of the City's intent to award this Contract:

- Project Construction Schedule, sequence, and phase sequence plan
- Preconstruction video on USB, 2 copies
- Copy of City Business License (Prime and Subcontractors)

- 24 Hr. Emergency Phone Call List
- Letters identifying site authorized Contractor’s representative or “Superintendent” and Contractor’s “Competent Person”
- Vehicular and Pedestrian Traffic Control Plan
- WPCP / Best Management Practices
- Asphalt Concrete material specifications and mix design
- Concrete material specifications and mix design
- Crushed Aggregate Base material specifications
- Topsoil material specifications
- Decomposed Granite specifications
- Detectable Warning System/Truncated Domes for access ramps
  - One (1) ADA tile sample, minimum 6” x 6”
  - Shop drawings for access ramp products showing fabrication details, composite structural system, tile surface profile, sound on cane amplification feature, plans showing tile placement including joints, and material to be used as well as outlining installation materials and procedure
- Construction Notices sample template shall be provided by the City to the Contractor and modified and submitted to the engineer for review and approval. Approved Construction Notice shall be distributed by Contractor. See Exhibit ”B”.
- Others as requested by the Engineer

**3-12 WORK SITE MAINTENANCE.**

**3-12.6.2 Best Management Practices (BMPs).**

Replace the entire subsection with the following:

Best Management Practices (BMPs) shall be defined as a method used to prevent or control stormwater runoff and the discharge of pollutants, including sediment, into local storm drains and/or drainage facilities leading to waterbodies. The contractor shall obtain and refer to the California Stormwater Quality Association’s *2023 Construction BMP Handbook*, the City of Hermosa Beach Community Development Department’s *Best Management Practices for Small Construction Sites* brochure, and any other materials provided by the City. The contractor shall, based on those documents, the contract documents, and latest industry best practices, provide a project-specific erosion control plan which will specify which BMPs will be utilized for wind erosion control, tracking control, erosion and sediment control, non-storm water control, and waste management and materials pollution control.

The contractor shall be responsible for installing, constructing, inspecting, maintaining, and removing and disposing of BMPs in accordance with the erosion control plan and as requested by

the Engineer throughout the duration of construction, including outside of working hours. Additional BMPs may be required due to change(s) in field conditions, contractor activities, or construction operations. The contractor shall be responsible for adjusting BMPs as requested by the Engineer to achieve erosion control objectives. The contractor shall also be responsible for BMP implementation and maintenance throughout any temporary suspension of the work.

Payment for BMPs shall be made per contract unit price per Lump Sum. The Contractor shall comply with the requirements described above in implementing BMPs including obtaining any required permits. No additional compensation will be made thereof.

### **3-13 COMPLETION, ACCEPTANCE, AND WARRANTY.**

Add the following subsection:

#### **3-13.4 Completion and Acceptance.**

In addition to the guarantees as required in Section 2-4 of the Standard Specifications, the Faithful Performance Bond shall remain in full force and effect for a period of one year after acceptance of the work by the City to insure that defects, which appear within said period, will be repaired, replaced, or corrected by the Contractor, at its own cost and expense, to the satisfaction of the Engineer within thirty (30) days of written notice thereof by the City.

## **SECTION 5 - LEGAL RELATIONS AND RESPONSIBILITIES.**

### **5-3 LABOR.**

Add the following subsection:

#### **5-3.6 Laws.**

Each Bidder must submit with the Bid Proposal a fully executed Certificate of Non-Discrimination by Contractors. Bids will not be considered unless accompanied by the completed Certificate.

After the opening of bids and the determination of the low Bidder, said low Bidder shall submit to the Public Works Department, no later than 5:00 P.M. on the third working day following the bid opening, a completed "Fair Employment Practices Contractor Compliance Report".

The Contractor shall comply with all applicable provisions of Sections 1776, 1777.5 and 1777.7 of the California Labor Code. The Contractor shall be responsible for compliance with Section 1776 and shall insert a provision in all subcontracts requiring subcontractors to comply with said section.

The Contractor is prohibited from performing work on this project with a subcontractor who is ineligible to perform work on the project pursuant to Section 1777.1 or 1777.7 of the Labor Code.

### **5-4 INSURANCE.**

Replace the entire subsection with the following:

The Contractor shall, at its expense, maintain in effect all times during the performance of work under the Contract not less than the following coverage and limits of insurance, which shall be maintained with insurers licensed to sell insurance in the State of California and having a "A-" or

higher rating in the latest edition of Best's Insurance Guide, and shall be subject to approval by the City's Risk Manager:

Workers' Compensation and Employer's Liability

- Workers' Compensation – coverage as required by law
- Employer's Liability – limits of at least \$1,000,000 per occurrence

Comprehensive General Liability

- \$5,000,000 per occurrence.

Automobile Liability

\$5,000,000 per accident for bodily injury and property damage.

All of the Contractor's policies shall contain an endorsement providing written notice shall be given to the City at least 30 calendar days prior to termination, cancellation or reduction of coverage in the policy

The Bodily Injury and Property Damage Liability policies shall contain the following:

1. An endorsement extending coverage to the City as an insured, in the same manner as the named insured as respects liabilities arising out of the performance of any work under the Contract. Such insurance shall be primary insurance as respects the interest of the City, and any other insurance maintained by the City shall be excess and not contributing insurance with the insurance required hereunder.
2. "Severability of Interest" clause.
3. Elimination of any exclusion regarding loss or damage to property caused by explosion or resulting from collapse of buildings or structures or damage to property underground, commonly referred to by insurers as the "XCU" hazards.
4. Provision or endorsement stating that such insurance, subject to all of its other terms and conditions, applies to the liability assumed by the Contractor under the Contract.

Promptly on execution of the Contract, and prior to commencement of any work, the Contractor shall deliver to the City copies of all required policies and endorsements thereto on the forms supplied by the City.

The Contractor shall require and verify similar insurance on the part of its subcontractors.

The foregoing requirements as to the types, limits and City approval of insurance coverage to be maintained by the Contractor are not intended to and shall not in any manner limit or qualify the liabilities and obligation assumed by the Contractor under the Contract.

Any policy or policies of insurance that the Contractor or his Subcontractors elects to carry as insurance against loss or damage to their construction equipment and tools or other personal property used in fulfillment of this Contract shall include a provision waiving the insurer's right of subrogation against the City.

The cost of all insurance shall be included in the Contractor's bid.

**5-7 SAFETY.**

Add the following subsection:

**5-7.9 Emergency Provisions.**

Unusual conditions may arise on the work which will require that immediate and unusual provision be made to protect the public from danger or loss or damage to life and property, due directly or indirectly to the prosecution of the work, and it is part of the service required of the Contractor to make such provisions and to furnish such protection.

Whenever, in the opinion of the City, an emergency exists of which the City is aware and against which the Contractor has not taken sufficient precaution for the safety of the public or the protection of utilities or of adjacent structures or property which may be injured by the progress of construction; and whenever, in the opinion of the City, immediate action shall be considered necessary in order to protect public or private personnel or property interests, or prevent likely loss of human life or damage on account of the operations under the Contract, then in that event the City may provide suitable protection to said interests by causing such work to be done and material to be furnished, as in the opinion of the City may seem reasonable and necessary, all at the expense of the Contractor.

Add the following subsections:

**5-8 LAWS TO BE OBSERVED.**

**5-8.1 Laws and Regulations.**

The Contractor shall keep himself fully informed of all Federal and State laws, County and City ordinances and regulations which, in any manner, affect those engaged or employed on the work, the materials used in the work or the conduct of the work. If any discrepancy or inconsistency should be discovered in this Contract or in the Plans or Specifications herein referred to, in relation to any such law, ordinance or regulation, the Contractor shall forthwith report the same in writing to the Engineer. The Contractor shall, at all times, observe and comply with and shall cause all his agents and employees to observe and comply with all such applicable laws, ordinances and regulations in effect or which may become effective before completion of this Contract. He shall protect and indemnify the City and its officers and agents against any claim or liability arising from or based on the violations of any such laws, ordinances or regulations whether by himself or by his employees or his subcontractors or their employees.

Except as otherwise explicitly provided in these Specifications, all permits and licenses necessary to the prosecution of the work shall be secured by the Contractor at his own expense and he shall pay all taxes properly assessed against his equipment or property used or required in connection with the work.

All state laws, all county and city ordinances and regulations now imposed by competent authority and relating to any materials required to be furnished under these specifications and works required to be done hereunder, shall be deemed to be and hereby are made controlling and part of these specifications.

**5-8.2 General.**

The Contractor shall keep himself fully informed of all existing state and national laws and

municipal ordinances and regulations which in any manner affect those engaged or employed in the work, or the materials used in the work or which in any way affect the conduct of the work and of all such orders and decrees of bodies or tribunals having any jurisdiction or authority over the same.

### **5-8.3 Eight-Hour Law.**

Eight (8) hours labor constitutes a legal day's work. The Contractor shall forfeit as a penalty \$25.00 (Twenty-five dollars) for each workman employed in the execution of the Contract by the Contractor or any subcontractor under him for each calendar day during which such workman is required or permitted to work more than eight (8) hours in any one calendar day and forty (40) hours in any one calendar week in violation of the provisions of the Labor Code and in particular, Section 1810 to Section 1815 thereof inclusive except that work performed by employees of Contractors in excess of eight (8) hours per day and forty (40) hours during any one week, shall be compensated at not less than one and one-half (1 1/2) times the basic rate of pay as provided in Section 1815.

### **5-8.4 Prevailing Rate of Per Diem Wages.**

Pursuant to the provisions of Section 1773 of the Labor Code, the general prevailing wage rates in the County in which the work is to be done have been determined by the Director of the California Department of Industrial Relations. These wages are set forth in the General Prevailing Wage Rates. The Federal Minimum wage rates for this project as predetermined by the United States Secretary of labor are set forth herein by addenda and in copies that may be examined at the offices described above where project plans, special provisions, and proposal forms may be seen. Addenda to modify the federal minimum wage rates, if necessary, will be issued to holders. Future effective general prevailing wage rates which have been predetermined and are on file with the California Department of Industrial Relations are referenced but not printed in the general prevailing wage rates.

Attention is directed to the Federal minimum wage rate requirements in these Special Provisions. If there is a difference between the minimum wage rates predetermined by the Secretary of labor and the general prevailing wage rates determined by the Director of the California Department of Industries Relations for similar classifications of labor, the Contractor and subcontractor shall pay not less than the higher wage rate. The City will not accept lower State wage rates not specifically included in the Federal minimum wage determination. This includes "helper" (or other classifications based on hours of experience) or any other classifications not appearing in the Federal wage rate determination. Where Federal wage determinations do not contain the State wage rate determination otherwise available for use by the Contractor and subcontractor, the Contractor and subcontractor shall pay not less than the Federal minimum wage rate which most closely approximates the duties of the employees in question.

The U.S. Department of Transportation (DOT) provides a toll-free "hotline" service to report bid rigging activities. Bid rigging activities can be reported Mondays through Fridays, between 8:00 a.m. and 5:00 p.m., eastern time, Telephone No. 1-800-424-9071. Anyone with knowledge of possible bid, Bidder collusion, or other fraudulent activities should use the "hotline" to report these activities. The "hotline" is part of the DOT's continuing effort to identify and investigate highway construction Contract fraud and abuse and is operated under the direction of the DOT Inspector General. All information will be treated confidentially and caller

anonymity will be respected.

The Contractor shall comply with Labor Code Section 1775. In accordance with said section, the Contractor shall forfeit as a penalty to the City \$50.00 (fifty dollars) for each calendar day, or portion thereof, for each workman paid less than the stipulated prevailing rates for such work or craft in which such workman is employed for any work done under the Contract by him or by any subcontractor under him in violation of the provisions of the Labor Code and in particular Labor Code Sections 1770 to 1780, inclusive. In addition to said penalty and pursuant to said Section 1775, the difference between such stipulated prevailing wage rates and the amount paid to each workman for each calendar day or portion thereof for which each workman was paid less than the stipulated prevailing wage rate shall be paid to each workman by the Contractor.

#### **5-8.5 Certified Payroll.**

Pursuant to Section 1776 of the Labor Code, the Contractor and/or subcontractors shall submit weekly to the City for each week in which any Contract work is performed a certified copy of all payroll records. Should the Contractor fail to provide such payroll certificates, the City may withhold.

\$1,000.00 for each weekly payroll certificate not received from payment due.

#### **5-9 FAIR EMPLOYMENT PRACTICE COMMISSION CERTIFICATION.**

The Contractor's attention is directed to the requirements in Section 12990 of the Government Code for nondiscrimination and compliance employment programs.

### **SECTION 6 – PROSECUTION AND PROGRESS OF THE WORK.**

#### **6-1 CONSTRUCTION SCHEDULE AND COMMENCEMENT OF THE WORK.**

##### **6-1.1 Construction Schedule.**

Add the following:

The Contractor's proposed construction schedule shall be submitted to the Engineer within ten (10) days of notification of the City's intent to award this Contract. The schedule shall be supported by written statements from each supplier of materials or equipment indicating that all orders have been placed and acknowledged and setting forth the dates that each item will be delivered.

In preparation of the construction schedule, the following items shall be considered:

- The City observes the following holidays, which shall be considered non-working days. If the Contractor elects to work on any of the City holidays the Contractor shall be responsible for paying any associated inspection costs, including overtime and holiday premiums. **Any work not completed and fully open to public traffic shall be maintained in a safe and delineated condition. Traffic control and safety devices shall be maintained at all times.**
  - New Year's Day
  - Martin Luther King Jr.'s Birthday

- Washington's Birthday
  - Cesar Chavez Day
  - Memorial Day
  - Juneteenth
  - Independence Day
  - Labor Day
  - Veterans Day
  - Thanksgiving
  - Christmas Day
- The Contractor's working hours shall be limited to the hours between 8:00 A.M. and 6:00 P.M., Monday through Friday. Deviation from normal working hours will not be allowed unless written permission has been duly obtained beforehand from the office of the City Engineer. The Contractor shall provide adequate light for proper prosecution of the work, for the safety of the workmen and the public, and for proper inspection.
  - In the event of either a requested or emergency deviation, inspection service fees will be charged against the Contractor. The service fees will be calculated at overtime rates including benefits, overhead and travel time. The service fees will be deducted from any amounts due to the Contractor.

Prior to issuing the Notice to Proceed, the Engineer will schedule a preconstruction meeting with the Contractor to review the proposed construction schedule and delivery dates, arrange utility coordination, discuss construction methods and clarify inspection procedures.

The names, addresses, and telephone numbers of the Contractor and subcontractors, or their representatives, shall be filed with the Public Works Manager and the City Police Department prior to beginning work.

The Contractor shall also notify the City of Hermosa Beach and the owners of all utilities and substructures not less than 72 hours prior to starting construction. The following utility companies list of names and telephone numbers is intended for the convenience of the Contractor and is not guaranteed to be complete or correct:

Southern California Edison Co.	310/783-9332
The Gas Co.	310/605-7837
Verizon	818/837-0394
Hermosa Beach Police & Fire	310/524-2750
Time Warner (Cable TV)	310/216-4184
West Basin Municipal Water District	310/217-2411
Athens Services	626/934-4696
California Water Service Co.	310/257-1428
Underground Service Alert	800/227-2600
Los Angeles County Flood Maintenance	562/861-0316

The Contractor shall submit periodic Progress Reports to the Director of Public Works by the tenth day of each month. The report shall include an updated Construction Schedule. Any deviations from the original schedule shall be explained. Progress payments will be withheld pending receipt of any outstanding reports.

#### **6-4.3 Payment for Delays.**

To the furthest extent permitted by law, replace the entire subsection with the following:

In compliance with the provisions of California Public Contract Code § 7102, the Contractor will be compensated for damages incurred due to delays in completing the Work due solely to the fault of the City, where such delay is unreasonable under the circumstances and not contemplated by the parties. The Contractor and City agree that determining actual damages is impracticable and extremely difficult. As such, the Contractor shall be entitled to the appropriate time extension and to payment of liquidated damages in the sum of \$1,200 per Day of delay in excess of the time specified for the Completion of the Work. Such amount shall constitute the only payment allowed and shall necessarily include all overhead (direct or indirect), all profit, all administrative costs, all bond costs, all labor, materials, equipment and rental costs, and any other costs, expenses and fees incurred or sustained as a result of such delay. The Contractor expressly agrees to be limited solely to the liquidated damages for all such delays as defined in this subsection.

#### **6-9 LIQUIDATED DAMAGES.**

Add the following:

The amount of liquidated damages is hereby amended to **\$1,200** for each consecutive calendar day.

### **SECTION 7 – MEASUREMENT AND PAYMENT.**

#### **7-3 PAYMENT.**

##### **7-3.2 Partial and Final Payment.**

Replace the entire subsection with the following:

The closure date for periodic progress payments shall be the twenty-fifth day of each month. Authorization to pay is commonly received on the tenth day of the following month. However, payments will be withheld pending receipt of any outstanding reports required by the Contract documents.

Each month, the Contractor shall meet with the Engineer, a minimum of three working days prior to the submittal of the progress payment to the City, to finalize and receive approval regarding the measurement of the Work performed through the closure date and the estimated value of the progress payment based on the contract Unit Prices or as provided for in the bid schedule. Any progress payment submitted without such approval will be considered incomplete and returned to the Contractor and no payment shall be considered until such approval is obtained. Payments will be withheld pending receipt of any outstanding reports required by the contract documents.

The final progress payment will not be released until the Contractor returns the control set of specifications and plans indicating the as-built conditions.

#### **7-3.4 Mobilization.**

Replace the entire subsection with the following:

Mobilization and demobilization shall include all site visits; preparation of all submittals; BMPs; obtaining all permits, insurance, and bonds; video recording of the site existing conditions; moving onto the site all materials and equipment; set up of any temporary facilities (e.g. sanitary facilities, parking, construction water, equipment and materials staging area, distribution of all notification materials; removal of same at completion of the work; site cleanup; and other work as required to perform and complete the work.

It shall be the Contractor's responsibility to secure the entire limit of the work site with temporary construction fencing. The fencing limits and layout are subject to approval by the Engineer.

No material, equipment, or vehicles to be left overnight on sidewalks or streets unless approved the Engineer.

A minimum of one week prior to the start of construction, the Contractor shall video record all areas where construction is to take place. Such video recordings shall be provided to the Engineer before construction commences. These video recordings shall serve as a record of the existing conditions for disputes arising from restoration and should therefore be taken along the line of construction and site access and staging areas at sufficient detail as necessary to clearly depict details of existing conditions. Video recordings shall document existing sidewalks, and adjacent conditions. The video recordings shall be on two USB copies and given to the Engineer. All video recordings shall be indexed and catalogued in such a manner that each photographed area is readily identifiable and shall also indicate the date and time (hour, minutes, and seconds) on which the recording was made. The Contractor shall also video record any unusual conditions encountered during construction that are not already a matter of photographic record. In any areas where existing conditions cannot be determined by means of video recording, the area shall be restored as approved by the Engineer at Contractor's expense. All video recordings shall become the property of the City.

Mobilization shall consist of preparatory work and operations including, but not limited to, those necessary for the movement of personnel, equipment, materials and incidentals to the project site necessary for work on the project and for all other work and operations which must be performed or costs incurred including bonds, insurance, construction permits and/or permit riders as may be required by law, and financing prior to beginning work on the various contract items on the project site.

Mobilization shall also include the cost, time and labor to move the necessary construction equipment to and from the job site, supervisory time on the job by the Contractor's personnel to keep the construction site in a safe condition and all other related work as required for all non-working days during the course of construction. Contractor is responsible for securing an adequate storage site for equipment and materials.

Mobilization shall include any work shown on the plans, including removal and/or relocation of an item of work shown on construction documents, which has no corresponding bid item for said

work. It shall also include removal of vegetation, removal and/or modifications to the existing planters, wall, fences, gates within the project area, on private properties and within the public right of way as shown on the construction documents. Full compensation relating to that work, including the furnishing of labor and materials, and the disposal of materials shall be included herein.

Mobilization shall include compliance with water quality and air quality laws; furnishing all water required for the construction work; protection of utilities, trees, fences, walls, landscaping, and other facilities; and the relocations as shown on the plans. All complaints received by the City associated with the construction alleging damage to private property and vehicles shall be responded to by the Contractor within one working day of notification. Failure to comply with this provision may result in a penalty of one hundred and fifty dollars (\$150.00) per occurrence.

The Contractor shall have on the work site at all times, as its agent, a competent superintendent capable of reading and thoroughly understanding the plans, specifications, other related documents, and directions from the Engineer.

Contractor shall confine his operations and work area within the project area. No encroachment into private property will be permitted without the prior written consent of the property owner. Obtaining this consent will be the responsibility and the costs of the Contractor. Material shown on the plans or designated in the Special Provisions which is to be used in the reconstructed work and which has been damaged or destroyed as a result of the Contractor's operations shall be repaired or replaced at the option of the Engineer by the Contractor at the Contractor's sole expense.

The Contractor shall provide personnel to keep the construction site in a safe condition at all times, including non-working hours. Mobilization shall include scheduling and phasing of the work per the requirements of the City. The Contractor shall coordinate all construction activities with the City.

Payment for mobilization shall be per the Lump Sum (LS) price bid not exceeding 5% of the total bid amount for the project and shall include obtaining and paying for all bonding, insurance, business licenses and permits, as required for entire project, from the City of Hermosa Beach and all related agencies including but not limited to utility companies and private and public agencies. The City of Hermosa Beach will waive its permit fee.

The Contractor shall comply with the requirements specified by each license or permit. Compensation also includes furnishing a crew to pothole at the discretion of the Engineer. Progress payments for this item shall be paid in accordance with the completion percentage of the project and shall include the costs of such mobilization and administration for the entire contract period.

Add the following subsection:

**7-3.9 Work Performed Without Direct Payment.**

Tools and materials of any class for which no price is fixed in the Proposal, it shall be understood that such work, equipment, labor, tools, and materials shall be provided without extra charge, allowance, or direct payment of any kind. The cost of performing such work or furnishing such equipment, labor, tools, and materials shall be included in the unit bid prices in the Proposal and no additional compensation will be paid therefor.

## **7-4.2 Basis for Establishing Costs.**

### **7-4.2.1 Labor.**

Replace the entire subsection with the following:

The costs of labor will be the actual cost for wages of workers performing the extra work at the time the extra work is done, plus the employer payments of payroll taxes, health and welfare, pension, vacation, apprenticeship funds, and other direct costs, resulting from Federal, State, or local laws, as well as assessments or benefits required by collective bargaining agreements.

## **7-4.3 Markup**

### **7-4.3.1 Work by the Contractor.**

Replace the entire subsection with the following:

An allowance for overhead and profit shall be added to the Contractor's costs and shall constitute the full and complete markup for all overhead and profit on extra work performed by the Contractor. The Contractor shall also be compensated for the actual increase in the Contractor's bond premium caused by the extra work. The markup shall be:

- a. Labor – 20%
- b. Materials – 15%
- c. Tool and Equipment Rental – 15%
- d. Other Items – 15%

### **7-4.3.2 Work by a Subcontractor.**

When any of the extra work is performed by a subcontractor, the markup shall be applied to the subcontractor's costs. An allowance for the Contractor's overhead and profit shall be added to the sum of the subcontractor's costs and markup and shall constitute the full and complete markup for all overhead and profit for the Contractor on work by the subcontractor. For Contractor markup of subcontractor's costs, the allowance shall be 10% on the first \$2,000 or portion thereof and 5% on costs in excess of \$2,000.

Add the following section:

## **7-6 PAYMENT FOR PROJECT BID ITEMS.**

### **7-6.1 Traffic Control and Public Safety.**

The Contractor shall provide and maintain all construction area traffic controls in accordance with Part 6 of the Standard Specifications for Public Works Construction, the latest version of the California Manual on Uniform Traffic Control Devices (CA MUTCD), and Work Area Traffic Control Handbook (WATCH), and as noted herein. All necessary traffic control devices shall be in place prior to the start of work on a project section.

The Contractor shall so conduct his operations as to offer the least possible obstruction and inconvenience to public traffic. Every effort shall be made to provide a clear and unobstructed view of all traffic control signs, signals, and markers.

The Contractor shall maintain access for emergency vehicles at all times. The Contractor shall maintain a 24-hour emergency service to remove, install, relocate, and maintain warning devices and shall furnish to the Engineer names and telephone numbers of three persons responsible for this emergency service. In the event these persons do not promptly respond when notified, or it becomes necessary to call other forces to accomplish emergency service, the Contractor will be responsible for any cost incurred.

All existing permanent traffic control signs, barricades, and devices shall remain in effective operation unless a substitute operation is arranged for and approved by the Engineer. In the event that a temporary traffic control device or sign conflicts with a permanent one, the Contractor shall cover the permanent device to eliminate the conflict.

Prior to the start of each workday, the Contractor shall perform all necessary work incidental to and commensurate with the proper signing, detouring, barricading, etc., heretofore and hereinafter specified that is required for that particular day's schedule of operations. No construction shall be permitted until such signing and detouring operations have been completed.

The Contractor may post "Temporary No Parking" signs only after notifying and receiving approval from the Engineer. Type of sign, method, and location of such posting shall conform to the California MUTCD sign chart. The Contractor shall be required to provide and maintain all necessary flag persons, barricades, delineators, signs, flashers, and any other safety equipment as set forth in the latest publication of the California MUTCD, or as required by the Engineer to ensure safe passage of traffic (vehicles, pedestrians, cyclists, etc.).

The Contractor shall submit a traffic control and phasing plan for approval prior to beginning construction. No work shall commence on a phase until the previous phase is completed unless approved by the Engineer. The Contractor shall include these sequences in their work progress schedule to be submitted. The Contractor shall provide written notification to all businesses and residents near the construction one week prior to the work start date. The notice shall be prepared by the Contractor, approved by the City, distributed by the Contractor, and will include a preliminary schedule, name of the job superintendent/foreman and a telephone number where they can be reached 24 hours a day in case of emergency.

The cost for all project noticing will be included in the price of the traffic control. Failure or refusal by the Contractor to comply with the above requirements shall be sufficient cause for the Engineer to order the work done by City forces and for all costs thereof to be borne by the Contractor.

This item shall also include non-skid steel plates and temporary AC including installation and removal; all associated temporary signing and striping; flashing arrow signs; flagging and/or flagger costs; and other items as requested by the Engineer to safely complete the work.

Should the Contractor appear to be negligent in furnishing warning and protective measures as above provided, the Engineer may direct attention to the existence of a hazard, and the necessary warning and protective measures shall be furnished and installed by the Contractor, at their expense. Should the Engineer point out the inadequacy of warning and protective measures, such action on the part of the Engineer shall not relieve the Contractor from responsibility for public safety or abrogate its obligation to furnish and pay for these devices.

The Contractor shall provide access as required to accommodate special circumstance at any residence including access for disabled, impaired, special medical needs, etc.

Payment for Traffic Control and Public Safety shall be made per contract unit price per Lump Sum and shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all the work involving placing, removing, storing, maintaining, moving to new locations, replacing and disposing of the components of traffic control system as specified in the SSPWC and these specifications, and as directed by the City.

#### **7-6.2 Survey and Construction Staking.**

The Contractor shall perform all necessary survey and construction staking required to complete the work per the contract documents.

Payment for Survey and Construction Staking shall be made per contract unit price per Lump Sum and shall include furnishing all labor, materials, tools, equipment, transportation, and incidentals for performing all work involved, complete and in place, as shown in the Plans and in accordance with the contract documents. No additional compensation will be allowed thereof.

#### **7-6.3 Temporary Construction Fencing.**

It shall be the Contractor's responsibility to secure the entire limit of the work site with temporary construction fencing. The fencing limits and layout are subject to approval by the Engineer.

Payment for Temporary Construction Fencing shall be made per contract unit price per Lump Sum . No additional compensation will be allowed thereof.

#### **7-6.4 Items 6 through 143 per Project's Bid Schedule**

The price paid for the work items listed in the Bid Schedule shall include full compensation for furnishing the labor, material, tools and equipment and doing all of the related and incidental work involved to complete the work per the plans, specifications and contract documents. Contractor will include the cost of work not listed but necessary to complete the project designated in the Contract Documents in the various listed work items on the Bid Form.

The General Provisions and specifications which are not listed in the schedule of work items of the bid form are, in general, applicable to more than one listed work item, and no separate work item is provided thereof. Include the cost of work not listed, but necessary to complete the project designated in the contract documents, in the various listed work items of the bid form. This shall include, but not be limited to, keeping a neat and orderly work site, free of trash, and based on the City's site inspections, the City shall back-charge the Contractor for any remedial trash pickup determined to be required by the City.

The bids for the work are intended to establish a total cost for the work in its entirety. Should the Contractor feel that the cost for the work has not been established by specific items in the bid form, he shall include the cost for that work in some related bid item so that his proposal for the project does reflect his total cost for completing the work in its entirety.

Work for bid schedule items shall be constructed per the plans, specifications and contract documents, complete-in-place.

## **PART 2 – CONSTRUCTION MATERIALS**

### **SECTION 200 – ROCK MATERIALS.**

#### **200-2 UNTREATED BASE MATERIALS.**

##### **200-2.1 General.**

Replace the entire subsection with the following:

Materials for use as untreated base or subbase shall be crushed aggregate base.

### **SECTION 201 – CONCRETE, MORTAR, AND RELATED MATERIALS.**

#### **201-1 PORTLAND CEMENT CONCRETE.**

##### **200-1.1 General.**

Add the following:

Concrete shall be type 520-C-2500 PSI concrete per the

#### **203-6 ASPHALT CONCRETE.**

##### **203-6.1 General.**

Add the following:

Asphalt concrete shall be type C2-PG 64-10 for surface courses. No reclaimed asphalt concrete material (RAP) is allowed.

## **PART 3 – CONSTRUCTION METHODS**

### **SECTION 300 – EARTHWORK.**

#### **300-1 CLEARING AND GRUBBING.**

##### **300-1.2 Root Pruning and Tree Trimming.**

Replace the entire section with the following:

a. Equipment

Pruning of roots shall be done using a Vermeer trenching machine with a root pruning attachment or a comparable piece of equipment, as approved by the Engineer. The equipment shall safely cut a narrow trench four to six inches wide to accommodate the installation of the root barrier.

Where sidewalks, curb ramp, or curbs are removed, the roots can be severed at the point adjacent to the edge of the new sidewalk, curb ramp, or curb to be installed, using other pneumatic tools to make the break-out and removal work more efficient.

Any roots over three inches in diameter must be cleanly cut using a chain saw or other sawing tool before the barrier is installed and the trench backfilled.

b. Execution

Tree roots and other objectionable material shall be removed from areas of construction to a depth of 6 inches below the bottom of concrete. Tree roots shall be removed from parkways if visible or if instructed by Engineer.

Cleanly cut roots do not need to be painted or treated in any way other than the installation of root deflection barrier.

#### **300-1.4 Payment.**

Replace the entire subsection with the following:

There shall be no separate payment for root pruning or tree trimming; all costs thereto shall be considered included in the Contract unit price for the items of work for which the pruning or trimming is required.

## **SECTION 301 – SUBGRADE PREPARATION, TREATED MATERIALS, AND PLACEMENT OF BASE MATERIALS.**

### **301-1 SUBGRADE PREPARATION.**

#### **301-1.1 General.**

Add the following:

Base is required under all PCC and AC improvements as shown on the Plans.

A minimum of 4 inches of CAB shall be placed under sidewalks and access ramps.

A minimum of 8 inches of CAB shall be placed under curb and gutter.

#### **301-1.7 Payment.**

Add the following:

There shall be no separate payment for placement and preparation of subgrade material under curb, curb and gutter, sidewalks, and access ramps; all costs thereto shall be considered included in the Contract unit prices for the items of work for which subgrade material is required.

## **SECTION 302 – ROADWAY SURFACING**

### **302-5 ASPHALT CONCRETE PAVEMENT.**

#### **302-5.4 Tack Coat.**

Replace the first sentence of the first paragraph with the following:

If the asphalt concrete pavement is being constructed directly upon an existing hard-surfaced pavement, a tack coat of performance grade PG 64-10 paving asphalt conforming to 203-1 applied at an approximate rate of 0.25 L/m<sup>2</sup> (0.05 gallon per square yard), or SS-1h emulsified asphalt applied at an approximate rate of 0.25 L/m<sup>2</sup> to 0.45 L/m<sup>2</sup> (0.05 to 0/10 gallon per square yard), shall be uniformly applied upon the existing pavement preceding the placement of the asphalt concrete.

Add the following paragraph:

A Tack Coat shall be applied between base and surface courses when the surface course is not placed immediately after the base course, and to existing paved surfaces where new asphalt concrete overlaps or abuts existing pavement. Tack Coat shall be as specified in Section 302-5.4. There shall be no separate payment for Tack Coat.

#### **302-5.5 Distribution and Spreading.**

Add the following:

The surface course shall be flush with adjacent existing pavement surface. Maximum variance of 1/8". Surface course adjacent to edge of gutter shall have a 3/8" lip over the top longitudinal edge of the gutter.

#### **302-5.8 Manhole (and other structures).**

Add the following:

Contractor shall be required to protect and maintain existing utility access frames, grates, and lids during paving operations. No grade difference at lip, between utility frame and asphalt concrete finished grade pavement, shall be allowed.

## **SECTION 303 – CONCRETE AND MASONRY CONSTRUCTION.**

### **303-5 CONCRETE CURBS, WALKS, GUTTERS, CROSS GUTTERS, ALLEY INTERSECTIONS, ACCESS RAMPS, AND DRIVEWAYS.**

#### **303-5.1 Requirements.**

##### **303-5.1.1 General.**

Add the following:

PCC access ramps, sidewalks, and driveways shall not be poured monolithically with any new concrete adjacent to them.

##### **303-5.5 Finishing.**

##### **303-5.5.2 Curb.**

Add the following:

Unless otherwise approved by the Engineer, the entire affected concrete curb or curb and gutter portion shall be removed by sawcutting the adjacent AC pavement two (2) feet from the edge of the area to be removed. The Contractor shall reconstruct this two-foot-wide section in accordance with Standard Plan 111-5 of the SPPWC or as directed by the Engineer.

Curb and curb and gutter shall be constructed within 72 hours of removal of sidewalks, ADA curb ramp, and curb and gutter in each location. Clearing and grubbing shall be in accordance with Subsection 300-1, per the SSPWC, including removal and disposal of materials, and pruning and removal of interfering tree roots underneath or adjacent to existing access ramp.

The Contractor shall contact the Engineer a minimum of 24 hours prior to performing any excavations within a 25-foot radius of a street tree. Any damage to the street tree may result in tree replacement by Contractor or payment of replacement costs by Contractor based on the value of the damaged tree.

##### **303-5.5.3 Walk.**

Add the following:

Sidewalk shall be constructed within 72 hours of removal of sidewalks in each location. The Contractor shall remove all existing concrete sidewalk shown on the plans to the nearest control joint. Clearing and grubbing shall be in accordance with Subsection 300-1, per the SSPWC, including removal and disposal of materials, and pruning and removal of interfering tree roots underneath existing sidewalk or adjacent to sidewalk.

Finished surfaces shall match the finish and color of adjacent concrete.

The Contractor shall be responsible for protecting newly constructed concrete improvements from damage. Contractor shall remove and replace all concrete damaged prior to acceptance. Concrete shall be replaced score line to score line unless otherwise directed by the Engineer. Patching damaged concrete is not allowed.

The Contractor shall contact the Engineer a minimum of 24 hours prior to performing any excavations within a 25-foot radius of a street tree. Any damage to the street tree may result in tree replacement by Contractor or payment of replacement costs by Contractor based on the value of the damaged tree.

The expansion joint and weakened joint pattern shall be maintained and reconstructed, unless otherwise directed by the Engineer.

The Contractor shall mark all manholes, valves, substructures, survey monuments, vaults, utility boxes, or any other items that are visible on the surface and that will interfere with constructing a fully compliant sidewalk. The Contractor shall protect and adjust to grade any such items to match grade of the surrounding concrete to the satisfaction of the Engineer.

Vegetation interfering with construction operations shall be carefully trimmed without damaging the integrity of the vegetation. Vegetation, which must be removed for construction, shall be removed, and disposed of by the Contractor. The Contractor shall protect in place or reconstruct any irrigation lines and sprinkler heads hindering (and adjacent to) the construction activity area as directed by the Engineer. Damage to existing irrigation lines and sprinkler heads shall be replaced at Contractors expense.

### **303-5.5.5 Alley Intersections, Access Ramps, and Driveways.**

Add the following:

Unless otherwise approved by the Engineer, the entire affected concrete curb or curb and gutter portion shall be removed by sawcutting the adjacent AC pavement two (2) feet from the edge of the area to be removed. The Contractor shall reconstruct this two (2) foot wide section in accordance with Standard Plan 111-5 of the SPPWC or as directed by the Engineer.

Curb ramps shall be constructed within 72 hours of removal of sidewalks, ADA curb ramp, and curb and gutter in each location. Clearing and grubbing shall be in accordance with Subsection 300-1, per the SSPWC, including removal and disposal of materials, and pruning and removal of interfering tree roots underneath or adjacent to existing access ramp.

The Contractor shall contact the Engineer a minimum of 24 hours prior to performing any excavations within a 25-foot radius of a street tree. Any damage to the street tree may result in tree replacement by Contractor or payment of replacement costs by Contractor based on the value of the damaged tree.

Where necessary to match existing grades at the back or side of the ramp, the Contractor shall construct a rear curb for curb ramps. Curb height shall be constructed to match existing grade. Where existing walls are adjacent to curb ramp construction, the rear side curb shall be constructed to protect existing walls. Contractor shall protect in place existing vegetation and miscellaneous items adjacent to rear curb for access ramps adjacent to private property.

The Contractor shall mark all manholes, valves, substructures, survey monuments, vaults, utility

boxes, or any other items that are visible on the surface and that will interfere with constructing a fully compliant curb ramp. The Contractor shall protect and adjust to grade any such items to match grade of the surrounding concrete to the satisfaction of the Engineer.

Vegetation interfering with construction operations shall be carefully trimmed without damaging the integrity of the vegetation. Vegetation, which must be removed for construction, shall be removed, and disposed of by the Contractor. The Contractor shall protect in place or reconstruct any irrigation lines and sprinkler heads hindering (and adjacent to) the construction activity area as directed by the Engineer. Damage to existing irrigation lines and sprinkler heads shall be replaced at Contractors expense.

The Contractor shall relocate existing facilities such as street sign poles that are within the curb ramp area that conflict with the new proposed improvement. Any damaged signs due to construction shall be replaced at the Contractor's expense. The new location for such facility shall be as directed by the Engineer, if not already included in the plans, in the field and shall be within the general vicinity of the existing.

The Contractor shall tie down any survey monuments/markers obliterated during construction and reestablish said monuments/markers following construction.

## **PART 4 – EXISTING IMPROVEMENTS**

### **SECTION 400 – PROTECTION AND RESTORATION.**

Add the following subsections:

#### **400-4 TREES.**

The Contractor shall take care to protect all trees not approved for removal by the Engineer.

There shall be no separate payment for protection of existing trees; all costs thereto shall be considered included in the Contract unit prices for the items of work for which the protection is required.

#### **400-5 SIGNPOST.**

Contractor shall remove existing sign post from parkway when shown on plans to be removed by excavating to a depth necessary to remove the post and any existing foundation or anchoring assembly. Contractor shall protect and store the existing post and signs for reinstallation.

Contractor shall install a new anchoring assembly and reinstall the existing post with signs.

Contractor shall obtain approval by the Engineer of sign placement before permanently installing the new post. All signs and posts shall be reset the same day as the existing signs and posts are removed.

The bottom of the lowest sign shall be 7 feet above the sidewalk, if applicable. The lowest sign can be lower if in the parkway as approved by the Engineer.

Where there is no curb, the lateral distance between the edge of the sign panel and the edge of the nearest travel way shall be a minimum of 6 feet. Where there is a curb, the lateral distance between the edge of the sign panel and the flowline shall be a minimum of 2 feet.

See Section 7 for payment details.

### **SECTION 401– REMOVAL.**

#### **401-8 TREES.**

The Contractor shall notify the Public Works Inspector 48 hours prior to beginning any work performed under this specification.

The Contractor shall notify all affected property owners, in writing, of the proposed construction 72 hours prior to beginning any work. The notification shall be in the form of fliers. The City Construction Notice Template is attached in Exhibit “B” ; template shall be modified by the Contractor and sent to the Engineer for review and approval. Contractor shall distribute notices to residents and commercial establishments affected by the construction once approved by the Engineer.

The Contractor shall be responsible for the removal of any trees adjacent to repair, removal, and/or replacement sites which, in the opinion of the City, require root loss that would mortally wound the tree, or result in destabilizing the tree to an unacceptable level.

Where a tree to be removed in close proximity to an overhead utility line or guy line, extreme caution shall be taken to avoid damage to these lines. Any damage that does occur shall be promptly reported to the City Police Department, and to the utility company that is involved. The cost of repair of the damage will be at the Contractor's expense.

If damage occurs to any adjacent shrubs or trees that are to remain, immediate treatment or necessary replacement of same type of shrubs or trees shall be carried out under the direction of the City at the Contractor's expense.

Where shown on the Plans, or as requested by the Engineer, tree removal shall consist of notifications; cutting and complete removal of the tree stump, branches, and large roots (those with a diameter larger than one inch) to a minimum depth of 24 inches from top of curb; excavation; hauling; disposal; backfill; and restoration of removal area. Stump grindings will be removed and replaced with Class A topsoil to grade within the tree well or parkway.

See Section 7 for payment details.

## **PART 6 – TEMPORARY TRAFFIC CONTROL**

### **SECTION 600 – ACCESS.**

#### **600-1 GENERAL.**

Add the following:

Access to street intersections, public and private parking lots, commercial businesses, residences, and other public and private properties shall be maintained at all times. At least 72 hours in advance of commencing any work that may affect the access to private properties, the Contractor shall provide construction notices to adjacent residential properties, and commercial establishments. The Construction Notice template ( Exhibit “B”) shall be modified by the Contractor and sent to the engineer for review and approval. The Contractor shall distribute notices to residents and commercial establishments affected by construction once approved by the Engineer. Vehicular access to and from commercial and residential driveways and parking lots shall be maintained at all times, except when performing items of work which cannot be accomplished without access restriction.

When access must be restricted, as determined by the Engineer, it shall occur only for the time period required to accomplish the particular item of work.

Modifications to traffic control shall be performed to correct any deficiencies in traffic flow (vehicular, bicycle, pedestrian, etc.) as deemed necessary by the Engineer or Public Works Inspector.

All traffic lanes shall be open for public use on the days and at the times specified below:

1. Saturdays, Sundays, and legal holidays: from 12:00 a.m. to 11:59 p.m.
2. Fridays and any day preceding a legal holiday: from 5:00 a.m. to 11:59 p.m.
3. All days not covered in 1 and 2 above: 7:00 a.m. to 8:30 a.m. and 4:00 p.m. to 6:00 p.m.
4. Non-construction hours: all hours when the Contractor's employees are not physically present at the construction site actively performing Contract work.
5. In the vicinity of any Elementary or Middle School, the Contractor shall determine arrival and departure times of said school and shall provide for adequate traffic control for any school age pedestrian and/or bicycle routes to the school during the arrival and departure periods. The submittal of traffic control plans shall include arrival and departure times for each school. At no time will traffic control be allowed in the immediate vicinity so as to cause a hazard to a school pedestrian crosswalk during arrival and departure time periods.

On those days and hours when closure of traffic lanes is not prohibited under the provisions of the preceding subparagraph A, no more than one lane may be closed at any time during construction hours. During any lane closure, Type II flashing arrow boards shall be used in accordance with the most recent Edition of the Manual on Uniform Traffic Control Devices (MUTCD), the California Supplement to the MUTCD hereinafter referred as CAMUTCD issued by the State of California.

## **SECTION 601 – TEMPORARY TRAFFIC CONTROL FOR CONSTRUCTION AND MAINTENANCE WORK ZONES.**

### **601-1 GENERAL.**

Replace the first paragraph with the following:

All work required for maintaining and controlling traffic shall conform to the most recent Edition of the Manual on Uniform Traffic Control Devices (MUTCD), the California Supplement to the MUTCD hereinafter referred as CAMUTCD issued by the State of California, Department of Transportation (Caltrans), and the "Work Area Traffic Control Handbook," published by Building News, Inc.

Add the following:

All construction work and traffic control shall be scheduled and constructed to provide for a minimum of inconvenience and a maximum of safety to the public vehicular, bicycle and pedestrian traffic.

The Contractor shall be responsible for the protection of vehicular, bicycle and pedestrian traffic until the work called for in the Plans, the Standard Specifications, and Special Provisions have been accepted by the Engineer.

The Contractor shall notify the Engineer of intent to begin work following notice to proceed before work is to begin. The Contractor shall cooperate with the Engineer relative to handling traffic through the area and shall make all arrangements relative to keeping the working area clear of parked vehicles.

Contractor's equipment and personal vehicles of the Contractor's employees shall not be parked on the traveled way nor on any section where traffic is restricted at any time.

During any period when two-way traffic is not provided, as approved by the engineer, the Contractor shall employ flaggers to control traffic through the construction zone.

The Contractor shall notify the Engineer of any operation that will affect two-way flow of traffic more than five minutes for every half hour of working time, at least two working days in advance of such operation. Submitted traffic control plans must be signed/stamped by a licensed Traffic Engineer.

If the Contractor fails to maintain and control traffic at any time during the construction period such that the safety to public vehicular, bicycle and/or pedestrian traffic is compromised in any way in the opinion of the Engineer or the City Police Department, the City will require the Contractor to stop work and open all traffic lanes, or immediately modify the traffic control plan, subject to approval by the City, to ensure that the unsafe situation is corrected. If, due to the nature of the work, it is impossible to open all traffic lanes, or the Contractor is unable to immediately modify the traffic control plan to restore safe and adequate traffic control, the City may mobilize emergency forces to re-establish adequate and safe traffic control. The emergency forces may include Police Department, Maintenance Services Division, Engineering Division, Contractors or consultants hired by the City or other personnel as required to re-establish adequate and safe traffic control.

The Contractor shall pay for the full and complete time and material cost for any emergency response by City forces and firms hired by the City as described herein. This payment shall be in addition to the liquidated damages provided for in Section 6-9 of these specifications. Contractor agrees to pay such costs as provided for in this paragraph, and in case the same are not paid, Contractor agrees that City may deduct the amount of such costs from any money that is due or that may be due the Contractor under the Contract. The Contractor shall not be entitled to any delay claims for work stopped by the City in order to correct an unsafe traffic condition, regardless of whether traffic control was set up in accordance with an approved traffic control plan.

**601-3.5 Signs and Signage.**

**601-3.5.1 General.**

Replace the entire subsection with the following:

Signs shall conform to the most recent Edition of the Manual on Uniform Traffic Control Devices (MUTCD), the California Supplement to the MUTCD hereinafter referred as CAMUTCD issued by the State of California, Department of Transportation (Caltrans), and the "Work Area Traffic Control Handbook," published by Building News, Inc. Each sign shall consist of a base, standard or framework, and a sign panel. Sign units shall be capable of being delivered to the work site and placed into immediate operation.

Signs shall include all temporary signs required for the direction of traffic through or around the work site. Sign placement shall conform to the documents listed above and the Traffic Control Plan.

Advance warning signs shall be provided with orange warning flags in advance of temporary stop signs. Temporary stop signs are required any time a traffic signal is dark. Temporary stop signs shall be mounted at 7 feet high.

The Contractor shall post standard "NO PARKING" construction zone signs 72 hours prior to construction, not more than 50 feet apart within the work area, showing the date and time of construction. "NO PARKING" signs are to have the language "By order of the H.B.P.D. 318-0360 CVC 22658 / HBMC 10.32.220 & 10.12.040" on the signs. Signs can be obtained from the City.

**601-3.5.2 Payment.**

Replace the entire subsection with the following:

See Section 7 for payment details.

## **PART 9 – SPECIFIC CONDITIONS**

### **SECTION 900 – CONSTRUCTION MANAGEMENT.**

#### **900-1 PROCORE SOFTWARE.**

The contractor shall use the Procore construction management software (with account for the project made available by the City at no additional cost) for various construction management activities related to the project including but not limited to submission of schedules, project material submittals, and RFIs. Project documents including plans and specifications will also be made available on Procore for the contractor's use for the duration of the project.

### **SECTION 901- SOLID WASTE BINS**

#### **901.1 TEMPORARY STORAGE OF SOLID WASTE BINS DURING CONSTRUCTION**

The existing solid waste storage area located at the northwest corner of the project site (adjacent to Palm Drive) will be relocated to southwest area of the reconstructed parking lot where a new solid waste enclosure will be constructed. Currently, the solid waste bins are being utilized by the businesses located along the west side of Palm Drive. These businesses must continue to have easy and safe access to the solid waste bins during the course of construction. The contractor shall make provisions to ascertain that the business owners will continue to utilize the solid waste bins by placing them on the project site immediately adjacent to Palm Drive until the new solid waste storage enclosure is built and the solid waste bins are relocated to the new storage location.

**EXHIBIT "A" – SCHEDULE OF PERFORMANCE**  
**CIP NO. 682 PARKING LOT "D" IMPROVEMENTS PROJECT**

**SECTION 1. BEGINNING OF WORK, TIME OF COMPLETION**

1. Attention is directed to the provisions of Section 6-1 ("Construction Schedule and Commencement of the Work"), Section 6-1.1 ("Construction Schedule"), and Section 6-9 ("Liquidated Damages"), of the State Specifications, and these Provisions.
  
2. The Contractor shall complete work within **ninety (90)** working days after receiving the "Notice to Proceed".
  
3. The Contractor and its securities will pay the sum of one thousand two hundred dollars **(\$1,200)** as liquidated damages for each consecutive calendar day of delay in the performance of the work in this agreement and as shown on the plans.

## EXHIBIT “B” – SOLID WASTE REPORTING

Pursuant to the California Integrated Solid Waste Management Act of 1989, the City is required to report the amount of solid waste generated within the City and the disposal of that waste with the ultimate required goal of being a reduction of at least 50% in the amount of solid waste being disposed in landfills. To permit the City to comply with this State law, the contractor is required to complete the Solid Waste Report form, a copy of which is included in these special provisions. The report includes a summary of the solid waste generated by the project, a summary of solid waste disposed of at class III landfills and a summary of solid waste diverted from disposal through recycling and re-use. The contractor may use a self-generated report format that includes all of the information included on the City form.

The report shall be filed with the City after project completion and prior to final payment. If the project time span includes more than one calendar year, a separate report is required for the solid waste in each calendar year. A report for a calendar year that does not coincide with project completion shall be filed with the City on or before January 31<sup>st</sup>.

Supporting documents to be submitted with the report shall include legible copies of weigh tickets, receipts, or invoices that specifically identify the job site location that generated the waste materials. If materials are taken to a location where weigh tickets, receipts, or invoices are not available, the contractor shall provide the documentation on its own company letterhead.

The contractor is encouraged to divert solid waste from disposal at landfills through recycling and re-use when possible while maintaining compliance with all other contract specifications and special provisions.

**Contractor's Construction and Demolition  
Waste Diversion Reporting Form**

Job Site Address (where waste was generated):

City Permit No.:

Material	Name of Facility/Site Where Taken	Disposal	Aggregate	Recycled or Reused				
				Alter- native landfill	Compost	Engineer ed Fill	Mulch	Other
				Tons	Tons	Tons	Tons	Tons
ASPHALT								
CONCRETE								
DIRT								
GREEN WASTE								
METAL								
OTHER SEGREGATED MATERIALS(Describe)								
ROCKS								
WOOD								
MIXED WASTE								
OTHER CONSTRUCTION OR DEMOLITION WASTE								
TOTAL								

COMPANY NAME:

DATE OF REPORT:

## EXHIBIT “C” – CONSTRUCTION NOTICE TEMPLATE

COMPANY LETTERHEAD

### NOTICE OF WORK/CONSTRUCTION

Name of Project Date of Notice

Dear Residents and Businesses (if applicable):

Provide a brief description of the work that is to be performed. Four to five sentences should suffice.

Map detailing  
what streets will  
be closed.

**What:** Provide a brief description of what is happening. One sentence should suffice.

**Start/Duration:** When is the project expected to start and how long is it anticipated to take for it to be completed? If there are different phases, indicate the estimated time.

**What to Expect:** Will there be noise? Will there be flaggers directing traffic? Will residents have access, or will it be a full closure? Will parking be temporarily blocked? Include enough details.

**Equipment in Use:** What kind of equipment will be seen?

**Working Hours:** What are the working hours and days?

#### **Contact Information**

Always include contact information for residents and business owners in case they have questions or concerns.

We apologize for any inconvenience and thank you for your patience. Sincerely,

Contractor Name

