SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained and paid for by Contractor.

1.2 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. American Concrete Institute (ACI):

506.4R-94 (R2004) .....Guide for the Evaluation of Shotcrete

C. American Society for Testing and Materials (ASTM):

A325-06 .....Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

A370-07 .....Definitions for Mechanical Testing of Steel Products

A416/A416M-06.....Steel Strand, Uncoated Seven-Wire for Prestressed Concrete

A490-06 .....Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength

C31/C31M-06 .....Making and Curing Concrete Test Specimens in the Field

C33-03.....Concrete Aggregates

C39/C39M-05 .....Compressive Strength of Cylindrical Concrete Specimens

C109/C109M-05 .....Compressive Strength of Hydraulic Cement Mortars

C138-07.....Unit Weight, Yield, and Air Content (Gravimetric) of Concrete

C143/C143M-05 .....Slump of Hydraulic Cement Concrete

C172-07.....Sampling Freshly Mixed Concrete

C173-07.....Air Content of freshly Mixed Concrete by the Volumetric Method

C330-05.....Lightweight Aggregates for Structural Concrete

C567-05.....Density Structural Lightweight Concrete

C780-07.....Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

C1064/C1064M-05 .....Freshly Mixed Portland Cement Concrete

C1077-06.....Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

C1314-07.....Compressive Strength of Masonry Prisms

D3666-(2002).....Minimum Requirements for Agencies Testing and Inspection Bituminous Paving Materials

D3740-07 .....Minimum Requirements for Agencies Engaged in the Testing and Inspecting Road and Paving Material

E94-04.....Radiographic Testing

E164-03.....Ultrasonic Contact Examination of Weldments

E329-07.....Agencies Engaged in Construction Inspection and/or Testing

E543-06.....Agencies Performing Non-Destructive Testing

E605-93(R2006) .....Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members

E709-(2001) .....Guide for Magnetic Particle Examination

E1155-96(R2008) .....Determining FF Floor Flatness and FL Floor Levelness Numbers

D. American Welding Society (AWS):

D1.1-07 .....Structural Welding Code-Steel

1.3 REQUIREMENTS:

Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of

accreditation must include the appropriate ASTM standards (i.e.; E 329, C 1077, D 3666, D3740, A 880, E 543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION

3.1 ASPHALT CONCRETE PAVING:

A. Aggregate Base Course:
   1. Determine maximum density and optimum moisture content for aggregate base material in accordance with ASTM D1557, Method D.
   2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with ASTM D1556.
   3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the applicable state highway standards and specifications.

B. Asphalt Concrete:
   1. Aggregate: Sample and test aggregates in stock pile and hot-bins as necessary to insure compliance with specification requirements for gradation (AASHTO T27), wear (AASHTO T96), and soundness (AASHTO T104).
   2. Temperature: Check temperature of each load of asphalt concrete at mixing plant and at site of paving operation.
   3. Density: Make a minimum of two field density tests in accordance with ASTM D1188 of asphalt base and surface course for each day's paving operation.

3.2 SITE WORK CONCRETE:

Test site work concrete including materials for concrete as required in Article CONCRETE of this section.

3.3 POST-TENSIONING OF CONCRETE:

A. Inspection Prior to Concreting: Inspect tendons, drape of tendons, and anchorage components for compliance prior to concreting.

B. Concrete Testing: As required in Article, CONCRETE of this section except make three test cylinders representing each area to be tensioned and cylinders shall be cured in same manner as concrete they represent. Make compression test prior to determining minimum specified strength required for post-tensioning.

C. Post-tensioning: Witness post-tensioning operation and record actual gauge pressures and elongations applied to each tendon.

D. Submit reports in quadruplicate of the following:

1. Inspection of placement and post-tensioning of all tendons.
2. Size, number, location, and drape of tendons.
3. Calculated elongations, based upon the length, modulus of elasticity, and cross-sectional area of the tendons used.
4. Actual field elongations. Check elongation of tendons within ranges established by manufacturer.
5. Calculated gauge pressure and jacking force applied to each tendon.
6. Actual gauge pressures and jacking force applied to each tendon.
7. Required concrete strength at time of jacking.
8. Actual concrete strength at time of jacking.
9. Do not cut or cover the tendon ends until the Contractor receives the Project Engineer’s written approval of the post-tensioning records.

3.4 CONCRETE:

A. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if

the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.

3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m^3 (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. Label each cylinder with an identification number. Project Engineer may require additional cylinders to be molded and cured under job conditions.
4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m^3 (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m^3 (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
9. Verify that specified mixing has been accomplished.
11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.

12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
15. Observe preparations for placement of concrete:
    a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
    b. Inspect preparation of construction, expansion, and isolation joints.
16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
17. Observe concrete mixing:
    a. Monitor and record amount of water added at project site.
    b. Observe minimum and maximum mixing times.
18. Measure concrete flatwork for levelness and flatness as follows:
    a. Perform Floor Tolerance Measurements F_F and F_L in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.
    b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
    c. Provide the Contractor and the Project Engineer with the results of all profile tests, including a running tabulation of the overall F_F and F_L values for all slabs installed to date, within 72 hours after each slab installation.
19. Other inspections:
    a. Grouting under base plates.
    b. Grouting anchor bolts and reinforcing steel in hardened concrete.

B. Laboratory Tests of Field Samples:

1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by Project Engineer. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
3. Furnish certified compression test reports (duplicate) to Project Engineer. In test report, indicate the following information:
   a. Cylinder identification number and date cast.
   b. Specific location at which test samples were taken.
   c. Type of concrete, slump, and percent air.
   d. Compressive strength of concrete in MPa (psi).
   e. Weight of lightweight structural concrete in kg/m^3 (pounds per cubic feet).
   f. Weather conditions during placing.
   g. Temperature of concrete in each test cylinder when test cylinder was molded.
   h. Maximum and minimum ambient temperature during placing.
   i. Ambient temperature when concrete sample in test cylinder was taken.
   j. Date delivered to laboratory and date tested.

3.5 REINFORCEMENT:

A. Review mill test reports furnished by Contractor.

B. Written report shall include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.

3.6 PRESTRESSED CONCRETE:

A. Inspection at Plant: Forms, placement and concrete cover of reinforcing steel and tendons, placement and finishing of concrete, and tensioning of tendons.

B. Concrete Testing: Test concrete including materials for concrete required in Article, CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.

C. Test tendons for conformance with ASTM A416 and furnish report to Project Engineer.

D. Inspect members to insure that specification requirements for curing and finishes have been met.

3.7 ARCHITECTURAL PRECAST CONCRETE:

A. Inspection at Plant: Forms, placement of reinforcing steel, concrete cover, and placement and finishing of concrete.

B. Concrete Testing: Test concrete including materials for concrete as required in Article CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.

C. Inspect members to insure specification requirements for curing and finishes have been met.

3.8 STRUCTURAL STEEL:

A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Welding shall conform to AWS D1.1 Structural Welding Code.

B. Prefabrication Inspection:

1. Review design and shop detail drawings for size, length, type and location of all welds to be made.
2. Approve welding procedure qualifications either by pre-qualification or by witnessing qualifications tests.
3. Approve welder qualifications by certification or retesting.
4. Approve procedure for control of distortion and shrinkage stresses.
5. Approve procedures for welding in accordance with applicable sections of AWS D1.1.

C. Fabrication and Erection:

1. Weld Inspection:

a. Inspect welding equipment for capacity, maintenance and working condition.

b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.

c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.

d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.

e. Measure 25 percent of fillet welds.

f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:

   1) 20 percent of all shear plate fillet welds at random, final pass only.

   2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.

   3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.

   4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.

   5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.

g. Welding Ultrasonic Testing: Test in accordance with ASTM E164 and AWS D1.1 for 100 percent of all full penetration welds, braced and moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.

SPEC WRITER NOTE: Specify radiographic testing only for very large jobs or those with complicated full penetration welds.

h. Welding Radiographic Testing: Test in accordance with ASTM E94, and AWS D1.1 for 5 percent of all full penetration welds at random.

i. Verify that correction of rejected welds are made in accordance with AWS D1.1.

j. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.

2. Bolt Inspection:
   a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
   b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
   c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
   d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.
   e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.
   f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.

D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to Project Engineer.

3.9 STEEL DECKING:

A. Provide field inspection of welds of metal deck to the supporting steel, and testing services to insure steel decking has been installed in accordance with contract documents and manufacturer's requirements.

B. Qualification of Field Welding: Qualify welding processes and welding operators in accordance with "Welder Qualification" procedures of AWS D1.1. Refer to the "Plug Weld Qualification Procedure" in Part 3 "Field Quality Control."

C. Submit inspection reports, certification, and instances of noncompliance to Project Engineer.

3.10 SHEAR CONNECTOR STUDS:

A. Provide field inspection and testing services required by AWS D.1 to insure shear connector studs have been installed in accordance with contract documents.

B. Tests: Test 20 percent of headed studs for fastening strength in accordance with AWS D1.1.

C. Submit inspection reports, certification, and instances of noncompliance to Project Engineer.

3.11 TYPE OF TEST:

	Approximate Number of Tests Required	
A. Concrete:		
Making and Curing Concrete Test Cylinders (ASTM C31)	_____	
Compressive Strength, Test Cylinders (ASTM C39)	_____	
Concrete Slump Test (ASTM C143)	_____	
Concrete Air Content Test (ASTM C173)	_____	
Unit Weight, Lightweight Concrete (ASTM C567)	_____	
Aggregate, Normal Weight:		
Gradation (ASTM C33)		_____
Deleterious Substances (ASTM C33)	_____	
Soundness (ASTM C33)		_____
Abrasion (ASTM C33)		_____
Aggregate, Lightweight		
Gradation (ASTM C330)		_____
Deleterious Substances (ASTM C330)		_____
Unit Weight (ASTM C330)		_____
Flatness and Levelness Readings (ASTM E1155) (number of days) _____		

B. Reinforcing Steel:

Tensile Test (ASTM A370) _____

Bend Test (ASTM A370) _____

Mechanical Splice (ASTM A370) _____

Welded Splice Test (ASTM A370) _____

C. Technical Personnel: (Minimum _____ months)

1. Technicians to perform tests and inspection listed above. Laboratory will be equipped with concrete cylinder storage facilities, compression machine, cube molds, proctor molds, balances, scales, moisture ovens, slump cones, air meter, and all necessary equipment for compaction control

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