



March 20, 2015

Valentine Mbah
Project Engineer
Ohio EPA - DEFA
Lazarus Government Center
50 W. Town St., Suite 700
P.O. Box 1049 Columbus, OH 43216-1049

SENT VIA EMAIL

**Re: Waiver Request from American Iron and Steel Provisions
Clean Water Revolving Loan Fund (CWSRF)
Dugway Storage Tunnel, Cleveland, Ohio**

Mr. Mbah:

The Northeast Ohio Regional Sewer District (the District) sending the following correspondence in regards to the American Iron and Steel Provisions (AIS) under the Clean Water Revolving Loan Fund (CWSRF) for the Dugway Storage Tunnel Project (DST). The Project consists of 14,900-ft long, 24-ft diameter tunnel, six (6) deep shafts with adit tunnel connections that will convey, store and control combined sewer overflows from discharging to Lake Erie. The Project is being completed as part of a consent decree with the United States EPA and the US Department of Justice in 2011. A copy of the project fact sheet has been included as Attachment A.

The Contractor, Salini Impregilo/Healy JV (SIHJV), notified the District in a letter dated March 3, 2015 formally requesting relief from the AIS provision on the basis of iron and steel products not produced in the United States in sufficient and reasonably available quantities. This waiver request is specifically related to the steel fiber reinforcement to be utilized in the production of the precast segmental tunnel liners to be used for the Project and utilized on the current Euclid Creek Tunnel Project being constructed by the District. The segmental liners are being manufactured and provided locally by CSI-Hanson, 7925 Empire Parkway, Macedonia, OH 44056-2144. A copy of the letter has been included in Attachment B.

The District has followed the step by step waiver process outlined in the Implementation of American Iron and Steel Provisions Memorandum issued by the USEPA Office of Wastewater Management and Office of Ground Water and Drinking Water, dated March 20, 2014. AIS requirements were incorporated within the contract bid

documents authorized for bidding by District Board Resolution dated July 17, 2014 and advertised on July 24, 2014. A copy of the legal notice advertising bids for the Project and Volume 1, Bid Booklet for the Project, and the Special Conditions Section, all containing and specifying the AIS requirements has been included as Attachment C. Bids were opened, reviewed and subsequently awarded November, 17, 2014 to SIHJ in the amount of \$153,013,052.00. A copy of the Bid Tabulations/Evaluation memorandum dated October 13, 2014 has been included as Attachment D. At the time of award, the SIHJV executed an AIS Waiver affidavit indicating that relief would be sought from the AIS provisions during the Construction phase of the project. A copy of the SIHJV's Executed Waiver Affidavit has been included as Attachment E.

During pre-construction, SIHJV, and through research conducted during the design process, it is understood that steel fiber reinforcement specified for use by the Design Engineer, (MWH/HMM JV) for the precast concrete segments used to line the tunnel could not be provided domestically. A copy of Specification 03 24 00 Steel Fiber Reinforced Concrete for PC Tunnel Lining has been included as Attachment F. MWH/HMM JV conducted an inquiry with suppliers and manufacturers during the design phase to determine the availability of domestically made steel fibers. A copy of email correspondence outlining this effort has been included as part of Attachment G. Based on the findings of this inquiry, a technical memorandum was prepared by MWH/HMM JV dated July 7, 2014. This technical memorandum outlines the basis of the District waiver of the AIS provision due to the unavailability of iron and steel products domestically.

Please accept this letter as the District's formal request for relief from the AIS requirements for the steel fiber reinforcement to be utilized for the precast concrete segmental tunnel liner for the Project. A copy of the AIS Waiver Checklist as specified for inclusion in the waiver request by the United States EPA Memorandum Dated March 20, 2014 has been included as Attachment I. The District acknowledges that a schedule is required to be included as part of the waiver request. At this time, a baseline schedule has not been developed by SIHJV at this time. A copy of the District's Current Capital Improvement Plan (CIP) Schedule for the Project has been included as Attachment J. The District and the Contractor feel confident that all other products incorporated into the Project will meet AIS requirements. The District will track and monitor all iron and steel products incorporated into the project as required per the terms of the loan agreement executed by and between the District and the OEPA. If you should have any further questions, please feel free to contact me at your earliest convenience.

Sincerely,

James W. Jones, P.E.
Project Manager

Attachment: Attachment A: DST Fact Sheet
Attachment B: SIHJV March 3, 2015 AIS Waiver Request Letter
Attachment C: DST Legal Advertisement and Contract Document Bid Booklet
Attachment D: MWH/HMM October 13, 2014 Bid
Tabulation/Evaluation/Recommendation Letter
Attachment E: SIHJV AIS Waiver Affidavit
Attachment F: Specification Section 03 24 00 Steel Fiber Reinforced Concrete for PC
Tunnel Lining
Attachment G: MWH/HMM JV Email Correspondence to PCC/Steel Fiber Suppliers
Attachment H: MWH/HMM JV American Iron and Steel Compliance Technical
Memorandum
Attachment I: AIS Waiver Application Checklist
Attachment J: NEORSD CIP Schedule

cc: J. Bunsey D. Gabriel D. Lopata R. Sullivan J. Tubero (NEORSD)
B. Pintabona M. Vitale B. DiFiore (MWH/HMM JV)

NOTE: The referenced attachments with project diagrams, schedules, and supplier correspondence are in formats that do not meet the Federal accessibility requirements for publication on the Agency's website. Hence, these exhibits have been omitted from this waiver publication. They are available upon request by emailing SRF_AIS@epa.gov.

ATTACHMENT F: Specification Section 03 24 00 Steel Fiber
Reinforced Concrete for PC Tunnel Lining

SECTION 03 24 00
STEEL FIBER-REINFORCED CONCRETE FOR PC TUNNEL LININGS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Section includes specifications for furnishing and mixing steel fiber-reinforced concrete for precast concrete tunnel linings, including the requirements for the supply of all labor, materials and equipment required for the manufacturing of concrete for precast concrete tunnel lining segments as indicated on the Contract Drawings and in the Specifications.
- B. Placement, finishing and curing is specified for Precast Concrete Tunnel Linings elsewhere in the Contract Documents.

1.2 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 117/117R Standard Tolerances for Concrete Construction and Materials
 - 2. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
 - 3. ACI 211.4 Guide for Selecting Proportions for High-Strength Concrete with Portland Cement and Fly Ash
 - 4. ACI 214.3R Simplified Version of the Recommended Practice for Evaluation of Strength Test Results of Concrete
 - 5. ACI 301 Specifications for Structural Concrete for Buildings
 - 6. ACI 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete
 - 7. ACI 305R Hot Weather Concreting
 - 8. ACI 306R Cold Weather Concreting
 - 9. ACI 308R Guide to Curing Concrete
 - 10. ACI 318/318R Building Code Requirements for Reinforced Concrete and Commentary
 - 11. ACI 347 Guide to Formwork for Concrete
 - 12. ACI 544.1 Report on Fiber Reinforced Concrete
 - 13. ACI 544.2 Measurement of Properties of Fiber Reinforced Concrete

14. ACI 544.3R Guide to Specifying, Proportioning, and Production of Fiber-Reinforced Concrete

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

1. ASTM A820 Specifications for Steel Fibers for Fiber-Reinforced Concrete
2. ASTM C31 Standard Specification for Making and Curing Concrete Test Specimens in the Field
3. ASTM C33 Standard Specification for Concrete Aggregates
4. ASTM C39 Standard Specification for Compressive Strength of Cylindrical Concrete Specimens
5. ASTM C42 Standard Specification for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
6. ASTM C78 Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
7. ASTM C94 Standard Specification for Ready-Mix Concrete
8. ASTM C114 Standard Test Methods for Chemical Analysis of Hydraulic Cement
9. ASTM C125 Standard Terminology Relating to Concrete and Concrete Aggregates
10. ASTM C138 Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
11. ASTM C143 Standard Test Method for Slump of Hydraulic Cement Concrete
12. ASTM C150 Standard Specification for Portland Cement
13. ASTM C156 Standard Test Method for Water Retention by Concrete Curing Materials.
14. ASTM C172 Standard Practice for Sampling Freshly Mixed Concrete
15. ASTM C173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
16. ASTM C192 Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
17. ASTM C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
18. ASTM C260 Standard Specification for Air-Entraining Admixtures for Concrete.

19. ASTM C387 Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar
20. ASTM C494 Standard Specification for Chemical Admixtures for Concrete.
21. ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
22. ASTM C666 Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
23. ASTM C685 Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
24. ASTM C989 Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
25. ASTM C995 Test for Time of Flow of Fiber-Reinforced Concrete through Inverted Slump Cone.
26. ASTM C1017 Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
27. ASTM C1077 Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
28. ASTM C1116 Standard Specification for Fiber-Reinforced Concrete and Shotcrete
29. ASTM C1240 Standard Specification for Silica Fume for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar and Grout
30. ASTM C1399 Standard Test Method for Obtaining Average Residual-Strength of Fiber-Reinforced Concrete
31. ASTM C1550 Standard Test Method for Flexural Toughness of Fiber-Reinforced Concrete (Using Centrally Loaded Round Panel)
32. ASTM C1585 Standard Test Method for Measurement of Rate of Absorption of Water by Hydraulic-Cement Concretes
33. ASTM C1602 Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
34. ASTM C1609 Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading).
35. ASTM D75 Standard Practice for Sampling Aggregates.

1.3 DEFINITIONS – NOT USED

1.4 QUALITY ASSURANCE AND QUALITY CONTROL

- A. Materials shall conform to ACI 301, ACI 544.3R, and shall be tested by the Contractor for conformance of the requirements to the Contract Documents. Materials may be inspected and tested by the Owner.
- B. Tests by the Contractor shall include, but not be limited to, the following:
 - 1. Obtaining certification of cement.
 - 2. Tests of aggregate.
 - 3. Test for establishing mixes of concrete and design of mix.
 - 4. Concrete cylinder tests.
 - a. Two sets of three cylinders from each day's production shall be cured with the segments. Cylinders shall be tested at 7, 14, and 28 days after casting.
 - 5. Air entrainment tests and slump tests will be taken as is necessary for control checks and acceptance purposes at the discretion of the Owner and always from same batch of concrete from which test cylinders are made.
 - 6. Tests for permeability shall be made in accordance with the protocol in CWP, as required for Precast Concrete Tunnel Linings and established elsewhere in the Contract Documents, and shall be conducted in a triaxial testing apparatus with a minimum pressure of 4 bars.
- C. Tests will be performed in accordance with the ASTM requirements referenced in this Section and other procedures detailed in the CWP as required for Precast Concrete Tunnel Linings and established elsewhere in the Contract Documents.
- D. Cooperate with and assist the Owner during inspections and tests.
- E. Remove defective materials and completed Work which fails the tests and replace as directed by the Owner.
- F. Where work or materials fail to meet strength requirements as indicated by test results, the Contractor shall pay the costs of any additional inspection and testing required for new replacement work or materials.
- G. Inspection or testing by the Owner will not augment or replace the Contractor's quality control nor relieve it of its contractual responsibilities.
- H. Testing Agency:
 - 1. Retain an independent testing agency certified by ASTM to perform the following additional required testing for fiber-reinforced concrete in accordance with the requirements within this Section.
 - 2. Pre-production Testing:

- a. For mix development provide testing to demonstrate, flexural strength and toughness of the fiber-reinforced concrete. A minimum of four flexural beams, 6 inch x 6 inch x 20 inch long, shall be tested to demonstrate the conformance to the specified requirements of the mix. The beams will be tested on an 18 inch span using concrete produced with the same fiber dosing equipment that will be used for the production concrete. The beams shall be tested at 28 days after casting.
 3. Production Testing:
 - a. Three, sized as for the pre-production testing, flexural beams shall be cast for each ten Rings of concrete lining produced. Following the demonstration of conformance of the first 500 Rings, the frequency of testing shall be reduced to one set for each twenty Rings of concrete lining produced thereafter.
 - b. The beams shall be tested at 28 days after casting and the average results from the tests shall conform to the specified requirements.
 4. One wash out test shall be performed for each five Rings of lining production in which fiber content shall be measured within a 0.5 cubic foot sample. Variations greater than 5% from the specified fiber dosage shall be considered a non-conformance.
- I. Records:
1. The Contractor shall furnish the Owner with a log on which the following information is printed, stamped or written:
 - a. Date of batching;
 - b. Serial number of each batch;
 - c. Amount of concrete in cubic meters;
 - d. Time of first mixing of cement and aggregate;
 - e. Time that the discharge of load was started;
 - f. Time that the discharge of load was completed;
 - g. The air temperature when the concrete was placed;
 - h. The test samples taken and the results of the test samples.
 2. Additional information designated by the Owner and required by the Specifications shall be furnished upon request.

1.5 SUBMITTALS

A. Samples:

1. Submit to the Owner for review and acceptance, at least 30 days prior to commencing precast concrete tunnel lining production, the following samples and information in accordance with Section 01 33 00:
 - a. Inform the Owner of proposed pit and stockpile locations for aggregates and provide access for sampling.
 - b. Submit to the Owner the name and source of all other concrete materials.
 - c. Submit to the Owner samples of the following materials proposed for use:
 - 1) 25 pounds of each type of Portland cement.

- 2) Five (5) pounds of each type of supplementary cementing material.
- 3) 25 pounds of each type of blended hydraulic cement (if used).
- 4) One (1) gallon of each admixture.
- 5) 0.25 pound of steel fibers.

B. Certificates:

1. At least 90 days prior to commencing precast concrete tunnel lining production, submit to the Owner for review and acceptance, the manufacturer's test data and certification by a qualified independent inspection and testing laboratory that the following materials will meet the requirements specified in this Section for the following:
 - a. Portland cement.
 - b. Blended hydraulic cement (if used).
 - c. Supplementary cementing materials.
 - d. Admixtures.
 - e. Aggregates.
 - f. Water.
 - g. Steel Fiber
2. Provide certification that the plant, equipment, and materials to be used in the concrete work comply with the ASTM requirements referenced in this Section and that the mix design is adjusted to prevent alkali aggregate reactivity problems.

C. Construction Quality Control:

1. Submit the proposed quality control procedures for the Owner's review and acceptance as part of the Construction Work Plan (CWP) as specified for Precast Concrete Tunnel Linings elsewhere in the Contract Documents.

D. Steel Fiber-Reinforced Concrete Mix Design:

1. At least 90 days prior to commencing precast concrete tunnel lining production, submit to the Owner for review and acceptance, concrete mix designs as follows:
 - a. Initial submittal shall include the proposed testing schedule to prove compliance with applicable requirements.
 - b. Supplement the initial mix design submission with test data as it becomes available.
 - c. Adjustments made to the mix designs may require additional tests on the new mix.
 - d. Method of mixing steel fibers to concrete mixture, which is to be in accordance with ACI 544.3R.
 - e. The Owner may perform independent testing of the mix or materials.
2. Submit to the Owner for review and acceptance, at least 30 days prior to commencing precast concrete tunnel lining production, the proposed steel fiber-reinforced concrete mix characteristics including:
 - a. Steel fiber source, type, technical specifications, and quantity.
 - b. ASTM C1609 beam test results as described in this Section.

3. Submit to the Owner for review and acceptance, at least 30 days prior to commencing precast concrete tunnel lining production, the name and qualifications of the independent testing laboratory to be used for Quality Control testing, as specified in this Section.
4. Do not place concrete before written acceptance of the mix design is received from the Owner.
5. Do not vary the approved mix without written acceptance from the Owner.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Store materials at the manufacturing site in accordance with the ASTM requirements referenced in this Section.
- B. Deliver materials to the manufacturing site in accordance with the ASTM requirements referenced in this Section.
- C. Protect the Work of this Section from damage. Protect other work from damage resulting from this Work. Repair damaged work to the satisfaction of Owner and at no cost to the Owner.
- D. Concrete shall not be delivered by truck mixer.
- E. Load, transport and store all materials so as to keep them clean and protected from damage. The product must be identified for traceability.
- F. Store the product in a dry, protected enclosure and in accordance with the manufacturer's recommendations.
- G. The product shall be stored on platforms, skids or other supports above the ground surface.
- H. Open and discharge contents of clearly marked, pre-weighed boxes or bags into the mixing system.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Use products in accordance with manufacturer's recommendations unless otherwise directed by the Owner.
- B. Portland Cement: ASTM C150, Type II.
- C. Cementitious Hydraulic Slag: ASTM C989, Grade 120.
- D. Fly Ash: ASTM C 618, Class F

- E. Supplementary Cementing Material: ASTM C 618.
- F. Silica Fume: ASTM C 1240, maximum 10 percent of total cementitious material content
- G. Coarse Aggregate:
 - 1. ASTM C33, tested in accordance with the current Los Angeles Abrasion Loss Specification. Qualifications may be based on historical test results from aggregate source.
 - 2. The maximum petrographic number for the coarse aggregate shall be 140.
 - 3. Gradation of Coarse Aggregate: ACI 211.1, Appendix 5, A5.3.2.1 or an alternate grading approved by the Owner.
 - 4. Maximum size: 3/4 inch.
- H. Fine Aggregate: ASTM C 33.
- I. All aggregates shall be from a tested source
- J. Water: Clean and potable, free of impurities detrimental to concrete.
- K. Admixtures:
 - 1. The use of calcium chloride or additional mixtures, other than those specified, is not acceptable.
 - 2. Use liquid admixtures for concrete from a single manufacturer unless the compatibility of materials from two or more suppliers can be demonstrated.
 - 3. Admixtures shall be used only with the written approval of the Owner and shall be used without alteration to the cement content.
 - 4. Water Reducing Admixture: ASTM C494, Type A.
 - 5. Set Retarding Admixture: ASTM C494, Type D.
 - 6. Set Accelerating Admixture: ASTM C494, Type C.
 - 7. Air Entraining Admixture: ASTM C260.
 - 8. Superplasticizer: ASTM C494, Type

2.2 REINFORCEMENT

- A. Steel fibers: Minimum quantity of 67 lbs per cubic yard of concrete Type Dramix RC 80/60 BN, Wirrand FF3 by Macaferrri or equal.
- B. Dosage and distribution shall be demonstrated by washout test.

- C. Washout test shall consist of taking 0.5 cu.ft sample of fresh concrete. The sample shall be sprayed with water to washout aggregate and cement. The fiber shall be then collected and counted.

2.3 CONCRETE MIX

- A. Produce concrete for all segments in accordance with the requirements specified as follows:
 - 1. Compressive strength at 28 Days: minimum 8,000 psi.
 - 2. Cement content: 520 lb/cy.
 - 3. Cementitious material content: minimum 600 lb/cy, maximum 828 lb/cy.
 - 4. Cementitious hydraulic slag: maximum 45% of total cementitious material content.
 - 5. Fly Ash: maximum 25% of total cementitious material content.
 - 6. Silica fume: maximum 10% of total cementitious material content.
 - 7. Water to total cementitious material ratio: maximum 0.35 by weight.
 - 8. Fine to coarse aggregate: percentage between 45% and 55%.
 - 9. Air entrainment: minimum percentage required to meet freeze-thaw test per ASTM C666.
 - 10. Slump: As required.
 - 11. Minimum total supplemental cementitious materials (slag, fly ash and/or silica fume): 25%.
 - 12. Permeability to water: maximum 10×10^{-13} m/s.
 - 13. Resistance to Chloride Ion Penetration: maximum 1000 coulombs.
 - 14. Total water-soluble alkali content: not greater than 5.4 lb/cy (Na_2O equivalent).
- B. Design concrete so that material will not segregate and excessive bleeding will not occur.
- C. The acceptance of any concrete mix proportion or material shall not preclude its future rejection if it is subsequently found to lack uniformity, or if it fails to conform to the requirements specified in the Contract Documents, or if its performance is found to be unsatisfactory.
- D. Mix concrete in accordance with ACI 301 and ACI 544.3R.

- E. Proportion mix for Steel Fiber-Reinforced Concrete (SFRC) using normal weight aggregate to produce the following properties:

| Age of Concrete from Time of Batching | Min. Flexural Strength (ASTM C1609) | Min. Performance Level (ASTM C1609) |
|---------------------------------------|-------------------------------------|-------------------------------------|
| 28 days | 670 psi | See paragraph 2.3.F.2 |

- F. Performance Level Testing:

1. Use ASTM C 1609 testing with the permitted specimen size of 20 inch x 6 inch x 6 inch on a 18 inch span in third point loading.
2. Specified fiber reinforced concrete performance level is achieved when:
 - a. The calculated flexural strength exceeds the design flexural strength of 670 psi and
 - b. The average load-deflection curve of three tests yields the residual equivalent flexural strength >464 psi (assume elastic stress-strain relationship) at any deflection at or beyond the deflection of 0.75mm ($L/600$) (see Figure 03408.1)

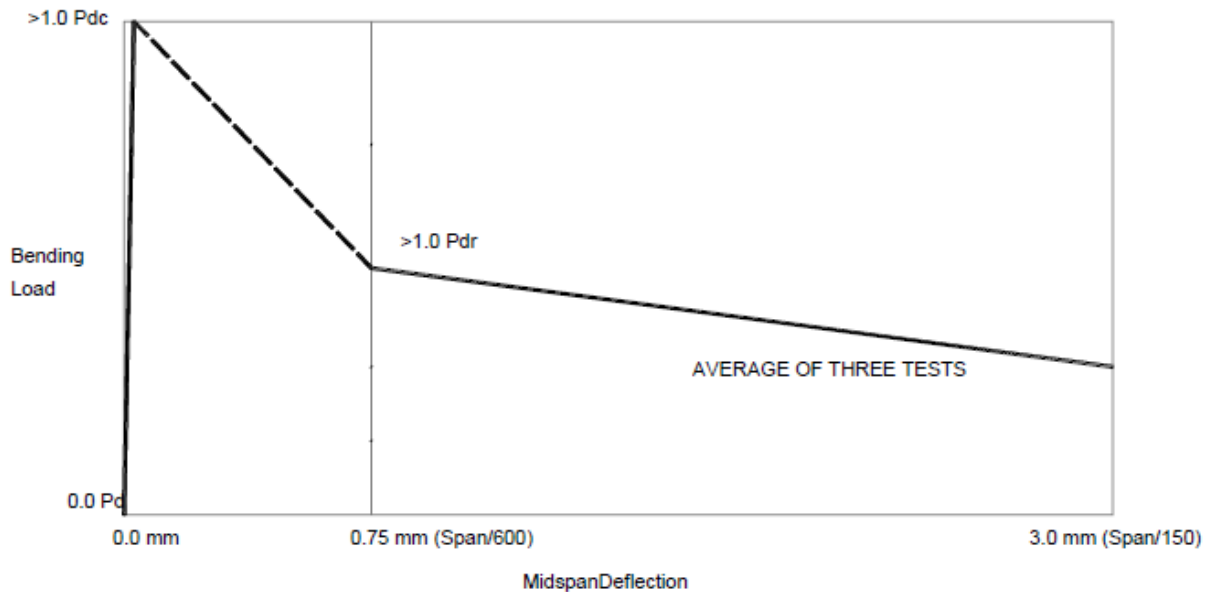


Figure 03408.1 – Load Deflection Template for Determining Toughness Performance Level (ASTM C 1609 Beam Testing). P_{dc} = load corresponding to the specified minimum flexural strength. P_{dr} = load corresponding to the specified residual equivalent flexural strength.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Admixtures:

1. Add admixtures to the concrete mix in accordance with the manufacturer's recommendations. Have the admixture manufacturer make available, at no cost to the Owner, upon 72 hours notice, the services of a qualified, full-time field representative to assure the proper use of admixtures.

B. Source Quality Control:

1. All testing will be done by the Contractor, in accordance with ASTM C31, ASTM C39, and ACI 214.3R.
2. Strength test means the average compressive strength of two companion compression test specimens tested at the same age. If a strength test falls below the specified strength, the concrete will be considered defective.
3. Provide a heated, enclosed and locked storage area not less than 65 sq.ft in a central location for storing concrete samples. Maintain humidity at 100%. Maintain the temperature in the storage area at 73°F ±4°F at all times. Provide a shelf in the storage area, for writing tags.
4. Provide transportation for the samples from the point that the samples are taken to the storage area. Forbid entry to the storage area by unauthorized personnel.
5. All materials used in the production of the segments shall be identified and recorded such that materials used in every segment can be traced back to its fabrication and source.

3.2 TEST PROCEDURES AND REQUIREMENTS

- A. The determination of within-batch uniformity, in the following table shall be based on concrete using normal weight aggregate whose nominal size does not exceed 3/4 inch. Two sets of tests for uniformity (slump, air content) shall be carried out prior to a decision on the acceptance of the equipment under tests:

1. Where the range, in each set of tests, is equal to or less than the acceptance limit, the concrete shall be considered uniform and accepted;
2. Where the range of any single set of tests is greater than the rejection limit, the concrete shall be considered non-uniform and shall be rejected;
3. Where the range of any single set of tests falls between the acceptance and rejection limits, additional tests shall be made on the next consecutive batch or load delivered by that unit. If the range of any single set of tests is then greater than the acceptance limit, the concrete shall be considered non-uniform and shall be rejected.

DETERMINATION OF WITHIN-BATCH UNIFORMITY

| Air Content (ASTM C231), % | 0.7 | 1.0 |
|----------------------------|-----|-----|
| Slump (ASTM C143), inches | 1.0 | 2.0 |

3.3 PRODUCTION OF CONCRETE

- A. Testing and Inspection Facilities: Provide a reasonably soundproof and dust-proof office for the Owner in the mixing plant with working space, heat, light and telephone.
- B. Batching and Delivery Facilities: Provide facilities which conform to the requirements of ACI 301 and ACI 544.3R.

3.4 DEFECTIVE CONCRETE

- A. Concrete shall be considered potentially defective if the concrete cylinder test for any group of segments fails to meet the specified strength. In such cases the concrete in that section may be checked by the Owner by core specimens drilled and tested in accordance with ASTM C42.
- B. If any test specimen has a compressive strength less than the specified strength, the Owner shall have the right to reject the defective group of segments. All costs, including coring, testing, and replacing shall be borne by the Contractor even if further evaluation of the design allows the unit to be classed acceptable.
- C. Concrete shall also be considered defective if it is structurally unsound, not watertight, honeycombed or improperly finished, as determined by the Owner. The Owner shall have the right to require replacement, strengthening or correction of the defective group of segments; all such Work shall be carried out under the Owner's supervision. All costs for strengthening, demolishing, correcting and replacing shall be borne by the Contractor.

3.5 BATCHING AND MIXING

- A. Batching plant mixing methods used for the preparation of batch-mixed fiber-reinforced concrete shall provide consistently distributed component materials free of balled fibers and shall be in accordance with ACI 304R, ACI 544.3, and ASTM C1116.

3.6 PLACING AND FINISHING

- A. Placing and finishing operations for fiber reinforced concrete shall be in accordance with ACI 304R and ACI 544.3R.

3.7 CURING AND PROTECTION

- A. Curing and protection of fiber reinforced concrete shall be in accordance with ACI 308R and ACI 544.3R.

3.8 CONCRETE MIX DESIGN AND QUALITY ASSURANCE

- A. Supply concrete to meet the project requirements for durability and watertightness, shrinkage and cracking.

END OF SECTION