PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes the following:
1. Provide labor, materials and equipment required for cast-in-place load bearing elements constructed using slurry wall techniques as shown on the drawings, including excavation, reinforcement, and concrete.
2. If during construction, subsurface conditions different from those encountered in the Geotechnical Report are observed, notify the Architect and the Owner's Geotechnical Engineer immediately so that a review of the condition can be made by the Owner's Geotechnical Engineer.

B. Related Sections:
1. 01 33 00 – Submittal Procedures
2. 01 45 00 – Structural Testing, Inspection, and Quality Assurance
3. 03 20 00 – Concrete Reinforcing
4. 03 30 00 – Cast-in-Place Concrete
5. 31 00 00 – Earthwork
6. 31 50 00 – Excavation Support System

C. Existing Conditions:
1. Underground Utilities: All underground utilities, basements, and footings of all buildings and other structures shall be identified and located before excavation operations and shall be protected from harm as required to prevent damage. The outside dimension of the load bearing elements shall clear utilities by a minimum of 5 feet.
2. Existing Adjacent Facilities: Before beginning construction, the Contractor shall ascertain the existing condition of adjacent structures.

1.3 REFERENCE STANDARDS

A. General: The latest versions of the publications listed below form a part of this specification; comply with provisions of these publications except as otherwise shown or specified.

B. Geotechnical Reports entitled "Transbay Tower Geotechnical Data Report," dated June 17, 2013, and “Transbay Tower Geotechnical Interpretive Report,” dated July 31, 2013.

* C. Geotechnical Memorandum entitled “Transbay Tower – Results of LBE Ocell Tests,” dated February 12, * 2014.

* D. Geotechnical Memorandum entitled “Transbay Tower – Skin Friction for Sandstone,” dated April 10, 2014.

E. American Concrete Institute (ACI):
1. ACI 318: Building Code Requirements for Structural Concrete

F. European Standard (EN):
1. EN 1538: Execution of Special Geotechnical Work – Diaphragm Walls

1.4 SUBMITTALS

A. General: Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

B. Concrete Mix Designs: Submit concrete mix designs in accordance with Section 03 30 00, "Cast-in-Place Concrete."

C. Concrete Reinforcement: Submit placing drawings, product data, etc., in accordance with Section 03 20 00, "Concrete Reinforcing."

D. Mill Tests: Submit certified mill test reports for reinforcement in accordance with Section 03 20 00, "Concrete Reinforcing."

E. Qualification Data: Submit qualification data for firms and persons specified in the article entitled "Quality Assurance" of this Section, to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

F. Reports: The Contractor shall submit four copies of the following reports to the Architect, with copy to others as will be designated.
   1. Two weeks prior to beginning load bearing element work and pre-construction conference, submit to the Owner's Structural Engineer and Geotechnical Engineer for review, a detailed excavation sequence and procedures for construction of load bearing elements, including but not limited to materials, methods, and equipment to be used. Include information related to mineral and/or polymer slurry, casings, excavation equipment, methods and equipment for cleaning excavations, methods and equipment for casting concrete, methods and equipment for removal of water and mineral and/or polymer slurry displaced by concrete placement, and methods for proceeding with construction when caving or adverse groundwater conditions are encountered.
      a. Include detailed information on methods for excavation and placing concrete in soil containing water. Include information on tremie concrete placement techniques.
      b. Address method for proceeding with construction when caving or adverse groundwater conditions are encountered.
   2. Certified report for each load bearing element recording actual elevation at bottom and top, final centerline location at top, variations from plumb, results of tests performed, levelness of bottom, seepage of water, unusual conditions, variation of dimensions from original design. Record dates and times of starting excavation, completion of excavation, and placement of concrete. Include record of concrete volume placed in relationship to calculated volume of hole. Reports shall be submitted to the Architect on a weekly basis or as determined at the pre-construction conference.

G. Record Drawings: The Contractor shall submit to the Owner and Architect record drawings showing location and dimensions of all concrete elements including unused or abandoned elements.

1.5 QUALITY ASSURANCE

A. Codes and Standards: For all load bearing elements, comply with EN 1538 and as herein specified. Where provisions of above standards conflict with building regulations in effect for this project, building regulation will govern, but only to establish minimum requirements.

B. Installer Qualifications: A minimum of 5 years of experience and not less than three successfully completed load bearing element or slurry wall contracts with similar soil and groundwater conditions, element size, depths, and volumes of work contained in this project.

C. Special Test and Inspections: Refer to article entitled "Field Quality Control" of this Section for special inspection and testing. Load bearing elements shall be installed under continuous observation of the Owner's Geotechnical Engineer. Notify Owner's Geotechnical Engineer at least 48 hours in advance of starting or restarting construction.

D. Survey Work: Engage a surveyor who is registered in the state of California, to perform surveys, layouts, and measurements for load bearing element work. Conduct layout work for each element to lines and levels required before excavation. Measure and report actual measurements for each element's horizontal axial location, element horizontal dimensions, and top elevations prior to placing reinforcement and concrete.
   1. Record and maintain information pertinent to each element and cooperate with Owner's Geotechnical Engineer and Owner's Testing Agency to provide data for required reports.

E. Pre-construction Conference: A minimum two weeks prior to scheduled commencement of load bearing element installation and associated work, meet at project site with installer of load bearing elements, installers of related work, Owner's Structural Engineer, Owner's Representative, Owner's Testing Agency, Owner's Geotechnical Engineer, and other representatives directly concerned with performance of the work. Review foreseeable methods and procedures related to load bearing element work. Record discussion of conference and decisions reached, and furnish copy of record to each party attending.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect reinforcing steel accessories, etc., in accordance with Section 03 20 00, "Concrete Reinforcing."

1.7 PROJECT CONDITIONS

A. Site Information: A Geotechnical Report has been prepared for this Project and is available for information only. The report is not part of the Contract Documents and is not guaranteed to represent conditions that will be encountered. Opinions expressed in this report are those of the Owner's Geotechnical Engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by the Owner's Geotechnical Engineer. The Owner will not be responsible for interpretations or conclusions drawn from this data by the Contractor.
   1. Additional test borings and other exploratory operations may be made by the Contractor at no additional cost to the Owner.
   2. The Geotechnical Report is referenced elsewhere in the Project Manual.

B. Existing Utility Lines and Foundations: Any existing underground utility lines and foundations shown on the Drawings are shown from the best possible information available and shall be verified prior to any excavation or grading work.
   1. Known utilities and foundations have been shown only where their existence has been determined by survey, investigation, or record drawings. The precise location of these lines, as well as careful reconnaissance of all areas for both above- and below-ground utilities as well as protection of same, shall be the sole responsibility of the Contractor.
   2. Existing utility lines to be retained and shown on the Civil Drawings, or the location of which are made known to the Contractor prior to excavation operations, shall be protected from damage during excavation, filling, and backfilling, and if damaged, shall be repaired by the Contractor, at his expense, and in a manner as directed by the Architect.
   3. New Utility Lines: New utility lines shown on the Civil Drawings, or the location of which are made known to the Contractor prior to load bearing element construction, shall be protected from damage during excavation, filling, and backfilling, and if damaged, shall be repaired by the Contractor, at his expense, and in a manner as directed by the Architect.

C. The Contractor shall conduct a pot-holing program prior to load bearing element installation. At each element location, the Contractor shall remove all potential obstructions from previous foundations and other debris in the vicinity of the element to a depth of at least 15 feet. If debris or other obstructions are found within the top 15 feet which appear to extend below 15 feet, these obstruction shall be removed as well. The excavations shall be backfilled to the ground surface prior to beginning the elements. The pot holes shall be dug one at a time in order to reduce excavation-induced ground movements. Any existing timber piles within 20 feet of the Transbay Transit Center shoring wall (bulkhead) shall be removed using a deformation controlled method.

D. The Contractor shall assume all responsibility for the premises and loss or damage to the property, adjoining property, public ways and utilities, shoring, bracing, and barricades and protecting adjacent property. All work shall conform to the requirements of the local jurisdiction. All costs for protecting, repairing, and replacing adjacent property shall be borne by the Contractor.

PART 2 PRODUCTS

2.1 CONCRETE AND RELATED MATERIALS

A. Concrete: Provide concrete mix conforming to the requirements as indicated in the "General Structural Notes" on the Structural Drawings. Consider the use of low heat-of-hydration cement at large element installations.

B. See Section 03 30 00, "Cast-in-Place Concrete," for concrete materials.

C. Reinforcing Bars and Dowels: See Section 03 20 00, "Concrete Reinforcing," for reinforcing materials and accessories.

D. Miscellaneous Materials:
   1. Bentonite Clay: Provide type to suit project conditions.
   2. Polymer: Provide type and comparable experience in similar geotechnical conditions
   3. Other: Provide other materials shown or required for a complete installation of load bearing elements.

PART 3 EXECUTION

3.1 SITE CONDITIONS

A. Survey Information: The survey information on the project drawings is shown for information only. The locations of existing site features shown on the Drawings are approximate only. The Contractor shall determine before commencing work the exact location of all existing features or elements, which may be disturbed or affect the new construction, including existing underground utilities. The Contractor shall be fully responsible for damages caused by the Contractor's failure to exactly locate and preserve existing site features.

B. Water and Caving Conditions: Groundwater is expected; refer to the Geotechnical Report. Where caving conditions are encountered, no further excavation will be allowed until the Contractor implements measures to prevent caving to the satisfaction of the Owner's Geotechnical Engineer, in order to maintain the design capacity of load bearing elements.

3.2 ELEMENT EXCAVATION

A. General: Excavate holes for load bearing elements as necessary to produce a sound, durable concrete element free of defects. Except as indicated below, elements shall be excavated to the elevations shown on the drawings, and then deeper where required to achieve suitable soil capacities as determined by Owner's Geotechnical Engineer. Excavate holes for elements within 30 feet of adjacent elements only after adjacent holes are filled with concrete and allowed to set for 48 hours minimum.

1. Design of load bearing elements is based on assumed soil friction and end bearing capacities as
* shown in the Geotechnical Memorandum. If the surrounding soils and/or end-bearing stratum are not capable of achieving the required load-carrying capacities, the load bearing elements shall be revised as directed by the Owner's Structural Engineer. Authorized revisions, which include excavating above or below planned excavations, will be paid for in accordance with the unit cost matrix.
2. Provide load bearing element bases of the dimensions and at the elevations indicated.
3. The equipment and methods used to construct the elements shall be selected by the Contractor.
4. The Contractor shall be prepared to encounter excavation obstructions when making holes for load bearing elements. Obstructions may be present which are not shown on the Drawings. This could include but not be limited to the following: existing buried concrete and demolition spoils, existing concrete elements, slabs, walls, and foundations, and natural obstructions such as cobbles and boulders. Excavation through obstructions shall be performed using the clam bucket/chisel or hydromill as outlined in the subcontract agreement.
5. Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to load bearing elements as determined by the Owner's Representative.
    a. Do not excavate elements deeper than elevations indicated, unless approved by the Owner's Representative.
    b. Additional approved excavation will be paid according to the Contract provisions for changes in the Work.
6. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to the Architect for review before proceeding.

B. Tolerances: Load bearing elements shall be installed so that the axis of the element at the top of the element is not more than 3 inches from its plan location at the top. Out-of-plumbness shall not exceed 1 percent. The top elevations of the element shall be no lower than its plan elevation and no higher than 2 feet above its plan elevation. The dimensions of the concrete element shall be no less than that shown in the drawings, or as accepted by the Owner's Geotechnical Engineer. Load bearing elements and holes shall not extend over the property line.

C. Loss of Ground:

1. The Contractor shall set guide walls with larger dimensions than that of the load bearing element. The Contractor shall take all required safety precautions with regard to the open hole.

D. Bottom of Load Bearing Elements: Excavate the bottom of elements to design elevations and clean all loose and/or disturbed materials before rebar and concrete is placed. The Owner's Representative will approve the cleanliness of the bottom of each element prior to rebar placement and concrete placement on the basis of a weighted graduated tape and tests on slurry samples taken no higher than 1 ft above the bottom of the element using an approved slurry sampling tool. The required properties for slurry samples are set out in paragraph E below. Where stated in paragraph E, the values 'with end bearing' shall apply.

E.

Required Slurry Properties		
Item to be measured	**Range of results at 68 F**	**Test methods**
1. Density before concreting, lb/ft^3, for slurry 1 ft from bottom of element		(Mud balance) ASTM D 4380
a. Mineral slurries (bentonite/ attapulgite)		
1. No end bearing	85 max	
2. With end bearing	72 max, unless otherwise approved by the geotechnical engineer for specific conditions	
b. Polymer slurry		
1. No end bearing	64 max	
2. With end bearing	64 max	
2. Marsh funnel viscosity for entry, s/qt		(Marsh funnel) API—RP13B—Section 2
a. Bentonite/attapulgite	26 to 50	
b. Polymer slurry	40 to 90*	
3. Sand content in slurry, immediately before concreting, 1 ft from bottom, by volume, %		(Sand screen set) ASTM D 4381
a. Mineral slurries (bentonite/ attapulgite)		
1. With end bearing	4 max	
2. No end bearing	20 max	
b. Polymer slurry		
1. With end bearing	1 max	
2. No end bearing	1 max	
4. pH during excavation	7 to 12	ASTM D 4972

* Or as recommended by manufacturer and accepted by the Owner's Representative-Geotechnical Engineer.

3.3 REINFORCING STEEL AND DOWELS

A. General: In accordance with Section 03 20 00, "Concrete Reinforcing."

B. Fabricate and erect reinforcing cages for load bearing elements as one continuous unit above the trench, which includes the mechanical couplers shown on the Drawings. Place reinforcing accurately and symmetrically about the axis of hole without disturbance to the soil. Hold securely in position during concrete placement. Use approved spacers and continuously verify that clear concrete cover is maintained.

C. Reinforcement shall be inspected by the Owner's Testing Agency in accordance with Section 03 20 00, "Concrete Reinforcing."

D. Provide blocking and holding devices to maintain required position during concrete placement, within tolerance of plus or minus 1/4 inch.

E. Protect exposed dowels and reinforcement from mechanical damage and exposure to weather.

3.4 CONCRETE PLACEMENT

A. General: In accordance with Section 03 30 00, "Cast-in-Place Concrete."

B. Immediately after the trench is evaluated and found to be suitable by the Owner's Geotechnical Engineer, set the reinforcing steel cage and commence placement of structural concrete as soon as possible thereafter.
1. Place concrete in-the-wet by tremie construction techniques.
2. Place concrete continuously in one pour from bottom to top. Cold joints are not acceptable unless shown on the Structural Drawings.
3. Maintain a sufficient head of concrete to prevent reduction in dimensions of the element by earth pressure and to prevent extraneous material from mixing with fresh concrete. Coordinate withdrawal of tremies with concrete a minimum of 10 feet above tremie bottom.
4. Stop concrete placement at cutoff elevation shown.
5. Dispose of excavated material resulting from excavation.

C. When ambient temperatures necessitate the use of hot- or cold-weather concreting, make provisions in advance of placing load bearing elements.

D. Maintain records and allow for continuous inspection in accordance with requirements of articles entitled "Reports" and "Construction Monitoring" in this Section.

3.5 FIELD QUALITY CONTROL

A. General: Work under this Section shall be subject to special inspection and testing by the Owner's Testing Agency and the Owner's Geotechnical Engineer; requirements for testing and inspections as specified in this Section are minimums. Refer to Section 01 45 00, "Structural Testing, Inspection, and Quality Assurance," for additional requirements.

B. Continuous Inspection: The Owner's Representative shall provide continuous inspection during all excavation operations and concrete placement and will inspect each concrete element for the following conditions:
1. Verify that the soil conditions are suitable for the concrete element support, that the hole is of correct dimension, and that the load bearing element conforms to the specified tolerances.
2. The Geotechnical Engineer, from subsurface conditions found in excavations, will determine actual concrete element lengths and bearing capacities.
3. Prior to placement of reinforcing steel, the Owner’s Geotechnical Engineer shall verify that all loose material has been removed. The Owner’s Geotechnical Engineer's inspection of holes shall be conducted in accordance with all local, state, and Federal safety requirements.
4. During concrete placement, the Testing Agency shall check for concrete level during the pour in slurry-filled holes and record data specified in this Section.
5. The Contractor shall prepared a load bearing element report for each element containing the information as follows:
    a. Actual top and bottom elevations.
    b. Elevation of strata changes.
    c. Description of soil materials.
    d. Description, location, and dimensions of obstructions.
    e. Final top centerline location.
    f. Variation of element from plumb.
    g. Element excavating method.
    h. Design and tested bearing capacity of bottom.
    i. Levelness of bottom and adequacy of cleanout.
    j. Description of soil movement, sidewall stability, loss of ground, and means of control.
    k. Date and time of starting and completing excavation.
    l. Slurry level at the beginning of each shift.
    m. Inspection report.
    n. Position of reinforcing steel.
    o. Concrete placing method, including elevation of consolidation and delays.
    p. Sign-off from the Owner’s Representative that the element is ready to receive concrete.

q. Concrete placing start and stop times and weather conditions.
r. Elevation of concrete during removal of casings.
s. Although construction joints are prohibited, if unexpected conditions require a construction joint, the location and condition of the construction joint shall be documented.
t. Remarks, unusual conditions encountered, and deviations from requirements.
u. Concrete testing results.

3.6 DISPOSAL OF MATERIALS

A. Remove surplus excavated material and slurry and legally dispose of it off the Owner's property.

END OF SECTION