SECTION 01 45 29 – STRUCTURAL TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-01 Specification Sections apply to work specified in this Section.

1.2 SCOPE OF WORK

A. The Owner's Testing Laboratory: An independent testing laboratory will sample and test materials as they are being installed for compliance with acceptance criteria as specified and report and interpret the results. The laboratory shall monitor and report on the installation of constructed work and shall perform tests on the completed construction as required to indicate Contractor's compliance with the various material specifications governing this work. The owner shall be responsible for paying the testing laboratory for these services.

B. The Contractor shall not engage the same testing laboratory for construction services as the Owner has for quality assurance testing, unless agreed to by the Owner.

1.3 SPECIAL INSPECTIONS

A. The Owner's Testing Laboratory or a separate agency shall serve as a Special Inspector to provide Special Inspection services for the items listed below. The scope of such services for each item shall be as defined in the Building Code or as defined in the local building code of the jurisdiction wherein the project is located. These inspections are mandatory for conformance to the legal requirements of the building code and shall be in addition to the inspections and tests otherwise defined in this specification.

1. Reinforcing Steel Placement
2. Concrete Work
3. Welding of Reinforcing Steel
4. Bolts to be Installed in Concrete and Their Installation to allow for higher allowable tension values
5. Prestressing Tendons Placement
6. Prestressing Operation
7. Grouting of Bonded Prestressing Tendons
8. Precast Concrete Erection
9. Inspection of Structural Steel, Bolting, and Welding Material
10. Welding of Structural Steel
11. High-Strength Bolting

12. Compacted Earth Fill

13. Pile Foundations

14. Pier Foundations

15. Shotcrete Work

16. Masonry Work

17. Wood Construction

B. Qualifications of Special Inspector: The special inspector shall be a qualified person who shall demonstrate competence, to the satisfaction of the Building Official, for inspection of the particular type of construction or operation being inspected. The Special Inspector shall meet the legal qualifications of the building code having jurisdiction.

C. Duties and Responsibilities of the Special Inspector:

1. The special inspector shall observe the work assigned to ascertain that, to the best of his/her knowledge, it is in conformance with the approved design drawings and specifications.

2. The special inspector shall furnish inspection reports to the Building Official, the Architect/Engineer, and the Owner. All discrepancies shall be brought to the immediate attention of the Architect/Engineer, Contractor, and Owner. A report that the corrected work has been inspected shall be sent to the Building Official, the Architect/Engineer, and the Owner.

3. The special inspector shall submit a final signed report stating whether the work requiring special inspection was, to the best of the inspector's knowledge, in conformance to the approved plans and specifications and the applicable workmanship provisions of the building code.

1.4 QUALIFICATIONS OF TESTING LABORATORY

A. The Testing Laboratory shall meet the basic requirements of ASTM E329 and shall submit to the Owner, Architect, and Engineer evidence of current accreditation from the American Association for Laboratory Accreditation, the AASHTO Accreditation Program or the "NIST" National Voluntary Laboratory Accreditation Program.

B. The Testing Laboratory shall be an Approved Agency by the Building Official of the city wherein the project is located to perform Special Inspections and other tests and inspections as outlined in the applicable building code.

C. Tests and inspections shall be conducted in accordance with specified requirements, and if not specified, in accordance with the applicable standards of the American Society for Testing and Materials or other recognized and accepted authorities in the field.

D. Qualifications of Welding Inspectors

1. Inspectors performing visual weld inspection shall meet the requirements of AWS D1.1 Section 6.1.4. Welding inspection shall be supervised and the inspection reports signed by an inspector with current certification as an AWS Certified Welding Inspector (CWI)

2. Inspectors performing nondestructive examinations of welds other than visual inspection (MT, PT, UT, RT) shall meet the requirements of AWS D1.1, Section 6.14.6.

E. Qualifications for Post-Tensioning Inspector - The technician for the Owner's Testing Laboratory performing the field inspections required for post-tensioned concrete shall possess a currently valid Level 2 Post-Tensioning Inspector Certification issued by the Post-Tensioning Institute. A copy of such certification for each such technician shall be submitted for Engineer review and approval.

1.5 AUTHORITIES AND DUTIES OF THE LABORATORY

A. Attending Preconstruction Conferences: The Owner's Testing Laboratory shall receive from the Owner and review the project plans and specifications with the Architect and Engineer immediately upon receipt and prior to the start of construction. The Laboratory shall attend preconstruction conferences with the Architect, Engineer, Project Manager, General Contractor, and Material Suppliers as required to coordinate materials inspection and testing requirements with the planned construction schedule and shall participate in such conferences throughout the course of the project.

B. Cost Proposal: The Testing Laboratory's proposal to the Owner shall contain unit price stipulations for specified tests and inspections and on an hourly basis for personnel. A total estimated price shall also be submitted.

C. Cooperation with Design Team: The Laboratory shall cooperate with the Architect, Engineer, and Contractor and provide qualified personnel promptly on notice.

D. The Laboratory shall perform the required inspections, sampling, and testing of materials as specified under each section and observe methods of construction for compliance with the requirements of the Contract Documents and the applicable building code.

E. Inspections Required by Government Agencies: The Testing Laboratory shall perform inspections and submit reports and certifications as required by government agencies having jurisdiction over the aspects of the project covered by this specification.

F. Notification of Deficiencies in the Work: The Laboratory shall notify the Architect, Engineer, and Contractor within 24 hours of discovery by telephone or e-mail, and then in writing of observed irregularities and deficiencies of the work and other conditions not in compliance with the requirements of the Contract Documents.

G. Reports:

1. Information on Reports: The Laboratory shall submit copies of reports of inspections and tests promptly and directly to the parties named below. The reports shall contain at least the following information:

a. Project Name
b. Date report issued
c. Testing Laboratory name and address
d. Name and signature of inspector
e. Date of inspection and sampling
f. Date of test
g. Identification of product and Specification section
h. Location in the project
i. Identification of inspection or test

j. Record of weather conditions and temperature (if applicable)
k. Results of test regarding compliance with Contract Documents

2. Copies: The Laboratory shall send signed copies of test and inspection reports to the following parties:

a. 2 copies to the Owner or his representative
b. 2 copies to the General Contractor
c. 1 copy to the Architect
d. 1 copy to the Engineer of responsibility

3. Certification: Upon completion of the job, the Laboratory shall furnish to the Owner, Architect, and Engineer of Record, a statement signed by a licensed professional engineer that, to the best of their knowledge, required tests and inspections were made in accordance with the requirements of the Contract Documents.

H. Accounting: The Testing Laboratory shall be responsible for separating and billing costs attributed to the Owner and costs attributed to the Contractor.

I. Monitoring Product and Material Certifications: The Testing Laboratory shall be responsible for monitoring the submittals of product and material certifications from manufacturers and suppliers as specified in the Specifications and shall report to the Owner, Architect, and Engineer when those submittals are not made in a timely manner.

J. Limitations of Authority: The Testing Laboratory is not authorized to revoke, alter, relax, enlarge upon, or release any requirements of the Specifications or to approve or accept any portion of the work or to perform any duties of the General Contractor and his Subcontractors.

1.6 CONTRACTOR'S RESPONSIBILITY

A. Cooperation with Design Team: The Contractor shall cooperate with laboratory personnel, provide access to the work, and to manufacturer's operations.

B. Furnishing Samples and Certificates: The Contractor shall provide to the laboratory certificates and representative samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.

C. Furnishing Casual Labor, Equipment and Facilities: The Contractor shall furnish casual labor, equipment, and facilities as required for sampling and testing by the laboratory and otherwise facilitate the required inspections and tests.

D. Advance Notice: The Contractor shall be responsible for notifying the Testing Laboratory sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests. Failure to sufficiently notify may result in additional costs incurred by the Testing Laboratory that may be back-charged to the Contractor by the Owner.

E. Payment for Substitution Testing: The Contractor shall arrange for and pay for any additional samples and tests above those required by the Contract Documents as requested by the Contractor for his convenience in performing the work.

F. Payment for Retesting: The Contractor shall be liable to the Owner for the cost for any additional inspections, sampling, testing, and retesting done by the Owner’s Testing

Laboratory as required when initial tests indicate work does not comply with the requirements of the Contract Documents.

G. Payment by Contractor: The Contractor shall furnish and pay for the following items if required:

1. Soil survey of the location of borrow soil materials, samples of existing soil materials, and delivery to the Contractor's Testing Laboratory.

2. Samples of concrete aggregates and delivery to the Contractor's Testing Laboratory.

3. Concrete mix designs as prepared by his concrete supplier.

4. Site-situated storage boxes for concrete cylinders

5. Concrete coring, tests of below strength concrete, and load tests, if ordered by the Owner, Architect, or Engineer.

6. Certification of reinforcing steel and prestressing steel mill order.

7. Certification of structural steel mill order.

8. Certification of portland cement, lime, fly ash.

9. Certification of welders and preparation of Welding Procedure Specifications.

10. Tests, samples, and mock-ups of substitute material where the substitution is requested by the Contractor and the tests are necessary in the opinion of the Owner, Architect or Engineer to establish equality with specified items.

11. The making and testing of concrete cylinders for the purpose of evaluating strength at time of form stripping or for post-tensioning or the time spent evaluating the in situ strength of concrete using the Maturity Method.

12. Any other tests when such costs are required by the Contract Documents to be paid by the Contractor.

H. Notification of Source Change: The Contractor shall be responsible for notifying the Owner, Architect, Engineer, and Owner's Testing Laboratory when the source of any material is changed after the original tests or inspections have been made.

I. Tests for Suspected Deficient Work: If in the opinion of the Owner, Architect, or Engineer any of the work of the Contractor is not satisfactory, the Contractor shall furnish and pay for all tests that the Owner, Architect, or Engineer deem advisable to determine its proper construction. The Owner shall pay all costs if the tests prove the questioned work to be satisfactory.

1.7 PAYMENT OF TESTING LABORATORY

A. The Owner will pay for the initial Laboratory services for testing of materials for compliance with the requirements of the Contract Documents. The Contractor will be liable to the Owner for the cost for testing and retesting of materials that do not comply with the requirements of the Contract Documents and shall furnish and pay for the testing and inspection of other items as specified in these Specifications.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCOPE OF WORK

A. The work to be performed by the Testing Laboratory shall be as specified in this Section of the Specification and as determined in meetings with the Owner, Architect, and Engineer.

3.2 EARTHWORK

A. Compacted Fill Inspection and Testing:

1. Inspection of Subgrade Below Compacted Fill: The Owner's Testing Laboratory shall observe and verify that the subgrade below compacted fill has been properly prepared before compact fill construction begins.

2. Verification of Fill Material: Perform classification and testing to verify that the fill material to be used complies with the project specifications.

3. During placement and compaction of fill, determine that the material being used and the maximum lift thickness comply with the specifications.

4. Field Density Testing: Perform field density testing as described below

a. Paved Areas and Building Slab Subgrade:
(1) Make at least one field density test of the natural subgrade for every 2500 square feet of paved area or building slab but in no case less than three tests.
(2) In each compacted fill layer or lift, make one field density test for every 2500 square feet of building slab or paved area but in no case less than three tests.

b. Foundation Wall Backfill: Make at least one field density test for each 200 lineal feet of wall with a minimum of 4 tests for the basement walls around the perimeter of each building and a minimum of one test for every other type of foundation wall on the site. Tests shall be performed in random lifts along each wall.

c. Compacted Fill Beneath Column and Wall Footings and Mat Foundations: Make at least one field density test in each compacted fill layer or lift for each column footing, one for each twenty-five lineal feet of wall and one for each 2500 sq. ft of mat foundation area or fraction thereof.

5. Field Density Tests: Field Density Tests shall be run according to ASTM D2937, or ASTM D2922 as applicable.

6. Acceptance Criteria: The results of field density tests by the Laboratory will be considered satisfactory if the average of any three consecutive tests has a value not less than the required density with no single test falling more than 2 percent below the required density and the moisture content conforms to the requirements of the specification.

7. Report Copies: Moisture-density curves and results of field density tests shall be submitted to the parties specified earlier in this section.

8. Additional Testing: If reports by the Laboratory indicate field densities lower than specified, additional tests will be run by the Laboratory with at least the frequencies scheduled above on recompacted fill and/or natural subgrade. The Testing Laboratory shall notify the Contractor on a timely basis for any required retesting so as not to delay the work. The costs of such tests shall be liable to the Owner for repayment by the Contractor.

B. Foundation Inspection by the Testing Laboratory:

1. Material Testing: The Owner's Testing Laboratory shall provide testing and inspection of materials used in foundation elements as described below.

2. Augercast Piles:

a. Grout Tests: Make and test one set of 6 2-inch cubes according to the requirements of ASTM C109. Each strength test shall be the average of two 28 day strengths. Test two cubes at 3 days, two at 7 days, and two cubes at 28 days. Make an additional set of three cubes and test them at 90 days if a special pozzolan is used in the grout mix. Make one set of cubes for each day's operation but not less than one set for each 25 cubic yards or one set for each pile cap.

3. Precast Concrete Piles:

a. Plant Inspection: Inspect forms, placement of reinforcing steel, and strands, placement and finishing of concrete, and tensioning of strands.
b. Concrete Cylinders: Make and test one set of four cylinders for each 50 cubic yards but not less than one set for each day's operation. Break one cylinder at 7 days and two at 28 days and one at 56 days.

4. Drilled Piers and Underreamed Footings:

a. Concrete Cylinders: Make and test concrete cylinders as specified for Cast-in-Place Concrete.
b. Reinforcing Steel: Inspect reinforcing steel for proper number and size of bars and confirm dowel or anchor bolt placement into top of pier.

5. Spread (Excavated) Footings

a. Concrete Cylinders: Make and test concrete cylinders as specified for Poured-in-Place Concrete.
b. Reinforcing Steel: Inspect reinforcing steel size, number of bars, and placement and confirm dowel or anchor bolt placement into footing.

6. Mat Footings

a. Concrete Cylinders: Make and test concrete cylinders as specified for Poured-in-Place Concrete.
b. Reinforcing Steel: Inspect reinforcing steel size, number of bars, and placement and confirm dowel or anchor bolt placement into footing.
c. Temperature Monitoring: Monitor the temperature of the concrete in the mat at different levels as it cures.

C. Foundation Inspection by the Geotechnical Engineer: The Geotechnical Engineer of Record shall provide inspection service for the following items before and during foundation installation as appropriate for the foundation type. The Geotechnical Engineer shall submit written field inspection reports promptly after inspection to the parties listed above and report his findings after each inspection by telephone or e-mail to the Engineer.

1. Spread (Excavated) Footing:

   a. Subgrade: Verify that foundation bearing conditions are consistent with soil report tests and that the footing is being installed in the proper soil strata at the proper elevation. Make recommendations regarding adjustment to subgrade or bearing elevation if subgrade is not adequate to support footing.

2. Mat Footing:

   a. Subgrade: Verify that foundation bearing conditions are consistent with soil report tests and that the footing is being installed in the proper soil strata at the proper elevation. Make recommendations regarding adjustment to subgrade or bearing elevation if subgrade is not adequate to support footing.

3. Augercast Piles:

   a. Dimensional Verification: Verify placement location, plumbness, diameter and length of piles.
   b. Monitoring Grout Quantity: Record for each pile inspected quantity of grout placed compared to the actual quantity required. Report discrepancies to Engineer.
   c. Continuously monitor the grouting operation to verify that the grout head is maintained at least 5 feet above the injection point.
   d. Grout Level: Continuously monitor and record top of pile elevation as grout sets over a 24 hour period. Immediately report any drop in pile elevation to Engineer.
   e. Report: For each pile installed, prepare and submit a report the lists the following information: pile location, pile number, pile diameter, actual tip elevation, actual top of grout elevation, pile length, theoretical volume of grout, actual volume of grout placed, reinforcing steel size and actual depth actually placed, drilling start and finish time, amount of drop of grout level in the first 24 hours after placing, and a list of any unusual occurrences that may affect pile performance. The report shall include the name of the project, the name of the piling contractor and the name of the drilling superintendent. The report shall be signed by a licensed engineer in the state where the project is located.

4. Precast Concrete Piles:

   a. Blow Counts: Record blow count per foot of penetration for each pile. Report any discrepancies to Engineer.
   b. Splices: Inspect 100% of piles splices for proper type and installation.
   c. Report: For each pile installed, prepare and submit a report that lists the following information: pile location and number, computed pile capacity, type and size of hammer used, type of pile-driving cap used, rate of operation of pile driving equipment, pile size or dimensions, elevation of point, elevation of butt before and after cut-off, ground elevation,

continuous record of number of blows for each foot of penetration, splice type and locations along length of pile, any pile deviation from specified tolerances, evidence and measurement of pile heave (if any), evidence of pile relaxation (drop-off in pile capacity with time), evidence of soil freeze (increase in pile capacity with time), retap data if a pile is driven further after initial installation, any unusual occurrences during pile driving and state whether or not the pile is capable of supporting the specified design load. The report shall state the recommended course of action for any damaged or mis-driven piles. The report shall include the name of the project, the name of the piling contractor and the name of the field superintendent. The report shall be signed by a licensed engineer in the state where the project is located.

5. Drilled Piers and Underreamed Footings:

   a. Bearing Elevation: Observe that piers are founded in proper bearing strata as defined in the Geotechnical Report and that bottom of hole is clean and properly formed. Recommend appropriate action if specified bearing elevation does not provide proper strength.
   b. Bell and Shaft Sizes: Verify that the shaft and bell diameters are within specified tolerances.
   c. Shaft Stability: Observe the shaft sides as drilling proceeds and recommend appropriate action if sloughing becomes excessive.
   d. Concrete Quantities: Record quantity of concrete placed in each pier and compare against theoretical quantity required. Report discrepancies to Engineer.
   e. Placement Method: Observe that piers are placed by approved methods as defined in the Geotechnical Report and in the specifications. Confirm that casings are being used as recommended in the Geotechnical Report. Confirm that concrete is not being contaminated by soil encroachment into pier.
   f. Report: For each drilled shaft installed, prepare and submit a report indicating the following information: pier number and location, pier shaft diameter, pier underream diameter (if applicable), bottom elevation, top elevation, pier length, theoretical volume of concrete in pier, estimate of actual volume of concrete placed, reinforcing steel size and depth actually placed, drilling start and finish time, concreting start and finish time, variation from specified tolerances including surveyed location and plumbness, construction method (dry method, casing method, or slurry displacement method), groundwater conditions (rate of water infiltration and depth of water in hole prior to concreting for dry piers; water elevation in hole for wet piers), elevation of top and bottom of any casing left in place, description of temporary or permanent casing (including purpose, diameter, wall thickness and length), description and elevation of any obstructions encountered and whether removal was obtained, description of pier bottom including amount and extent of loose material, method of concrete placement, any difficulties encountered in drilling or concreting operations, and any deviations from specifications. The report shall include the name of the project, the name of the drilling contractor and the name of the field superintendent. The report shall be signed by a licensed engineer in the state where the project is located.

D. Pile Load Test: The Geotechnical Engineer shall supervise a pile load test(s) as specified on the drawings according to ASTM D1143-74. He shall submit a written report of his findings to the parties listed above and report by telephone or e-mail to the

Engineer, the results of the pile load tests. Refer to the Pile Specification for additional requirements of the test.

3.3 REINFORCING STEEL

A. Mechanical Tension Splices: The Owner's Testing Laboratory shall provide 100% visual inspection of mechanical tension splices on the project. Inspection shall verify compliance with specifications and conformance with the manufacturer's recommendations for installation after consulting with the manufacturer, who is to be present for the first installation of the splice on the project. The Laboratory shall additionally conduct monotonic tension tests in accordance with ASTM A1034 of mechanical tension splices of the type as specified on the structural drawings. It is not necessary that the specimens to be tested are production splices, however, the specimens to be tested shall have been made by the Contractor's personnel under field conditions. The rate of testing shall be as follows:

1. Two specimens for the first 50 splices (or fraction thereof for small jobs) at the beginning of the job. Splices not meeting tension requirements shall be retested at Contractor's expense until all splices meet the tension requirements.

2. One specimen for every 100 (or fraction thereof) additional splices occurring on the job. Any splices not meeting tension requirements shall be retested at Contractors expense until all splices have passed the test.

3. A minimum of one test specimen shall also be selected from transition splices (splices of one bar size to another bar size), if any.

B. Compression Butt Splices: The Owner's Testing Laboratory shall provide 100% visual inspection of compression butt splices on the job. Inspection shall verify splice conformance with the requirements for end bearing splices as set forth in ACI 318 Building Code Requirements for Reinforced Concrete as well as the manufacturer's instructions.

C. Reinforcing Steel Field Inspection: The Owner's Testing Laboratory or designated Special Inspector shall inspect 100 % of reinforcement before each concrete pour to verify the information noted below. Inspection reports shall be prepared and distributed in accordance with the local building code and as specified in this specification.

1. Primary and secondary, longitudinal reinforcement has correct size and number in proper layers.

2. Longitudinal reinforcement has correct length and lap.

3. Ties and stirrups are of correct size, spacing, and number and have the proper termination-hook geometry.

4. Unscheduled face reinforcement in beams are provided and are of correct size, number and spacing and have the proper end terminations.

5. Proper hooks are provided at bar ends as detailed.

6. Reinforcement is properly supported and braced to formwork to prevent movement during concreting operation.

7. Reinforcement has proper cover.

8. Sufficient spacing between reinforcement for concrete placement.

9. Dowel reinforcement is of proper size, at proper spacing, and has proper lap length and embedment length.

10. Welded wire reinforcement is composed of flat sheets, has proper wire gage and spacing, is properly supported, and is properly lapped with a length of one square plus two inches.

11. Proper Construction/Control/Expansion joint spacing and reinforcement.

12. Reinforcement around embedded items is erected according to details.

13. Welded reinforcement has been done according to AWS requirements. Review the Welding Procedure Specification (WPS) submitted by the contractor for any reinforcing steel other than ASTM A 706 that is proposed to be welded for consistency with acceptable welding practices and the AWS.

14. Proper installation of flat-slab shear-head reinforcement

D. Welded Reinforcing: Continuous inspection of the welding of reinforcing bars to ensure compliance with the requirements of AWS shall be done for the following items:

1. Reinforcing steel resisting flexural and axial forces.

2. Boundary elements of reinforced concrete walls

3. Shear reinforcement

3.4 CONCRETE MATERIALS AND POURED IN PLACE CONCRETE

A. Concrete Mix Designs: The Owner's Testing Laboratory shall review the submitted mix designs for conformance to the specifications and for suitability for use in the project. The Testing Laboratory shall attend the Mix Design Conference and the Pre-Concrete Conference as noted in the Cast-in-Place Concrete Specification.

B. Concrete Batch Plant Inspection: An initial batch plant inspection shall be made by the Owner's Testing Laboratory prior to the start of concrete work. The scope of batch plant inspection shall include the following:

1. Inspection of Batch Plant Facilities: The Laboratory shall inspect batch plant facilities proposed for use in the work and report in writing inspection results to the Architect, Engineer, and Owner for approval. The inspection shall confirm the batch plant conforms to the standards set forth in ASTM C94 and can show proof of certification by the National Concrete Ready Mix Association. Inspection shall include:

a. Batch Plant operations and equipment
b. Truck mixers
c. Scales
d. Stockpile placement
e. Material storage
f. Admixture dispensers

2. Multiple Batch Plants: The Contractor shall reimburse the Owner for the costs accrued to the Owner's Testing Laboratory for visits to more than 1 batch plant.

C. Job Site Inspection: The scope of the work to be performed by the inspector on the jobsite shall be as follows:

1. Prior to Concrete Placing

a. Spread Footings
   (1) Verify footing dimension.
   (2) Verify top of footing elevation.
   (3) Verify that forms are plumb and straight, braced against movement, and lubricated for removal.
   (4) Inspect reinforcement per REINFORCING STEEL section.

b. Grade Beams
   (1) Verify width, depth and elevation of grade beams.
   (2) Verify that forms are plumb and straight, braced against movement, and lubricated for removal.
   (3) Verify that carton forms below grade beam are dry.
   (4) Verify that carton forms are neatly formed around piers.
   (5) Inspect reinforcement per REINFORCING STEEL section.

c. Slab-on-Grade
   (1) Verify that moisture retarder is provided, is lapped properly, and is not torn or punctured.
   (2) Verify formwork at turndowns and slab edges is plumb and straight, braced against movement and lubricated for removal.
   (3) Inspect reinforcement per REINFORCING STEEL section.
   (4) Verify there is no standing water or debris in pour area.

d. Columns
   (1) Verify that forms are plumb and straight, braced against movement, lubricated for removal, and conform to approved shop drawings.
   (2) Verify proper dimensions and orientation.
   (3) Verify that top of column elevation is set in form and that it is 1/2 inch below the future slab soffit.
   (4) Inspect reinforcement per REINFORCING STEEL section.
   (5) Verify that debris is removed.

e. Elevated Deck (General)
   (1) Verify that formwork conforms to signed and sealed shop drawings.
   (2) Verify that shoring layout conforms to signed and sealed shop drawings.
   (3) Verify that reshores at all levels conforms to signed and sealed shop drawings.
   (4) Verify that forms are plumb and straight, braced against movement, and lubricated for removal.
   (5) Verify that the forms used for exposed finish surfaces are of the type specified and provide a joint system as shown on the Architect's drawings.
   (6) Verify the proper dimensions of girders, beams and joists.
   (7) Verify that the slab thickness and top-of-slab elevation is correct.
   (8) Verify that openings and sleeves are correct size and location.
   (9) Verify that horizontal and vertical sleeves through girders, beams, or joists have been approved by the Engineer and that approved reinforcement is provided.
   (10) Verify the top of columns are 1/2 inch below the deck soffit.

(11) Inspect reinforcement per REINFORCING STEEL section.
(12) Verify that debris is removed.

f. Pan Form Slabs
(1) Verify that pans used are of the type specified and are free of dents, surface irregularities, sags, rust, or stains.
(2) Verify that the discontinuities that will be created in the slab soffit at the splice points of the pans do not exceed the value specified.

g. Flat Slabs
(1) Verify that the top of columns are 1/2 inch below the deck soffit.
(2) Verify that openings in the slab are shown on the structural drawings. Notify the engineer immediately of any openings in the field that are not shown on the drawings.
(3) Inspect the shearhead reinforcing at each column to ensure that it conforms to the structural details.

h. Tilt-wall Panels
(1) Verify that the formwork complies with shop drawings
(2) Inspect reinforcement per REINFORCING STEEL section
(3) Verify that the lifting devices are installed according to the shop drawings.

2. On-Site Concrete Material Testing and Inspection

a. Verify that the Contractor is following appropriate concreting practices consistent with any extreme environmental conditions at the point of placement in the structure as defined below.
b. Inspect concrete upon arrival to verify that the proper concrete mix number, type of concrete, concrete strength, and that it is meeting job specifications, is being placed at the proper location. Report concrete not meeting the specified requirements and immediately notify the Contractor, Batch Plant Inspector, Architect, Engineer, and Owner.
c. Inspect plastic concrete upon arrival at the jobsite to verify proper batching. Observe mix consistency and adding of water as required to achieve target slumps in mix designs. Record the amount of water added and note if it exceeds that allowed in the mix design. The responsibility for adding water to trucks at the job site shall rest only with the Contractor's designated representative. The Contractor is responsible that all concrete placed in the field is in conformance to the Contract Documents.
d. Obtain concrete test cylinders as specified below.
e. Perform tests to determine slump, concrete temperature, unit weight, and air entrainment as specified below. The slump tests shall be made on concrete taken from the same location from which the concrete for the test cylinders is obtained.
f. Record information for concrete test reports as specified below.
g. Pick up and transport to Laboratory, cylinders cast the previous day.

3. During concrete placing, provide continuous monitoring to:

a. Verify that the concrete is not over 90 minutes old at the time of placement.
b. Verify that Hot-Weather or Cold-Weather techniques are being applied as required.
c. Verify that concrete deposited is uniform and that vertical drop does not exceed six feet and is not permitted to drop freely over reinforcement causing segregation.
d. Verify that there are no cold joints.

e. Verify that the concrete is properly vibrated.
f. Verify that the finishing of the concrete surface is done according to specifications.
g. Verify that sawcut control joints on slab-on-grades are cut within 12 hours of placement.
h. Verify that the formwork has remained stable during the concreting operation.
i. Inspect bolts embedded in concrete prior to and during concrete placement for proper grade, size and length and verification they have been properly installed to the specified embedment.

4. Post-Installed Anchors in Concrete: Provide inspection of post-installed anchor installations at the frequency noted in the specifications and in accordance with the published, currently valid, Evaluation Service Report (ESR) for each anchor product.

a. Periodic Inspection: Verify initial installation of post-installed anchors in concrete for each individual installer with each individual anchor product in accordance with the requirements stated below for each type of anchor. Periodically inspect anchor installation after the initial verification.
b. Continuous Inspection: Verify each installation of post-installed anchors in concrete in accordance with the requirements stated below for each type of anchor.
c. All Post-Installed Anchors: Verify that the anchor is installed in accordance with manufacturer's printed installation instructions as well as the following design requirements.
(1) concrete type, concrete strength and concrete thickness are in accordance with design drawings
(2) anchor manufacturer and product, including material, is in accordance with design drawings or approved substitution
(3) anchor diameter, length and installed embedment depth
(4) drill bit type and diameter
(5) anchor edge distance and spacing
(6) hole diameter and depth
(7) hole cleaning procedure and cleanliness
(8) anchor maximum tightening torque
d. Adhesive Anchors: In addition to the requirements for All Post-Installed Anchors, verify adhesive identification and expiration date.
e. The installation of all adhesive anchors shall be continuously inspected when anchors are subject to sustained tension loads, such as anchors for shelf angles and as noted on the drawings, or when anchors are installed in an upwardly inclined condition.

5. In-situ Concrete Strength Verification: The Owner's Testing Laboratory shall verify that the concrete has reached the required minimum strength before form removal by evaluating the specified tests.

a. If concrete strength for form stripping is to be determined using field-cured cylinders, one additional cylinder per set will be required for formed slab and pan joist floors for the purpose of evaluating the concrete strength at the time of form stripping. This cylinder shall be stored on the floor where form removal is to occur under the same exposure conditions as the floor concrete. The cylinder shall be cured under field conditions in accordance with ASTM C31. Field cured test cylinders shall be molded at the same time and from the same samples

as Laboratory cured test specimens. The cylinder shall be broken at the time of form removal as directed by the Contractor. The Contractor shall reimburse the Owner for the cost of making and testing these cylinders.

b. If concrete strength for form stripping is to be determined using the Maturity Method, the Owner's Testing Laboratory shall verify that the requirements of ASTM C 1074 are being followed and that the proper criteria for determining concrete strength by this method has been established and is being followed.

6. After Concrete Floor Placing and Finishing

a. Verify that the curing process is according to specifications and that any curing compound used is applied in accordance with manufacturer's recommendations.

b. Floor Flatness and Levelness Measuring

(1) The Testing Service providing Services for the Owner shall measure the floor for flatness and levelness according to ASTM E 1155.

(2) Measurement of the finished concrete surface profile for any test section shall be made when requested by the Owner's Representative at his option. Notwithstanding, measurements shall be made within 24 hours after completion of finishing operations. For structural elevated floors measurement shall also be made prior to removal of forms and shores. The Contractor shall be notified immediately after the measurements of any section are complete and a written report of the floor measurement results shall be submitted within 72 hours after finishing operations are complete.

(3) The concrete surface profile shall be measured using equipment manufactured for the purpose such as a Dipstick Floor Profiler as manufactured by the Edward W. Face Company in Norfolk, Virginia, F-Meters manufactured by Allen Face & Company in Norfolk, Virginia, optical, or laser means or other method specified in ASTM E 1155.

(4) Each floor test section and the overall floor area shall conform to the two-tiered measurement standard as specified herein.

(a) Minimum Local Value (MLV). The minimum local F_F/F_L values represent the absolute minimum surface profile that will be acceptable in any one floor test section.

(b) Specified Overall Value (SOV). The specified overall F_F/F_L values represent the minimum values acceptable for all combined floor test sections representing the overall floor.

(5) For purposes of this specification a floor test section is defined as the smaller of the following areas:

(a) The area bounded by column and/or wall lines.

(b) The area bounded by construction and/or control joint lines.

(c) Any combination of column lines and/or control joint lines.

(d) Test sample measurement lines within each test section shall be multidirectional along two orthogonal lines as defined by ASTM E 1155.

(e) The precise layout of each test section shall be determined by the Owner's Testing Laboratory and shall be submitted for Architect/Engineer review and approval.

c. Testing of Concrete Floor Slabs for Acceptability to Receive an Adhesive-Applied, Low-Permeable Floor Covering

(1) The following tests shall be performed by the Owner's Testing Laboratory as a part of quality assurance testing to insure that the proper moisture condition and alkalinity of the substrate has been achieved prior to installing adhesive-applied, low-permeability floor coverings such as vinyl composition tile (VCT), linoleum, sheet vinyl, vinyl-backed carpet, rubber, athletic flooring, synthetic turf, wood, acrylic terrazzo, thin-set tile, epoxy overlays and adhesives, et.al.

(2) Moisture Vapor Emission Rate: Perform testing according to ASTM F 1869 to determine if the moisture emission rate from the floor is below the flooring manufacturer's maximum recommended value but not greater than 5lbs/1000sq.ft./24h.

(3) Relative Humidity Determination Test: As an alternate to the Moisture Vapor Emission Rate Test, and if agreed to by the Contractor, Architect and Owner, perform testing according to ASTM F 2170 to determine if the relative humidity of the concrete slab is below the flooring manufacturer's maximum recommended value but not greater than 75%.

(4) Alkalinity Testing: Perform testing in accordance with ASTM F 710-03, paragraph 5.3, to determine if the pH level of the concrete slab surface is below the flooring manufacturer's maximum recommended value but not greater than 10. Perform one test per 1000 sq. ft. with a minimum of three tests within the total area being tested.

7. The job site inspector shall report any irregularities that occur in the concrete at the job site or test results to the Contractor, Architect, Owner, and Engineer.

D. Concrete Test Cylinders: The Owner's Testing Laboratory shall mold and test concrete test cylinders as described below.

1. Cylinder Molding and Testing: Cylinders for strength tests shall be molded and Laboratory cured in accordance with ASTM C31 and tested in accordance with ASTM C39. Cylinders may be either 6" in diameter by 12" or 4" in diameter by 8", however, the diameter of the cylinder shall be at least three times the nominal maximum size of the coarse aggregate in the mix tested. All of the cylinders for each class of concrete shall be of the same dimension for all sets of that class.

2. Field Samples: Field samples for strength tests shall be taken in accordance with ASTM C172.

3. Frequency of Testing: Each set of test cylinders shall consist of a minimum of four standard test cylinders. A set of test cylinders shall be made according to the following minimum frequency guidelines:

a. One set for each class of concrete taken not less than once a day.
b. Mat Foundation: One set for each 250 cubic yards or fraction thereof.
c. Piers, Piles, Underreamed Footings: One set for each 50 cubic yards or fraction thereof.
d. Pressure-injected Footings: One set for each 50 cubic yards or fraction therof.

e. Spread Footings: One set for each 50 cubic yards or fraction thereof.
f. Pile Caps: One set for each 50 cubic yards or fraction thereof.
g. Basement Walls: One set for each 150 cubic yards.
h. Floors: One set for each 150 cubic yards or fraction thereof but not less than one set for each 5000 square foot of floor area.
i. Columns: One set for each 50 cubic yards or fraction thereof with a minimum of 2 sets per floor.
j. Shear Walls: One set for each 50 cubic yards but not less than 2 sets per floor.
k. Tilt-wall Panels: One set for every 50 cubic yards or fraction thereof.
l. All Other Concrete: A minimum of one set for each 150 cubic yards or fraction thereof.
m. No more than one set of cylinders at a time shall be made from any single truck.
n. If the total volume of concrete is such that the frequency of testing as specified above would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.
o. The above frequencies assume that one batch plant will be used for each pour. If more than one batch plant is used, the frequencies cited above shall apply for each plant used.

4. The cylinders shall be numbered, dated, and the point of concrete placement in the building recorded.

5. For concrete specified on the drawings to reach the required strength at 28 days, break one cylinder of the set at seven days, two 6” by 12” cylinders or three 4” by 8” cylinders at 28 days, and one kept in reserve for testing at the Engineers direction.

6. For concrete specified on the drawings to reach the required strength at 56 days, break one cylinder of the set at seven days, one cylinder at 28 days, two 6” by 12” cylinders or three 4” by 8” cylinders at 56 days, and one kept in reserve for testing at the Engineers direction.

7. For concrete specified on the drawings to reach the required strength at 90 days, break one cylinder of the set at seven days, one cylinder at 28 days, one cylinder at 56 days, two 6” by 12” cylinders or three 4” by 8” cylinders at 90 days, and one kept in reserve for testing at the Engineers direction.

8. Cylinder Storage Box: The Contractor shall be responsible for providing a protected concrete cylinder wooden storage box at a point on the job site mutually agreeable with the Testing Laboratory for the purpose of storing concrete cylinders until they are transported to the Laboratory. The box shall be constructed and equipped to maintain the environment specified for initial curing in ASTM C31.

9. Transporting Cylinders: The Owner’s Testing Laboratory shall be responsible for transporting the cylinders to the Laboratory in a protected environment such that no damage or ill effect will occur to the concrete cylinders including loss of moisture, freezing temperatures or jarring.

10. Information on Concrete Test Reports: The Owner’s Testing Laboratory shall make and distribute concrete test reports after each job cylinder is broken. Such reports shall contain the following information:

a. Truck number and ticket number
b. Concrete Batch Plant
c. Mix design number
d. Accurate location of pour in the structure
e. Strength requirement
f. Date cylinders made and broken
g. Technician making cylinders
h. Concrete temperature at placing
i. Air temperature at point of placement in the structure
j. Amount of water added to the truck at the batch plant and at the site and whether or not it exceeds the amount allowed by the mix design
k. Slump
l. Unit weight
m. Air content
n. Cylinder compressive strengths with type of failure if concrete does not meet Specification requirements. Seven day breaks are to be flagged if they are less than 60% of the required 28 day strength. 28 day breaks are to be flagged if either cylinder fails to meet Specification requirements.

11. Standards for Tests of Concrete :

a. Slump Tests: Slump Tests (ASTM C143) shall be made at the beginning of concrete placement for each batch plant and for each set of test cylinders made. The slump test shall be made from concrete taken from the end of the concrete truck chute. The concrete shall be considered acceptable if the slump is within plus or minus 1 inch of the slump noted on the mix design submittal form for that class of concrete.
b. Air Entrainment: Air entrainment tests (ASTM C231 or C173, C173 only for lightweight concrete) shall be made at the same time slump tests are made as cited above.
c. Concrete Temperature: Concrete temperature at placement shall be measured (ASTM C1064) at the same time slump tests are made as cited above.
d. Unit Weight Test: ASTM C138

12. Evaluation and Acceptance of Concrete:

a. Strength Test: A strength test shall be defined as the average strength of two cylinder breaks from each set of cylinders tested at the time indicated above.
b. Quality Control Charts and Logs: The Owner's Testing Laboratory shall keep the following quality control logs and charts for each class of concrete containing more than 2,000 cubic yards. The records shall be kept for each batch plant and submitted on a weekly basis with cylinder test reports:
    (1) Number of strength tests made to date.
    (2) Strength test results containing the average of all strength tests to date, the high test result, the low test result, the standard deviation, and the coefficient of variation.
    (3) Number of tests under specified strength.
    (4) A histogram plotting the number of strength test cylinders versus compressive strength.
    (5) Quality control chart plotting compressive strength test results for each test.

(6) Quality control chart plotting moving average for strength where each point plotted is the average strength of three previous test results.
(7) Quality control chart plotting moving average for range where each point plotted is the average of 10 previous ranges.

c. Acceptance Criteria: The strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met:
(1) The average of all sets of three consecutive strength tests equal or exceed the required f'c.
(2) No individual strength test falls below the required f'c by more than the greater of 10% of f'c or 500 PSI.

d. If either of the above requirements is not met, the Testing Laboratory shall immediately notify the Engineer by telephone. Steps shall immediately be taken to increase the average of subsequent strength tests.

E. Investigation of Low Strength Concrete Test Results:

1. Cost of Investigations for Low Strength Concrete: The Contractor shall reimburse the Owner for the costs of investigations of low strength concrete, as defined above.

2. Scope of Investigations: See Specification Section 03300, Cast-In-Place Concrete, for the investigations that may be required by the Engineer. The Owner's Testing Laboratory will conduct these investigations.

F. Causes for Rejection of Concrete: The Contractor shall reject concrete delivered to the site for any of the following reasons:

1. Wrong class of concrete (incorrect mix design number).

2. Environmental Conditions: Environmental condition limits shall be as follows unless appropriate provisions in concreting practices have been made for cold or hot weather:

a. Cold Weather: Air temperature must be 40°F and rising or the average daily temperature cannot have been lower than 40°F for 3 consecutive days unless the temperature rose above 50°F for at least one-half of any of those 24 hour periods.
b. Hot Weather: Environmental conditions must be such that cause an evaporation rate from the concrete surface of 0.2 lb./sq. ft./hr. or less as determined by Figure 2.1.5 in ACI 305R-91.

Concrete may be placed at other environmental condition ranges only with approval of the job inspector for the Owner's Testing Laboratory or other duly appointed representative.

3. Concrete with temperatures exceeding 95°F shall not be placed in the structure.

4. Air contents outside the limits specified in the mix designs.

5. Slumps outside the limits specified.

6. Excessive Age: Concrete shall be discharged within 90 minutes of plant departure or before it begins to set if sooner than 90 minutes unless approved by the Laboratory job inspector or other duly appointed representative.

G. Concrete Batch Trip Tickets: Concrete batch trip tickets shall be collected and retained by the Contractor. Compressive strength, slump, air, and temperature tests shall be identified by reference to a particular trip ticket. Tickets shall contain the information specified in ASTM C94. Each ticket shall also show the amount of water that may be added in the field for the entire batch that will not exceed the specified water cement ratio for the design mix. The Contractor and Owner's Testing Laboratory shall immediately notify the Architect/Engineer and each other of tickets not meeting the criteria specified.

3.5 POST-TENSIONED CONCRETE

A. The extent of Testing Laboratory services required for post-tensioned concrete structures shall include the services specified for concrete materials and poured in place concrete and reinforcing steel for concrete plus the additional services specified under this section.

B. Review of Contract Documents and Submittals:

1. The Testing Laboratory inspector shall review and become familiar with the structural drawings, shop drawings, and specifications in so far as they relate to post tensioning materials, installation, and stressing.

2. The Owner's Testing Laboratory shall review the mill certificates for post-tensioning steel and the design calculations for the post-tensioning design for consistency with each other and with recognized engineering practice.

C. Field Inspection Requirements: The duties and responsibilities of the inspector for the Owner's Testing Laboratory shall be as follows:

1. Check the general layout, number of strands, size, spacing, and profile of post tensioning steel for conformance to the shop drawings of the Prestress Supplier. Specific attention and emphasis shall be placed upon horizontal and vertical profiles around floor openings not shown on the shop drawings. Also check for the proper size, grade, number and proper placement of mild reinforcing steel in the post-tensioned elements.

2. Inspect 100% of end and intermediate anchorages and inserts required for stressing for proper size, type and placement.

3. Inspect for any mild steel reinforcing bars or spirals required by the Prestress Supplier near stressing anchors.

4. Perform inspection during concrete placement to observe and report any damage or misalignment of post tensioning steel and embedded anchorages.

D. Inspection during Stressing Operation: The Owner's Testing Laboratory shall be continuously present during the stressing operations and shall have the following responsibilities and duties.

1. Review current calibration data on the proposed stressing equipment.

2. Ascertain that the concrete compressive strength meets the minimum required strength prior to stressing by evaluating the results of specified tests.

a. If concrete strength for tendon stressing is to be determined using field-cured cylinders, one additional cylinder per set will be required for post-tensioned concrete floors or walls for the purpose of evaluating concrete strength at the time of stressing. This cylinder shall be stored on the floor where form removal is to occur under the same exposure conditions as the floor concrete. The cylinder shall be cured under field conditions in accordance with ASTM C31. Field cured test cylinders shall be molded at the same time and from the same samples as Laboratory cured test specimens. The cylinder shall be tested at the time of stressing as directed by the Contractor. The Contractor shall reimburse the Owner for the cost of making and testing these cylinders.
b. If concrete strength for tendon stressing is to be determined using the Maturity Method, the Owner's Testing Laboratory shall verify that the requirements of ASTM C 1074 are being followed and that the proper criteria for determining concrete strength by this method has been established and is being followed.

3. Check the stressing sequence, and verify the required post tensioning forces by observing and inspecting the stressing operation and recording the following information:

a. Floor, pour and tendon identification numbers. For walls, indicate wall location.
b. Actual measured elongation for each jacking point, and totals for each tendon compared with calculated elongation submitted by Contractor.
c. Range of allowable elongations for jacking force or a measure of the deviation of the measured elongations from the calculated elongations. Deviations that do not comply with the specified tolerances shall be noted for the Architect/Engineer to review.
d. Stressing ram number, initial and final gauge load reading during stressing for each tendon.
e. Required and actual concrete strength at time of jacking.
f. Obvious irregularities or stress loss during anchoring procedures.
g. Date of stressing operation and signature of the Contractor's stressing personnel and inspector witnessing the operation.

4. Inspect for spalled concrete, broken tendons or wires, anchorage slippage, or cracks in the concrete near anchors. Immediately notify the Engineer by telephone of any "blowouts" occurring after the stressing operation. Observe the repair of any cracked or spalled concrete as recommended by the Engineer.

5. If bonded tendons are specified, inspect the grouting procedure.

6. Testing of Barrier Cables: Confirm that the provided minimum gauge pressure matches required level shown on the shop drawings.

E. Reports: The Owner's Testing Laboratory shall submit written inspection reports to the parties as specified describing the tests and inspections made and showing the action taken for nonconforming work. Report uncorrected deviations from plans and specifications and verify implementation of any changes authorized by the Engineer.

3.6 STRUCTURAL PRECAST CONCRETE

A. Testing and Inspection at the Plant: The Owner's Testing Laboratory shall furnish the necessary technicians and equipment to perform the following tests and inspection at the Precast Concrete Plant. Schedule the time for visits to the precast plant in consultation

with the Precast Supplier and the Owner. Submit a proposed unit price for each visit and base the total proposed price on providing [NUMBER OF PRECAST PLANT SITE VISTS] visits. Inspections shall be performed by a qualified technician with a minimum of two years of experience in precast concrete testing and inspection:

1. Preliminary plant inspection prior to the start of fabrication including the following:

    a. Verify that the fabricator's fabrication and quality control procedures provide a sound basis for inspection control of workmanship and of the ability to conform to construction documents and industry standards. Review the procedures for completeness and adequacy relative to code requirements for the fabricator's finished product.
    b. Inspection of the batching facilities including aggregate stock piles, material handling facilities, concrete batching and mixing facilities, and in plant concrete handling, placing, and consolidating procedures and equipment.
    c. Inspection of the in-plant testing and curing facilities.
    d. Inspection of the casting beds shall be made to check for cleanliness, alignment, and surface condition of the bed.
    e. Inspection of the stressing blocks and stressing procedures including verification of the calibration of the stressing jacks to be used in the work.
    f. A review of the concrete mix designs proposed for use in the work.

2. Inspection prior to placing concrete including the following:

    a. Inspect formwork for finish condition, dimensions, and dimensional tolerances.
    b. Verify reinforcing steel placement and concrete cover.
    c. Inspect 100% of hardware and embedded items for proper size, location, and finish.
    d. For prestressed members, observe and inspect the stressing operation recording the following information:
        (1) Initial and final gauge load reading during tendon stressing.
        (2) Tendon elongation measurement.
        (3) Obvious irregularities or stress loss during anchoring procedures.

3. Inspection during the concreting operation including the following:

    a. Verify that environmental conditions and concrete temperatures are within the limits stipulated.
    b. Verify that the proper class of concrete is being used for the members being poured.
    c. Inspect plastic concrete to verify proper batching and mix consistency.
    d. Verify the molding, curing and testing of concrete cylinders by the Precast Producer are in accordance with the specifications and project requirements.

4. For prestressed members, inspection during the transfer of stress load to the concrete:

    a. Verify minimum concrete strength at time of stress transfer.
    b. Witness transfer of stress to concrete and report procedures used including release sequence of multi-tendon transfer.

5. Inspection after form stripping including the following:

a. Check dimensions of precast units.
b. Verify required cambers.
c. Visually inspect the precast units for proper finish, cracks, and other surface defects and imperfections.

6. The Testing Laboratory shall write an inspection report promptly after each plant and site visit for distribution to the parties specified.

7. Any irregularities in the work shall be immediately reported by telephone to the Engineer and Architect.

B. On-site Inspection: Inspection of bearing conditions, members and connections shall include the following:

1. Inspect anchor bolt layout, embedment, and bolt tightening to base plates.

2. Check base plates for proper grouting.

3. Check connection of bearing walls to foundation for proper bolting and grouting. For welded connections, check for proper location of embedded plates or angles and check the quality and completeness of field welds.

4. For double tee or precast plank floor members, check the following:

a. Proper length and width of bearing at each support end.
b. Proper width, length, thickness, and type of bearing pads.
c. Proper connection of tees or planks to each other and to support members at each end.
d. Proper vertical alignment of tees or planks with respect to each other and to supports.
e. Excessive camber or deflection after pouring of topping slabs.
f. Any damage of tees or planks sustained during erection or shipping.
g. Any flexural cracking sustained in bottom webs after erection and pouring of topping slabs.

5. For precast beams, both interior and spandrel, check the following:

a. Proper length and width of bearing at each support end.
b. Proper width, length, thickness, and type of bearing pads.
c. Proper connection of beams to columns at each end and to intersecting floor members.

6. For structures with poured in place topping slabs, check the following:

a. Proper type (normal or lightweight) and strength of concrete.
b. Proper thickness of topping.
c. Proper slope of topping, if required.
d. Proper mesh size and placement including lap between mesh sheets or rolls.
e. Proper finish.
f. Crack control joints and/or check of waterproofing requirements.

7. Verify proper finish (painted or galvanized) of 100 % of steel connection plates and angles including touch-up of welds.

8. For garage structures with cable guardrails, verify:

    a. Proper type, grade and strength of cable.
    b. Proper cable finish (plastic coated or galvanized).
    c. Proper finish (painted or galvanized) to guardrails.

9. For precast structures with expansion joints, verify:

    a. Proper expansion joint material.
    b. Proper expansion joint width.
    c. Proper installation of plates, angles, epoxy nosings and other components of the expansion joint type.

3.7 ARCHITECTURAL PRECAST PANELS

A. For architectural precast panels, verify:

    a. Proper bolting and/or welding of panel connection to the structure.
    b. Proper panel position with specified panel joint thickness.
    c. Proper sealant materials and methods at joints.
    d. Report any cracked panels or panels with improper finish to the Architect and Engineer.

3.8 SHOTCRETE

A. Concrete Mix Design: The Owner's Testing Laboratory shall review the submitted mix designs for conformance to the specifications and for suitability for use in the project.

B. On-Site Construction Inspection and Testing: The duties and responsibilities of the Owner's Testing Laboratory during shotcreting operations shall be as follows:

1. Provide continuous inspection of shotcrete placement operations for proper application techniques and adherence to specification requirements. Provide a daily written report of the day's activities including the disposition of any discrepancies in procedure or materials brought to the attention of the Contractor. Contact the Engineer and Architect by telephone in the event any reported discrepancy is not satisfactorily resolved.

2. Observe the preparation of test panels is in accordance with specified standards. A test panel is to be made daily for each mix, and for each shooting position but no less than 1 for every 50 cu. yds. placed.

3. Obtain, test, and report results for three drilled cores for compressive strength from each test panel in accordance with ASTM C 1140.

4. Provide a visual grade score for each drilled core in accordance with the criteria in ACI 506.2

3.9 STRUCTURAL STEEL

A. Contract Obligations:

1. Owner Responsibility: The Owner shall pay for initial shop and field inspections and tests as required during the fabrication and erection of the structural steel.

2. Testing Laboratory Responsibility: The inspection by the Owner's Testing Laboratory of the Fabricator's work shall be in sequence, timely, and performed in such a manner so that corrections can be made without delaying the progress of the work. Inspections shall be performed by qualified technicians with a minimum of two years experience in structural steel testing and inspection. See "Qualifications of Testing Laboratory" section for special requirements for welding inspectors. The Testing Laboratory shall provide test reports of inspections. All test reports shall indicate types and locations of defects found during inspection, the measures required and performed to correct such defects, statements of final approval of welding and bolting of shop and field connections, and other fabrication and erection data pertinent to the safe and proper welding and bolting of shop and field connections. In addition to the parties listed in this Specification the Fabricator and Erector shall receive copies of the test reports.

3. Rejection of Material or Workmanship: The Owner, Architect, Engineer, and Testing Laboratory reserve the right to reject any material or workmanship not in conformance with the Contract Documents at any time during the progress of the work. However, this provision does not allow waiving the obligation for timely, in sequence inspections.

B. Shop Inspection and Testing: The Owner's Testing Laboratory shall provide the following inspections at the designated fabrication shops:

1. Shop Inspection Waiver: The requirement to perform fabricating shop inspection may be waived if the Fabricator produces evidence from the Building Official of being a registered, approved fabricating shop and if allowed by the Engineer.

2. An initial shop inspection prior to the start of any fabricating work shall be made to accomplish the following:

   a. Verify the fabrication shop's certification from AISC.
   b. Verify that the fabricator's fabrication and quality control procedures provide a sound basis for inspection control of workmanship and of the ability to conform to construction documents and industry standards. Review the procedures for completeness and adequacy relative to code requirements for the fabricator's finished product.
   c. Perform steps 1, 2 and 3 of welding inspection duties described below in "Weld Inspection and Process Monitoring" when shop welding is to be performed.
   d. Perform step 1 of bolt inspection duties described below in "High-Strength Bolting Inspection and Testing" when shop bolting involves joints that are designated on the plans as "Pretensioned" or "Slip-Critical".

3. Process Monitoring:

   a. Provide continuous monitoring of welding for all CJP,PJP, Multipass fillet welds and Single-pass fillet welds greater than 5/16 inch as described below in the Weld Inspection and Testing section.
   b. Periodically monitor welding of single-pass fillet welds that are less than or equal to 5/16 inch.
   c. Provide continuous monitoring of high-strength bolt installation in pre-tensioned or slip-critical joints using turn-of-the-nut without matchmarking or calibrated wrench method of bolt installation.
   d. Provide periodic verification of specified camber of steel beams.

C. Field Inspections: The Owner's Testing Laboratory shall provide the following inspections in the field:

1. Obtain the planned erection procedure, and review with the Erectors supervisory personnel.

2. Check the installation of base plates for proper leveling, grout type, and grout application.

3. Check structural steel and cold-formed steel deck as received in the field for possible shipping damage, workmanship, and identification marking to conform to AISC 360 for structural steel and as specified ASTM standards for other steel and steel deck.

4. Verify that surveys are occurring as specified to check plumbness and frame alignment as erection progresses. Review the submitted survey report.

5. Periodically inspect the steel frame for such items as bracing and stiffening details, member locations, and joint details at each connection for compliance with approved construction documents.

6. Inspect 100% of the column compression and base joints for verification that gaps in contact bearing do not exceed 1/16 inch. Gaps greater than 1/16 inch but less than 1/4 inch shall be reported to the Owner and Engineer for assessment. All gaps greater than 1/4 inch shall be shimmed with non-tapered mild steel shims.

7. Endeavor to guard the Owner against the Contractor cutting, grinding, reaming, or making any other field modification to structural steel without the prior approval of the Engineer. Report any noted unauthorized modifications to the Owner and Engineer.

D. Weld Inspection and Process Monitoring: The Owner's Testing Laboratory shall make the following inspections of the welds and welding processes. Welds performed in the fabricating shop may be inspected in the field unless continuous monitoring of the welding process is herein specified or if access in the field due to other work or shop finishes makes field inspection impractical:

1. Approve Welding Procedure Specifications submitted by the Contractor. Approve any changes submitted by the Contractor to any WPS that has already been approved. Obtain the Welding Procedure Qualification Record (WPQR) for each successful WPS qualification.

2. Verify welder qualifications either by certification and/or by retesting. Obtain welder certificates.

3. Verify welding electrodes to be used and other welding consumables as the job progresses.

4. Periodically observe joint preparation, assembly practice, welding techniques including preheating and sequence, and the performance of welders with sufficient frequency to assure compliance with code and contract document requirements. Check preheating to assure conformance with AWS D1.1, Section 5.6. Verify procedure for control of distortion and shrinkage stresses.

5. Observe joint preparation and fit up, backing strips, and runout plates for welded moment connections and column splices.

6. Periodically provide visual inspection of the root pass of partial and complete joint penetration welds.

7. Visually inspect 100 % of welds for proper size, length, location, and weld quality in accordance with AWS D1.1 requirements. Unless specifically noted otherwise, all welding shall be considered statically loaded nontubular connections

8. Visually inspect 100% of the welding or other attachment method of steel deck to the structure and at sidelaps.

9. Visually inspect 100% of completed shear connectors in each beam and perform bend tests as required according to inspection procedures outlined in AWS D1.1. In addition, perform field bend tests on an additional 2% of completed shear connectors in each beam but not less than one connector per beam

10. Visually inspect 100% of the welds of anchors to embedded plates that are to be cast into concrete elements.

11. In addition to the inspections above, perform the following:

    a. Continuously monitor and observe joint preparation, assembly practice, welding techniques including preheating and sequence, and the performance of welders for 100% of complete and partial joint penetration welds, multipass fillet welds, and single-pass fillet welds greater than 5/16 inch. Check preheating to assure conformance with AWS D1.1, Section 5.6. Verify procedure for control of distortion and shrinkage stresses.
    b. Periodically monitor welding of single-pass fillet welds that are less than or equal to 5/16 inch.
    c. Periodically monitor the method of attaching the steel floor and roof decking to the structural frame.
    d. Periodically monitor the welding of headed studs to floor beams.

12. Weld Verification Testing Scope:

    a. Perform nondestructive examination services using a qualified technician with the necessary equipment to perform the following:
        (1) Nondestructive examination conducted in accordance with the specific requirements for the item being examined including radiographic (RT), ultrasonic (UT), magnetic particle (MT), or dye-penetrant inspection (PT). Nondestructive inspection procedures shall conform to AWS D1.1.
        (2) Interpret, record, and report results of the nondestructive tests.
        (3) Mark for repair, any area not meeting Specification requirements. Correction of rejected welds shall be made in accordance with AWS D1.1.
        (4) Re-examine repair areas and interpret, record, and report the results of examinations of repair welds.
        (5) Verify that quality of welds meet the requirements of AWS D1.1..
    b. Fillet welds. provide the following:
        (1) MT test a minimum of 10% of the length of each fillet weld exceeding 5/16".

(2) Periodic MT testing of representative fillet welds 5/16" and less but need not exceed 10% of all such welds, except as provided in (3) below.
(3) Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.

c. Partial joint penetration welds, including flare-bevel groove welds. provide the following:
(1) MT test a minimum of 25% of the length of each PJP weld exceeding 5/16" effective throat.
(2) Periodic MT testing of representative PJP welds 5/16" and less but need not exceed 10% of all such welds, except as provided in (3) below.
(3) Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.

d. Complete joint penetration welds. provide the following:
(1) All CJP welds exceeding 5/16" thickness shall be 100% UT tested per AWS D1.1 Chapter 6 Part F. The testing laboratory shall review the CJP joints to determine where geometry or accessibility precludes the use of standard scanning patterns per AWS D1.1 Chapter 6 Part F. At these locations the testing laboratory shall develop and submit for approval a written testing procedure in accordance with AWS D1.1 Annex K.
(2) Periodic MT testing of representative CJP welds 5/16" and less not to exceed 10% of all such welds, except as provided in (3) below.
(3) Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.

e. Acceptance Criteria
(1) Visual, MT, PT shall be per AWS D1.1 Table 6.1.
(2) UT testing shall be per AWS D1.1 6.13.1 and Table 6.2.

f. Base metal thicker than 1.5 inches, where subjected to through-thickness weld shrinkage strains, shall be UT tested for discontinuities behind and adjacent to such welds. UT testing shall occur no sooner than 24 hours after the weld has cooled to ambient temperatures. Any material discontinuities shall be recorded on the basis of ASTM A435 or ASTM A898 (Level 1 criteria) and reported for Engineer disposition.

g. Welds of Anchors to Embedded Plates:
(1) Headed Studs: Perform field bend tests according to AWS D1.1 on 2% of the studs welded to plates, but not less than one stud per plate.
(2) Deformed Bar Anchors: Perform MT testing on 10% of deformed bar anchors larger than #5 bar.

h. The costs of repairing defective welds and the costs of retesting by the Testing Laboratory providing services for the Owner shall be borne by the Contractor. If removal of a backing strip is required by the Testing Laboratory to investigate a suspected weld defect, such cost shall be borne by the Contractor.

E. High-Strength Bolting Inspection and Testing: The Owner's Testing Laboratory shall perform the following inspections and test for connections joined with high-strength bolting. Bolting performed in the shop may be inspected in the field unless continuous monitoring of the bolting operation is herein specified:

1. Observe preinstallation verification testing of the pretensioning method to be used in accordance with the requirements of the "Specification for Structural Joints Using ASTM A325 and A490 Bolts".

2. Daily check the calibration of impact wrenches used in field bolted connections.

3. Inspect bolt installation for 100% of high strength bolted connections according to inspection procedures outlined in the "Specification for Structural Joints Using ASTM A325 or A490 Bolts".

4. Perform Arbitration Testing and Inspection according to procedures outlined in the "Specification for Structural Joints using ASTM A325 or A490 Bolts" when a disagreement exists between the Testing Laboratory and the Fabricator as to the minimum tension of installed bolts that have been inspected according to paragraph above.

5. Monitoring of Bolting Installation:

   a. Continuous Monitoring: The Owner's Testing Laboratory shall be continuously present and monitor the bolting installation for compliance with the selected procedure for installation as specified in the "Specification for Structural Joints Using ASTM A325 and A490 Bolts" for joints using high-strength bolts that are designated on the plans as Pretensioned (PT) or Slip-Critical (SC) type joints and that are being installed using the calibrated wrench method or the turn-of-nut without matchmarking method of installation.
   b. Periodic Monitoring: All other joint types and bolt installation methods may be monitored on a periodic basis.

3.10 NON-SHRINK GROUT FOR BASE PLATES, BEARING PLATES AND PRECAST WALL PANELS

A. Compressive Strength Tests (by the Owner's Testing Laboratory): Compressive strength of grout shall be determined by testing grout cubes according to the requirements of ASTM C109 - Modified. Test one set of three cubes at 1 day, and one set of three cubes at 28 days.

B. Frequency of Testing: One set of cubes (6 cubes) shall be made for every ten base plates and bearing plates or fraction thereof but not less than one set for each day's operation. One set of cubes shall be made for each day's operation of grouting wall panels.

3.11 SAND CEMENT GROUT FOR GROUTING POST-TENSIONING DUCTS AND SOIL ANCHORS

A. Compressive Strength Tests (by the Owner's Testing Laboratory): Compressive strength of grout shall be determined by testing grout cubes according to the requirements of ASTM C109 - Modified. Test one set of three cubes at 1 day, and one set of three cubes at 28 days.

B. Frequency of Testing: One set of cubes (6 cubes) shall be made for each day's operation of grouting ducts.

3.12 MASONRY

A. Verification Testing Frequency: Verification of masonry strength (f'_m) will be performed at the beginning of masonry construction and during construction for each 5000 square feet of wall area or portion thereof.

B. Concrete Masonry Unit: For each type of concrete masonry unit indicated, verify compliance with ASTM C90 and the strength required by design. Verification may be by reviewing certification from unit producer showing compliance.

C. Mortar:

1. Throughout construction, verify the proportions of the site-prepared mortar mix comply with the requirements of ASTM C270 for the type specified.

2. Verify the proportions of materials in premixed or preblended mortar comply with the requirements of ASTM C270 for the type specified as delivered to the site.

D. Grout:

1. Prior to grouting, verify the proportions of site-prepared grout mix comply with the requirements of ASTM C476 for each type of grout used.

2. Verify the proportions of materials in premixed or preblended grout comply with the requirements of ASTM C476 as delivered to the site.

E. Prism Test Method:

1. Compression Test: For each type of wall construction indicated for testing, test representative masonry prisms by methods of sampling and testing of ASTM C1314, and as follows:

   a. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.
   b. For concrete masonry prisms adhere to requirements as specified under preconstruction testing. Build prisms on job using same materials and methods as for wall construction. Store prisms in air at temperature not less than 65°F in a facility supplied by the contractor where they will be undisturbed for seven (7) days. After seven (7) days, transport to laboratory in a manner which will not disturb mortar bond.
   c. Cap each prism with suitable material to provide bearing surfaces on each end.
      (1) Plane within 0.003 inch
      (2) Approximately perpendicular to the axis of the prism.
   d. The preparation of prisms shall be observed by the testing agency that will test the prisms.

2. Report test results in writing and in form specified under each test method, to Architect and Contractor, on same day tests are made.

3. Retests: Where prism tests indicate non-compliance with specified requirements, additional testing shall be performed at the frequency of two additional tests for each unsatisfactory test. The cost of such additional testing shall be the responsibility of the Contractor. Where retesting fails to indicate conformance with specified requirements, any masonry construction represented by unsatisfactory tests shall be removed and replaced with acceptable masonry construction.

F. Mortar Joints: Throughout construction,verify that mortar joints are being prepared in accordance with these specifications and ACI 530.1/ASCE 6/TMS 602.

G. Reinforcement and Connectors: Prior to grouting, verify the size, grade, type and placement of reinforcement and connectors is in compliance with specified requirements.

H. Grouting: Prior to any grouting procedure, the grout space shall be inspected to verify that it is clean and that cleanouts, if required, are in place and conform to requirements. Verify through continuous inspection that the placement of grout is in compliance with the requirements of the contract specifications and ACI 530.1/ASCE 6/TMS 602.

I. Anchors: Continuously inspect the installation of anchors including anchors of masonry to other structural members, frames, or construction verifying their type, size, location, and installation.

J. Anchors: Periodically verify the type, size and location of anchors including anchors of masonry to other structural members, frames, or construction is in compliance with specified requirements.

K. Welding of Reinforcing Bars: Continuously observe the welding of reinforcing bars.

L. Installed items: Verify that installed flashing, weep holes, construction joints, control joints and wall vents are installed in accordance with specifications.

M. Prestressed Unit Masonry: The following inspections and test shall be made for unit masonry that is shown on the drawings to be prestressed:

1. Reinforcment: Prior to grouting, verify the grade, size, and location of prestressing tendons.

2. Prestressing: Continuously observe the application of prestressing force and verify the proper force was applied to tendons.

3. Grout for Bonded Tendons: Prior to grouting, verify the proportion of site-prepared prestressing grout is in compliance.

4. Grouting: Through continuous observation, verify that the grouting of bonded tendons complies with the requirements of ACI 530.1/ASCE 6/TMS 602.

3.13 OPEN WEB STEEL JOISTS

A. Scope: The Owner's Testing Laboratory shall perform inspection of open web steel joists as herein described.

B. Plant Inspection of Fabrication:

1. Verify that the fabricator maintains detailed quality control procedures that provide a basis for inspection control of workmanship and of the ability to conform to approved construction documents and industry standards. Verify that these procedures are complete and adequate relative to code requirements for fabricator's scope of work.

2. Verify welding procedures, welder qualifications and weld material prior to the start of work.

3. Provide periodic inspection of the welding work in progress.

4. Visually inspect 100% of welds prior to shipment of shop welded assemblies.

5. Verify camber requirements.

C. Field Inspection: The duties of the Owner's Testing Laboratory shall be as follows:

1. Visually inspect a representative sample of joist shop welds not to exceed 10% of such welds, for compliance with SJI specifications. Increase inspection frequency if inspected welds incur a high rejection rate.

2. Visually inspect 100% of welded chord splices for compliance with SJI and project specifications.

3. Inspect joists for damage during shipment.

4. Verify proper bearing of joist supports..

5. Confirm bridging size and location.

6. Review field welder qualifications by certification or verify by retesting. Obtain welder certificates.

7. Visually inspect 100% of field attachment of joists to supports (welding or bolting).

8. Confirm bolting of joists to supports at column lines as required by OSHA requirements.

9. Verify that no joists have been damaged during erection.

10. Perform Magnetic Particle testing (MT) on representative field welds not to exceed 10% of such welds unless rejection rates become high, in which case, frequency inspection shall be increased to ensure acceptable welding.

3.14 WOOD

A. Fabrication Shop Inspection: Shop Inspection of wood structural elements shall be as follows:

1. Shop Inspection Waiver: The requirement to perform fabricating shop inspection may be waived if the Fabricator produces evidence from the Building Official of being a registered, approved fabricating shop and if allowed by the Engineer.

2. Prefabricated Wood Structural Elements: Verify that the fabricator maintains detailed quality control procedures that provide a basis for inspection control of workmanship and of the ability to conform to approved construction documents and industry standards. Verify that these procedures are complete and adequate relative to code requirements for fabricator's scope of work.

B. Field Inspection: Provide inspection of the following elements for conformance to approved shop drawings and plans:

1. Prefabricated wood trusses, including member sizes, grade of wood, and connections.

2. Load bearing stud walls, including member sizes, grade, spacing, and connections.

3. Floor and roof joists, including member size, grade, spacing, and connections.

4. Wood Diaphragms: Verify grade of wood, thickness, the nominal size of framing members at panel edges, nail or stapler diameter and length, number of fastener lines and spacing.

5. Horizontal diaphragms, including grade, thickness, size, spacing of edge connections and fastener size and spacing.

6. Elements that are part of the lateral load resisting system, including vertical plywood sheathing and load bearing wall bracing, and blocking. Check member sizes, grade, size, and spacing of connections.

7. Long-span Wood Trusses: When metal-plate-connected wood trusses span more than 60 feet, verify that the temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.

8. All glued laminated members, including sizes, grade, and connections.

END OF SECTION 01 45 29