WACA/WSDOT Meeting
Minutes for Wednesday, September 22, 2010

Attendees:

Mike Polodna, WSDOT	Tom Weist, Oldcastle	David Burg, Ash Grove
Robert Raynes, Cemex	Craig Matteson, Central Pre-Mix	Mohammad Sheikhizadeh, WSDOT
Neil Guptill, CalPortland	Dick Boss - Cadman	Tom McGraw, Lafarge
Kurt Williams, WSDOT	Kevin Wolf, CalPortland	Maha Ablson, WSDOT
Rob Molohon, WSDOT	Bruce Chattin, WACA	

Location: WSDOT Office, Tumwater, WA

Next WACA Meeting Date:
Wednesday, December 8, 2010 at WACA's Office in Des Moines, 9:30 AM – 12:00 Noon

Future WACA Meetings Dates:
Wednesday, March 9, 2011 at WSDOT HQ Mats Lab, Main Conf Room, 9:30 AM – 12:00 Noon
Wednesday, June 8, 2011, at WACA's Office in Des Moines, 9:30 AM – 12:00 Noon

Meeting Minutes are available at: http://www.wsdot.wa.gov/biz/mats/

Issue: Performance Specifications for Concrete Mix Designs - Mo Sheikhizadeh

Develop performance specification parameters for concrete.

9/22/10 Mo- An internal Bridge/Construction/Materials (BCM) team is meeting to implement performance specifications. There is general consensus to phase deck mixes into the specification.
Kurt-WSDOT is planning on 4 to 5 demonstration projects next year and asked for feedback on specification from WACA.WACA members commented that the freeze/thaw and creep tests take a long time and projects need a long lead time for them to prepare their proposals . There was discussion about pre-announced contracts, and/or requiring contractors to select concrete producers X months prior to concrete placement. Mike will send out the current specification to all WACA members. There was discussion regarding naming the performance mixes with different letters to avoid confusion. Suggestions included 4000D Performance, or 4000D HPC or 4000J Dick Boss suggested eliminating all prescriptive aspects of the specifications Including transit time, temperature, revolutions.

Action Plan: Continue to give updates to WACA at quarterly meetings.

Issue: Degradation for concrete Aggregate/Base Course – Kurt Williams
A research study is on-going to test the effect of using aggregate with low degradation values in concrete mixes.

9/22/10 –Mike Polodna reported that results will be available by December 2010 meeting.

Action Plan: Continue to give updates to WACA at quarterly meetings.

Issue: Proposed Specification Change to Section 6-02.3(2) Proportioning Materials – Mo Sheikhizadeh

WSDOT 4000D mix currently requires a minimum of 660 pounds of portland cement plus 100 pounds of fly ash and addition fly ash can be added to Alkali Silica Reactivity mitigation which can raise the total cementitious above 800 pounds.

9/22/10 –Kurt passed out proposed changes to the specification and reviewed changes to the table in 6-02.3(2). A suggestion was made to round off the minimum cementitious amounts from 564 to 560 pounds and to lower the minimum requirement for Class 3000 to 470 pounds. ASTM now uses the term slag-cement instead of GGBFS. WSDOT will address that in the 2012 specification book. Kurt asked members to provide him any feedback on the proposed changes by 10-1-10.

Action Plan: Changes have been added to the January 2010 Standard Specifications amendments. See attachment. Issue complete.

Issue: Proposed Change to Standard Specification 9-01.2(4) Blended Hydraulic Cement – Rob Shogren

9/22/10 – Kurt passed out proposed new specification Section 9-01.2(4) Blended Hydraulic Cement and asked for comments and noted the plan is to get these in the next amendment package. Note: The changes to the specification have been included in the January 2010 amendment package and are included in today's handout.

9-23.13 Blended Supplementary Cementitious Material

Blended Supplementary Cementitious Material (SCM) shall meet the requirements of ASTM C1697. Blended SCMs shall be limited to binary or ternary blends of fly ash, ground granulated blast furnace slag, microsilica fume, and metakaolin. Fly ash shall meet the requirements of section 9-23.9. Ground granulated blast furnace slag shall meet the requirements of section 9-23.10. Microsilica fume shall meet the requirements of section 9-23.11. Metakaolin shall meet the requirements of section 9-23.12. The individual SCMs composing the blended SCM shall be individually listed on the WSDOT QPL.

Action Plan: Changes have been added to the January 2010 Standard Specifications amendments. See attachment. Issue complete.

Issue: Proposal to Add Metakaolin to Standard Specifications – Kurt Williams

9-23.12 Metakaolin

Metakaolin shall conform to the requirements of AASHTO M 295 Class N including optional chemical requirements as set forth in Table 2 and with a further limitation that the loss on ignition shall be a maximum of 1.5 percent.

9/22/10 – Kurt passed out proposed new specification Section 9-23.12Metakaolin and asked for comments and noted the plan is to get these in the next amendment package. Note: The changes to the specification have been included in the January 2010 amendment package and are included in today's handout.

Action Plan: Changes have been added to the January 2010 Standard Specifications amendments. See attachment. Issue complete.

Issue: Water for Concrete - Bob Raynes
Bob reported that WSDOT Standard Specification 9-25.1 Water for Concrete requires that in order to use recycled water the lab that tests their water must meet R-18. The consensus was that no one is currently using recycled water because of the R-18 requirement.

9/22/10 – Bob inquired if they could use ASTM C1602 with in-house testing instead of the R-18 requirement. The group discussed briefly and Kurt asked for a submittal in writing on what is being proposed and Bob Raynes agreed to provide a proposed specification update to Section 9-25.1 to Mike.

Action Plan: Review WACA proposal at next meeting.

Issue: J-ring for SCC – Craig Matteson
Is J-ring testing a pre-qualification test only, or is it an acceptance test also?.

9/22/10 – Because of possible variables in the field Mo wants to use the J-ring test for acceptance as well as for pre-qualification testing until WSDOT has more experience with the mixes.

Action Plan: J-ring testing will be required for both pre-qualification and acceptance testing. Issue complete.

New Issue: Draft Specification-SCC- Kurt Williams:
SCC for Precast Units will be added to the Standard Specifications. Kurt passed out the proposed specification and asked for comments by October 1. Mike emailed a copy of the specification to WACA members on September 30.

Action Plan: Review final changes that will be in the January 2010 specification amendments.

New Discussion Item: Prestressed Girders Constructed with SCC – Mo Sheikizadeh
WSDOT is designing a bridge in Spokane that will use prestressed girders constructed with SCC. WSDOT will continue to discuss the use of SCC for cast-in-place construction in the BCM team.

New Discussion Item: Novacem -MoSheikizadeh
Novacem is a new product by Lafarge that Mo is interested in receiving any available research reports. Tom McGraw reported that he had nothing available to report. Bruce Chattin questioned whether WSDOT is interested in pursuing this type of cement. Mo replied that was not the case. Mo has some information on this cement which he will copy for Mike to distribute.

Attachment 1
Changes to Standard Specifications

New Addition to Section 1-01.3 Definitions

Cementitious Materials

The following are considered cementitious materials: portland cement, blended hydraulic cement, fly ash, ground granulated blast-furnace slag, microsilica fume, and metakaolin.

2-09.3(1)E Backfilling

The backfilling of openings dug for Structures shall be a necessary part of and incidental to the excavation. Unless the Engineer directs otherwise, backfill material shall be nonclay material containing no pieces more than 3-inches across, no frozen lumps, and no wood or other foreign material.

When specified in the Contract or when approved by the Engineer, the Contractor shall supply controlled density fill as backfill material.

Alternative Sources. When material from Structure excavation is unsuitable for use as backfill, the Engineer may require the Contractor to:

1. use other material covered by the Contract if such substitution involves Work that does not differ materially from what would otherwise have been required;
2. substitute selected material in accordance with Section 2-03.3(10);
3. use Controlled Density Fill (CDF) also known as Controlled Low Strength Material (CLSM)), or;
4. obtain material elsewhere. Material obtained elsewhere will be paid for in accordance with Section 1-04.4.

Controlled Density Fill (CDF) or Controlled Low-Strength Material (CLSM).

CDF is a self compacting, cementitious, flowable material requiring no subsequent vibration or tamping to achieve consolidation. The Contractor shall provide a mix design in writing to the Engineer on WSDOT Form 350-040 and utilize ACI 229 as a guide to develop the CDF mix design. No CDF shall be placed until the Engineer has reviewed the mix design. CDF shall be designed to have a minimum 28-day strength of 50 psi and a maximum 28-day strength not to exceed 300-psi. The CDF consistency shall be flowable (approximate slump 3 to 10-inches).

The following testing methods shall be used by the Contractor to develop the CDF mix design:
28-day compressive strength - ASTM D 4832,
Unit weight, yield, and air content - ASTM D 6023,
Slump - WSDOT FOP for AASHTO T 119.

The water/cement ratio shall be calculated on the total weight of cementitious material. ~~The following are considered cementitious materials: Portland cement, fly ash, ground granulated blast furnace slag and microsilica fume.~~

5-05.3(1) Concrete Mix Design for Paving

The Contractor shall provide a concrete mix design for each design of concrete specified in the Contract. The Contractor shall use ACI 211.1 as a guide to determine proportions. Concrete strength, placement, and workability shall be the responsibility of the Contractor. Following approval of the Contractor's proposal, all other requirements of Section 5-05 shall apply.

1. **Materials.** Materials shall conform to Section 5-05.2. Fine aggregate shall conform to Section 9-03.1(2), Class 1. Coarse aggregate shall conform to Section 9-03.1(4), AASHTO grading No. 467. An alternate combined gradation conforming to Section 9-03.1(5) may be proposed, that has a nominal maximum aggregate size equal to or greater than a 1½-inch sieve.

   Fly ash, if used, shall not exceed 35-percent by weight of the total cementitious material, shall conform to Section 9-23.9 and shall be limited to Class F with a maximum CaO content of 15-percent by weight.

   Ground granulated blast furnace slag, if used, shall not exceed 25-percent by weight of the total cementitious material and shall conform to Section 9-23.10. When both ground granulated blast furnace slag and fly ash are included in the concrete mix, the total weight of both these materials is limited to 35-percent by weight of the total cementitious material. As an alternative to the use of fly ash, ground granulated blast furnace slag and cement as separate components, a blended hydraulic cement that meets the requirements of Section 9-01.2(4) Blended Hydraulic Cements may be used.

   The water/cement ratio shall be calculated on the total weight of cementitious material. ~~The following are considered cementitious materials: Portland cement, fly ash, ground granulated blast furnace slag and microsilica.~~ The minimum cementitious material for any mix design shall be 564-pounds per cubic yard.

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6-02.2 Materials

Materials shall meet the requirements of the following sections:

Portland Cement	9-01
Aggregates for Portland Cement Concrete	9-03.1
Gravel Backfill	9-03.12
Joint and Crack Sealing Materials	9-04
Reinforcing Steel	9-07
Epoxy-Coated Reinforcing Steel	9-07
Pigmented Sealer Materials for Coating of Concrete Surface	9-08.3
Prestressed Concrete Girders	9-19
Grout	9-20.3
Mortar	9-20.4
Curing Materials and Admixtures	9-23
Fly Ash	9-23.9
Ground Granulated Blast Furnace Slag	9-23.10
Microsilica Fume	9-23.11
Metakaolin	9-23.12
Plastic Waterstop	9-24
Water	9-25
Elastomeric Bearing Pads	9-31

6-02.3(2) Proportioning Materials

The soluble chloride ion content shall be determined by the concrete supplier and included with the mix design. The soluble chloride ion content shall be determined by (1) testing mixed concrete cured at least 28-days or (2) totaled from tests of individual concrete ingredients (cement, aggregate, admixtures, water, fly ash, ground granulated blast furnace slag, and other supplementary cementing materials). Chloride ion limits for admixtures and water are provided in Sections 9-23 and 9-25. Soluble chloride ion limits for mixed concrete shall not exceed the following percent by mass of cement when tested in accordance with AASHTO T 260:

Category	Acid-Soluble	Water-Soluble
Prestressed concrete	0.08	0.06
Reinforced concrete	0.10	0.08

Unless otherwise specified, the Contractor shall use Type I or II Portland cement in all concrete as defined in Section 9-01.2(1).

The use of fly ash is required for Class 4000D and 4000P concrete, except that ground granulated blast furnace slag may be substituted for fly ash at a 1:1 ratio. The use of fly ash and ground granulated blast furnace slag is optional for all other classes of concrete and may be substituted for Portland cement at a 1:1 ratio as noted in the table below.

~~Class of Concrete~~	~~Maximum Percent replacement of fly ash for Portland cement~~	~~Maximum Percent replacement of ground granulated blast furnace slag for Portland cement~~
~~4000~~	~~35~~	~~40~~
~~4000A~~	~~20~~	~~30~~
~~4000D~~	~~20~~	~~30~~
~~4000P~~	~~35~~	~~40~~
~~4000W~~	~~35~~	~~40~~
~~3000~~	~~35~~	~~40~~

~~Commercial Concrete~~	~~35~~	~~40~~

Class of Concrete	Minimum Cementitious Content (Pounds)	Minimum Percent replacement of Fly Ash or Ground Granulated Blast Furnace Slag for portland cement	Maximum Percent replacement of fly ash for portland cement	Maximum Percent replacement of ground granulated blast furnace slag for portland cement
4000	560	*	35	40
4000A	560	*	20	30
4000D	660	10	20	30
4000P	600	15	35	40
4000W	560	*	35	40
3000	560	*	35	40
Commercial Concrete	**560	*	35	40
Lean Concrete	140 - 200	*	35	40

* No minimum specified

** For Commercial Concrete the minimum cementitious content is only required for sidewalks, curbs and gutters

Table 1 Cementitious Requirement for Concrete

When both ground granulated blast furnace slag and fly ash are included in the concrete mix, the total weight of both these materials is limited to 40-percent by weight of the total cementitious material.

The water/cement ratio shall be calculated on the total weight of cementitious material. ~~The following are considered cementitious materials: Portland cement, fly ash, ground granulated blast furnace slag and microsilica~~. With the Engineers written approval microsilica fume and metakaolin can be used in Class 4000 and Class 4000A concrete and is limited to a maximum of 10% of the cementitious material.

As an alternative to the use of fly ash, ground granulated blast furnace slag and cement as separate components, a blended hydraulic cement that meets the requirements of Section 9-01.2(4) Blended Hydraulic Cements may be used.

6-02.3(2)A Contractor Mix Design

The Contractor shall provide a mix design in writing to the Engineer for all classes of concrete specified in the Plans except for those accepted based on a Certificate of Compliance. No concrete shall be placed until the Engineer has reviewed the mix design. The required average 28-day compressive strength shall be selected per ACI 318, Chapter 5, Section 5.3.2. ACI 211.1 and ACI 318 shall be used to determine proportions. All proposed concrete mix shall meet the requirements of Table 1 Cementitious Requirement for Concrete in Section 6-02.3(2). ~~The proposed mix for Class 4000P shall provide a minimum fly ash or ground granulated blast furnace slag content per cubic yard of 100 pounds, and a minimum cement content per cubic yard of 600 pounds. The proposed mix for Class 4000D shall provide a minimum fly ash or ground granulated blast furnace slag content per cubic yard of 75 pounds, and a minimum cement content per cubic yard of 660 pounds. All other~~

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~~concrete mix designs, except those for lean concrete and commercial concrete, shall have a minimum cementitious material content of 564 pounds per cubic yard of concrete.~~

The Contractor's submittal of a mix design shall be on WSDOT form 350-040 and shall provide a unique identification for each mix design and shall include the mix proportions per cubic yard, the proposed sources, the average 28-day compressive strength for which the mix is designed, the fineness modulus, and the water cement ratio. Concrete placeability, workability, and strength shall be the responsibility of the Contractor. The Contractor shall notify the Engineer in writing of any mix design modifications.

Fine aggregate shall conform to Section 9-03.1(2) Class 1 or Class 2.

Coarse aggregate shall conform to Section 9-03. An alternate combined aggregate gradation conforming to Section 9-03.1(5) may also be used. The nominal maximum size aggregate for Class 4000P shall be ⅜-inch. The nominal maximum size aggregate for Class 4000D shall be 1-inch. The nominal maximum size aggregate for Class 4000A shall be 1-inch.
Nominal maximum size for concrete aggregate is defined as the smallest standard sieve opening through which the entire amount of the aggregate is permitted to pass.

Class 4000D and 4000P concrete shall include a water reducing admixture in the amount recommended by the manufacturer. A retarding admixture is required in concrete Class 4000P. Water reducing and retarding admixtures are optional for all other concrete classes.

A high-range water reducer (superplasticizer) may be used in all mix designs. Microsilica fume may be used in all mix designs. The use of a high-range water reducer or microsilica fume shall be submitted as a part of the Contractor's concrete mix design.

Air content shall be a minimum of 4.5-percent and a maximum of 7.5-percent for all concrete placed above the finished ground line.

Attachment 2
SCC Concrete for Precast Units

6-02 CONCRETE STRUCTURES

6-02.3 Construction Requirements

6-02.3(27) Concrete for Precast Units

Precast units shall not be removed from forms until the concrete has attained a minimum compressive strength of 70 percent of the specified design strength as verified by rebound number determined in accordance with WSDOT FOP for ASTM C 805. Type III portland cement is permitted to be used in precast concrete units.

Precast units shall not be shipped until the concrete has reached the specified design strength as determined by testing cylinders made from the same concrete as the precast units. The cylinders shall be made, handled, and stored in accordance with WSDOT FOP for AASHTO T 23 and compression tested in accordance with AASHTO Test Method T 22 and AASHTO Test Method T 231.

~~Self compacting concrete (SCC) may be used for precast concrete barrier covered under Section 6-10 and drainage items covered under Section 9-12. If self compacting concrete has been approved for use the requirements of Section 6-02.3(4)C consistency shall not apply. Self compacting concrete is concrete that is able to flow under its own weight and completely fill the formwork, even in the presence of dense reinforcement, without the need of any vibration, while maintaining homogeneity. When using SCC modified testing procedures for air content and compressive strength will be used. The modification shall be that molds will be filled completely in one continuous lift without any rodding, vibration, tamping or other consolidation methods other than lightly taping around the exterior of the mold with a rubber mallet to allow entrapped air bubbles to escape. In addition the fabricators QC testing shall include Slump Flow Test results, which do not indicate segregation. As part of the plants approval for use of SCC the plant fabricator shall cast one barrier, or drainage item and have that barrier or drainage item sawed in half for examination by the Contracting Agency to determine that segregation has not occurred.~~

6-02.3(27)A Use of Self Consolidating Concrete for Precast Units

~~Concrete Class ____~~Self Consolidating Concrete (SCC) is concrete that is able to flow under its own weight and completely fill the formwork without the need of any vibration while maintaining homogeneity, even in the presence of dense reinforcement. ~~Class ____~~SCC ~~concrete~~ shall be capable of flowing through the steel reinforcing bar cage without segregation or buildup of differential head inside or outside of the steel reinforcing bar cage.

~~Concrete Class ____~~SCC may be used for the following precast concrete structure elements:

1. Precast roof, wall and floor panels, and retaining wall panels in accordance with Section 6-02.3(28).
2. Precast reinforced concrete three sided structures in accordance with Section 6-02.3(28) as supplemented in the Special Provisions.
3. Precast concrete barrier in accordance with Section 6-10.3(1).
4. Precast concrete wall stem panels in accordance with Section 6-11.3(3).
5. Precast concrete noise barrier wall panels in accordance with Section 6-12.3(6).
6. Structural earth wall precast concrete facing panels in accordance with Section 6-13.3(4).
7. Precast drainage structure elements in accordance with Section 9-05.50.
8. Precast junction boxes, cable vaults, and pull boxes in accordance with Section 9-29.2.

6-02.3(27)B Submittals for Self Consolidating Concrete for Precast Units

With the exception of items 3, 7, and 8 in section 6-02.3(27)A , ~~T~~the Contractor shall submit the mix design for ~~Class ____~~SCC ~~concrete~~ to the Engineer for annual approval in accordance with Section ~~6-02.3(2)A~~ 6-02.3(28)B ~~at least 30 calendar days prior to beginning related construction operations~~. The mix design submittal shall include items specified in Section 6-02.3(2)A and results of the following tests conducted on concrete that has slump flow within the slump flow range defined below:

1. Slump Flow.
   a. The mix design shall specify the target slump flow in inches, in accordance with WSDOT FOP for ASTM C 1611. The slump flow range is defined as the target slump flow plus or minus 2-inches.
   b. The visual stability index (VSI) shall be less than or equal to 1.5, in accordance with ASTM C 1611, Appendix X1, using Filling Procedure B.
   c. The T_{60} flow rate results shall be less than 6-seconds in accordance with ASTM C 1611, Appendix X1, using Filling Procedure B.
2. Column Segregation.
   a. The maximum static segregation shall be 10-percent in accordance with ASTM C 1610.
   b. The Maximum Hardened Visual Stability Index (HVSI) shall be 1 in accordance with AASHTO PP 58.

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3. J ring test results for passing ability shall be less than or equal to 1.5-inches in accordance with the WSDOT FOP for ASTM C 1621.
4. Air content shall be tested in accordance with WSDOT Test Method T 818, and shall conform to Section 6-02.3(2)A.
5. Concrete unit weight results in pounds per cubic foot shall be recorded in accordance with AASHTO T 121, except that the concrete shall not be consolidated in the test mold.
6. The temperature of all concrete laboratory test samples shall be tested in accordance with AASHTO T 309 and shall conform to the placement limits specified in Section 6-02.3(4)D.
7. The modulus of elasticity in pounds per square inch at 28 days shall be recorded in accordance with ASTM C 469.

~~The use of a viscosity modifying admixture (VMA) is permitted in accordance with the recommendations of the VMA manufacturer. The VMA shall conform to the Section 9-23.6(9) requirements for Type S specific performance admixtures.~~

Use of Type III cement is permitted.

~~The Contractor shall submit a plan for placing Class ____SCC concrete for construction operations to the Engineer for approval.~~ Placement for construction may include ~~minimal~~ consolidation, but the requirements of Section 6-02.3(4)C for consistency will not apply.

Items 3, 7, and 8 in Section 6-02.3(27)A require the precast plant to cast one of each type of structure and have the structure sawn in half for examination by the Contracting Agency to determine that segregation has not occurred. The Contracting Agencies approval of the sawn structure will constitute approval of the precast plant to use SCC ~~Concrete~~ and a concrete ~~. M~~mix design submittal~~s~~ is~~are~~ not required.

6-02.3(27)C Acceptance Testing of Self Consolidating Concrete for Precast Units

Acceptance testing shall be performed by the Contractor and test results shall be submitted to the Engineer.. ~~Sampling shall be in accordance with the procedures established by the precast fabrication facility's annual precast plant review and approval process.~~ Placement of ~~Class ____~~SCC for concrete testing such as cylinder preparation shall be in accordance with WSDOT Test Method T 819~~, which removes all vibration or rodding for consolidation~~. ~~Testing results shall be submitted to the Engineer.~~

~~As part of the plant's approval for use of Class ____SCC concrete the fabricating plant shall cast one precast concrete structure element item for each type of precast concrete structure element specified in the list above and fabricated under this Contract, and shall have that precast concrete structure element item sawn in half for examination by the Contracting Agency to confirm that segregation has not occurred.~~

~~Concrete Class ____~~SCC for items 1,2 4, 5, and 6 in section 6-02.3(27)A will be accepted in accordance with Section 6-02.3(5) procedures, and based on conformance to the requirements specified above and in Section 6-02.3(2)A, for the following:

1. Temperature.
2. Air content.
3. Compressive strength at 28-days.
4. Slump flow within the target slump flow range.
5. J ring ~~P~~passing ability less than or equal to 1.5-inches.

VSI less than or equal to 1.

~~Concrete Class ____~~SCC for concrete barrier will be accepted in accordance with temperature, air, and compressive strength testing listed above.

~~Concrete Class ____~~SCC for precast junction boxes, cable vaults, and pull boxes will be accepted in accordance with temperature and compressive strength testing listed above.

~~Concrete Class ____~~SCC for precast drainage structure elements will be accepted in accordance with the requirements of AASHTO M 199.

6-02.3(28) Precast Concrete Panels

The Contractor shall perform quality control inspection. The manufacturing plant for precast concrete units shall be certified by the Precast/Prestressed Concrete Institute's Plant Certification Program for the type of precast member to be produced, or the National Precast Concrete Association's Plant Certification Program or be an International Congress Building Officials or International Code Council Evaluation Services recognized fabricator of structural precast concrete products, and shall be approved by WSDOT as a Certified Precast Concrete Fabricator prior to the start of production. WSDOT Certification will be granted at, and renewed during, the annual precast plant review and

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approval process. Products that shall conform to this requirement include noise barrier panels, wall panels, floor and roof panels, marine pier deck panels, retaining walls, pier caps, and bridge deck panels. Precast concrete units that are prestressed shall meet all the requirements of Section 6-02.3(25).

The Contracting Agency intends to perform Quality Assurance Inspection. By its inspection, the Contracting Agency intends only to facilitate the work and verify the quality of that work. This inspection shall not relieve the Contractor of any responsibility for identifying and replacing defective material and workmanship.

Prior to the start of production of the precast concrete units, the Contractor shall advise the Engineer of the production schedule. The Contractor shall give the Inspector safe and free access to the work. If the Inspector observes any nonspecification work or unacceptable quality control practices, the Inspector will advise the plant manager. If the corrective action is not acceptable to the Engineer, the unit(s) will be rejected.

6-02.3(28)A Shop Drawings

Before casting the structural elements, the Contractor shall submit:

1. Seven sets of shop drawings for approval by the Department of Transportation Bridge and Structures Engineer, Construction Support, addressed as follows:

   If sent via US Postal Service,
   Washington State Department of Transportation
   Bridge and Structures Engineer, Construction Support
   P. O. Box 47340
   Olympia, WA 98504-7340
   If sent via FedEx,
   Washington State Department of Transportation
   Bridge and Structures Engineer, Construction Support
   7345 Linderson Way SW
   Tumwater, WA 98501-6504; and

2. Two sets of shop drawings to the Project Engineer.

These shop drawings shall show complete details of the methods, materials, and equipment the Contractor proposes to use in prestressing/precasting work. The shop drawings shall follow the design conditions shown in the Plans unless the Engineer approves equally effective variations.

The shop drawings shall contain as a minimum:

1. Unit shapes (elevations and sections) and dimensions.
2. Finishes and method of constructing the finish (i.e., forming, rolling, etc.).
3. Reinforcing, joint, and connection details.
4. Lifting, bracing, and erection inserts.
5. Locations and details of hardware attached to the structure.
6. Relationship to adjacent material.

Approval of these shop drawings shall not relieve the Contractor of responsibility for accuracy of the drawings or conformity with the Contract. Approval will not indicate a check on dimensions.

The Contractor may deviate from the approved shop drawings only after obtaining the Engineer's approval of a written request that describes the proposed changes. Approval of a change in method, material, or equipment shall not relieve the Contractor of any responsibility for completing the work successfully.

Before completion of the Contract, the Contractor shall provide the Engineer with reproducible originals of the shop drawings (and any approved changes). These shall be clear, suitable for microfilming, and on permanent sheets that conform with the size requirements of Section 6-01.9.

6-02.3(28)B Casting

Before casting precast concrete units, the Contractor and Fabrication Inspector shall have possession of an approved set of shop drawings.

Concrete shall meet requirements of Section 6-02.3(25)B for annual pre-approval of the concrete mix design, and slump~~, except that if the Contractor elects to use Class ____SCC concrete for precast roof, wall and floor panels and retaining wall panels in accordance with Section 6-02.3(27)~~. If ~~A~~SCC is used~~,~~ the concrete shall conform to Sections 6-02.3(27)B and 6-02.3(27)C.

Precast units shall not be removed from forms until the concrete has attained a minimum compressive strength of 70 percent of the specified design strength. A minimum compressive strength at other than 70 percent may be used for specific precast units if the fabricator requests and receives approval as part of the WSDOT plant certification process.

Forms may be steel or plywood faced, providing they impart the required finish to the concrete.

6-02.3(28)C Curing

Concrete in the precast units shall be cured by either moist or accelerated curing methods. The methods to be used shall be preapproved in the WSDOT plant certification process.

1. For moist curing, the surface of the concrete shall be kept covered or moist until such time as the compressive strength of the concrete reaches the strength specified for stripping. Exposed surfaces shall be kept continually moist by fogging, spraying, or covering with moist burlap or cotton mats. Moist curing shall commence as soon as possible following completion of surface finishing.
2. For accelerated curing, heat shall be applied at a controlled rate following the initial set of concrete in combination with an effective method of supplying or retaining moisture. Moisture may be applied by a cover of moist burlap, cotton matting, or other effective means. Moisture may be retained by covering the unit with an impermeable sheet.

Heat may be radiant, convection, conducted steam or hot air. Heat the concrete to no more than 100ºF during the first two hours after pouring the concrete, and then increase no more than 25ºF per hour to a maximum of 175ºF. After curing is complete, cool the concrete no more than 25ºF per hour to 100ºF. Maintain the concrete temperature above 60ºF until the unit reaches stripping strength.

Concrete temperature shall be monitored by means of a thermocouple embedded in the concrete (linked with a thermometer accurate to plus or minus 5ºF). The recording sensor (accurate to plus or minus 5ºF) shall be arranged and calibrated to continuously record, date, and identify concrete temperature throughout the heating cycle. This temperature record shall be made available to the Engineer for inspection and become a part of the documentation required.

The Contractor shall never allow dry heat to directly touch exposed unit surfaces at any point.

6-02.3(28)D Contractors Control Strength

The concrete strength at stripping and the verification of design strength shall be determined by testing cylinders made from the same concrete as the precast units. The cylinders shall be made, handled, and stored in accordance with WSDOT FOP for AASHTO T 23 and compression tested in accordance with AASHTO Test Method T 22 and AASHTO Test Method T 231.

For accelerated cured units, concrete strength shall be measured on test cylinders cast from the same concrete as that in the unit. These cylinders shall be cured under time-temperature relationships and conditions that simulate those of the unit. If the forms are heated by steam or hot air, test cylinders will remain in the coolest zone throughout curing. If forms are heated another way, the Contractor shall provide a record of the curing time-temperature relationship for the cylinders for each unit to the Engineer. When two or more units are cast in a continuous line and in a continuous pour, a single set of test cylinders may represent all units provided the Contractor demonstrates uniformity of casting and curing to the satisfaction of the Engineer.

The Contractor shall mold, cure, and test enough of these cylinders to satisfy specification requirements for measuring concrete strength. The Contractor may use 4-inch by 8-inch or 6-inch by 12-inch cylinders. The Contractor shall let cylinders cool for at least one-half hour before testing for release strength.

Test cylinders may be cured in a moist room or water tank in accordance with WSDOT FOP for AASHTO T-23 after the unit concrete has obtained the required release strength. If, however, the Contractor intends to ship the unit prior to standard 28-day strength test, the design strength for shipping shall be determined from cylinders placed with the unit and cured under the same conditions as the unit. These cylinders may be placed in a noninsulated, moisture-proof envelope.

To measure concrete strength in the precast unit, the Contractor shall randomly select two test cylinders and average their compressive strengths. The compressive strength in either cylinder shall not fall more than 5 percent below the specified strength. If these two cylinders do not pass the test, two other cylinders shall be selected and tested.

6-02.3(28)E Finishing

The Contractor shall provide a finish on all relevant concrete surfaces as defined in Section 6-02.3(14), unless the Plans or Special Provisions require otherwise.

6-02.3(28)F Tolerances

The units shall be fabricated as shown in the Plans, and shall meet the dimensional tolerances listed in the latest edition of PCI MNL-135, unless otherwise required by the Plans or Special Provisions.

6-02.3(28)G Handling and Storage

The Contractor shall lift all units only by adequate devices at locations designated on the shop drawings. When these devices and locations are not shown in the Plans, Section 6-02.3(25)L shall apply.

Precast units shall be stored off the ground on foundations suitable to prevent differential settlement or twisting of the units. Stacked units shall be separated and supported by dunnage of uniform thickness capable of supporting the units. Dunnage shall be arranged in vertical planes. The upper units of a stacked tier shall not be used as storage areas for shorter units unless substantiated by engineering analysis and approved by the Engineer.

6-02.3(28)H Shipping

Precast units shall not be shipped until the concrete has reached the specified design strength, and the Engineer has reviewed the fabrication documentation for contract compliance and stamped the precast concrete units " Approved for Shipment". The units shall be supported in such a manner that they will not be damaged by anticipated impact on their dead load. Sufficient padding material shall be provided between tie chains and cables to prevent chipping or spalling of the concrete.

6-02.3(28)I Erection

When the precast units arrive on the project, the Project Engineer will confirm that they are stamped "Approved for Shipment." The Project Engineer will evaluate the present units for damage before accepting them.

The Contractor shall lift all units by suitable devices at locations designated on the shop drawings. Temporary shoring or bracing shall be provided, if necessary. Units shall be properly aligned and leveled as required by the Plans. Variations between adjacent units shall be leveled out by a method approved by the Engineer.

6-10 CONCRETE BARRIER

6-10.3 Construction Requirements

6-10.3(1) Precast Concrete Barrier

The fabrication plant for precast concrete barriers shall be approved by Contracting Agency prior to the use of barrier and the plant shall perform quality control testing and inspection on all barrier used by the Contracting Agency. The Contractor shall advise the Engineer of the production schedule for the fabrication of barrier.

Test results from the fabricators QC testing shall demonstrate compliance with sections 6-02.3(4)C consistency, 6-02.3(4)D temperature and time of placement, 6-02.3(2)A air content, and compressive strength. All tests will be conducted per section 6-02.3(5)D.

~~If self-compacting concrete (SCC) has been approved for use the requirements of Section 6-02.3(4)C consistency shall not apply. Self-compacting concrete (SCC) is concrete that is able to flow under its own weight and completely fill the formwork, even in the presence of dense reinforcement, without the need of any vibration, while maintaining homogeneity. When using SCC modified testing procedures for air content and compressive strength will be used. The modification shall be that molds will be filled completely in one continuous lift with out any rodding, vibration, tamping or other consolidation methods other than lightly taping around the exterior of the mold with a rubber mallet to allow entrapped air bubbles to escape. In addition the fabricators QC testing shall include Slump Flow Test results that do not indicate segregation. As part of the plants approval for use of SCC the plant fabricator shall cast one barrier and have that barrier sawed in half for examination by the Contracting Agency to ensure that segregation has not occurred.~~

The fabricators QC tester conducting the sampling and testing shall be qualified by ACI, Grade I to perform this work. The equipment used shall be calibrated/certified annually.

All test results and certifications shall be kept at the fabricator's facility for review by the Contracting Agency.

The Contracting Agency intends to perform Quality Assurance Inspection. This inspection is for the qualification of the plant QC process. This inspection shall not relieve the Contractor of any responsibility for identifying and replacing defective material and workmanship.

The concrete in precast barrier shall be Class 4000 and comply with the provisions of Section 6-02.3. If Self Consolidating Concrete is used the concrete shall conform to Sections 6-02.3(27)B and 6-02.3(27)C.

~~, except that if the Contractor elects to use Class ____SCC concrete for precast concrete barrier in accordance with Section 6-02.3(27)A, the concrete and precast plant shall conform to Sections 6-02.3(27)B and 6-02.3(27)C.~~ No concrete barrier shall be shipped until test cylinders made of the same concrete and cured under the same conditions show the concrete has reached 4000 psi.

The Contractor may use Type III Portland cement, but shall bear any added cost.

Precast barrier shall be cast in steel forms. After release, the barrier shall be finished to an even, smooth, dense surface, free from any rock pockets or holes larger than $^1/_4$-inch across. Troweling shall remove all projecting concrete from the bearing surface.

Precast concrete barrier shall be cured in accordance with Section 6-02.3(25)D except that the barrier shall be cured in the forms until a rebound number test, or test cylinders which have been cured under the same conditions as the barrier, indicate the concrete has reached a compressive strength of a least 2500 psi. No additional curing is required once the barrier is removed from the forms.

The barrier shall be precast in sections as the Standard Plans require. All barrier in the same project (except end sections and variable length units needed for closure) shall be the same length. All barrier shall be new and unused. It shall be true to plan dimensions. The manufacturer shall be responsible for any damage or distortion that results from manufacturing.

Only one section less than 20-feet long for single slope barrier and 10-feet long for all other barriers may be used in any single run of precast barrier, and it must be at least 8-feet long. It may be precast or cast-in-place. Hardware identical to that used with other sections shall interlock such a section with adjacent precast sections.

Barrier connection voids for permanent installations of precast single slope barrier shall be filled with grout.

6-11 REINFORCED CONCRETE WALLS

6-11.3 Construction Requirements

6-11.3(3) Precast Concrete Wall Stem Panels

The Contractor may fabricate precast concrete wall stem panels for construction of Standard Plan Retaining Walls. Precast concrete wall stem panels may be used for construction of non-Standard Plan retaining walls if allowed by the Plans or Special Provisions. Precast concrete wall stem panels shall conform to Section 6-02.3(28), and shall be cast with Class 4000 concrete. If Self Consolidating Concrete is used the concrete shall conform to Sections 6-02.3(27)B and 6-02.3(27)C.

~~, except that if the Contractor elects to use Class ____SCC concrete for precast concrete wall stem panels in accordance with Section 6-02.3(27)A, the concrete shall conform to Sections 6-02.3(27)B and 6-02.3(27)C~~.

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The precast concrete wall stem panels shall be designed in accordance with the following codes:

1. For all loads except as otherwise noted - AASHTO LRFD Bridge Design Specifications, latest edition and current interims. The seismic design shall use the acceleration coefficient and soil profile type as specified in the Plans.
2. For all wind loads - AASHTO Guide Specifications for Structural Design of Sound Barriers, latest edition and current interims.

The precast concrete wall stem panels shall be fabricated in accordance with the dimensions and details shown in the Plans, except as modified in the shop drawings as approved by the Engineer.

The precast concrete wall stem panels shall be fabricated full height, and shall be fabricated in widths of 8 feet, 16 feet, and 24 feet.

The construction tolerances for the precast concrete wall stem panels shall be as follows:

Height	±1/4	inch
Width	±1/4	inch
Thickness	+1/4	inch
	-1/8	inch
Concrete cover for steel reinforcing bar	+3/8	inch
	-1/8	inch
Width of precast concrete wall stem panel joints	±1/4	inch
Offset of precast concrete wall stem panels (Deviation from a straight line extending 5 feet on each side of the panel joint)	±1/4	inch

The precast concrete wall stem panels shall be constructed with a mating shear key between adjacent panels. The shear key shall have beveled corners and shall be 1-1/2 inches in thickness. The width of the shear key shall be 3-1/2 inches minimum and 5-1/2 inches maximum. The shear key shall be continuous and shall be of uniform width over the entire height of the wall stem.

The Contractor shall provide the specified surface finish as noted, and to the limits shown, in the Plans to the exterior concrete surfaces. Special surface finishes achieved with form liners shall conform to Sections 6-02.2 and 6-02.3(14) as supplemented in the Special Provisions. Rolled on textured finished shall not be used. Precast concrete wall stem panels shall be cast in a vertical position if the Plans call for a form liner texture on both sides of the wall stem panel.

The precast concrete wall stem panel shall be rigidly held in place during placement and curing of the footing concrete.

The precast concrete wall stem panels shall be placed a minimum of one inch into the footing to provide a shear key. The base of the precast concrete wall stem panel shall be sloped ½ inch per foot to facilitate proper concrete placement.

To ensure an even flow of concrete under and against the base of the wall panel, a form shall be placed parallel to the precast concrete wall stem panel, above the footing, to allow a minimum one foot head to develop in the concrete during concrete placement.

The steel reinforcing bars shall be shifted to clear the erection blockouts in the precast concrete wall stem panel by 1-1/2 inches minimum.

All precast concrete wall stem panel joints shall be constructed with joint filler installed on the rear (backfill) side of the wall. The joint filler material shall extend from two feet below the final ground level in front of the wall to the

top of the wall. The joint filler shall be a nonorganic flexible material and shall be installed to create a waterproof seal at panel joints.

The soil bearing pressure beneath the falsework supports for the precast concrete wall stem panels shall not exceed the maximum design soil pressure shown in the Plans for the retaining wall.

6-12 NOISE BARRIER WALLS

6-12.3 Construction Requirements

6-12.3(6) Precast Concrete Panel Fabrication and Erection

The Contractor shall fabricate and erect the precast concrete panels in accordance with Section 6-02.3(28), and the following requirements:

1. Concrete shall conform to Class 4000. If Self Consolidating Concrete is used the concrete shall conform to Sections 6-02.3(27)B and 6-02.3(27)C.

~~, except that if the Contractor elects to use Class ____SCC concrete for precast concrete noise barrier wall panels in accordance with Section 6-02.3(27)A, the concrete shall conform to Sections 6-02.3(27)B and 6-02.3(27)C~~.

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2. Except as otherwise noted in the Plans and Special Provisions, all concrete surfaces shall receive a Class 2 finish in accordance with Section 6-02.3(14)B.
3. The precast concrete panels shall be cast in accordance with Section 6-02.3(28)B. The Contractor shall cast the precast concrete panels horizontally. The Contractor shall fully support the precast concrete panel to avoid bowing and sagging surfaces.

   After receiving the Engineer's approval of the shop drawings, the Contractor shall cast one precast concrete panel to be used as the sample panel. The Contractor shall construct the sample panel in accordance with the procedure and details specified in the shop drawings approved by the Engineer. The Contractor shall make the sample panel available to the Engineer for approval.

   Upon receiving the Engineer's approval of the sample panel, the Contractor shall continue production of precast concrete panels for the noise barrier wall. All precast concrete panels will be evaluated against the sample panel for the quality of workmanship exhibited. The sample panel shall be retained at the fabrication site until all precast concrete panels have been fabricated and have received the Engineer's approval. After completing precast concrete panel fabrication, the Contractor may utilize the sample panel as a production noise barrier wall panel.
4. In addition to the fabrication tolerance requirements of Section 6-02.3(28)F, the precast concrete panels for noise barrier walls shall not exceed the following scalar tolerances:

   Length and Width: $\pm$ $^1/_8$-inch per five feet, not to exceed $^1/_4$-inch total.

   Thickness: $\pm$ $^1/_4$-inch.

   The difference obtained by comparing the measurement of the diagonal of the face of the panels shall not be greater than $^1/_2$-inch.

   Dimension tolerances for the traffic barrier portion of precast concrete panels formed with traffic barrier shapes shall conform to Section 6-10.3(2).
5. Precast concrete panels shall not be erected until the foundations for the panels have attained a minimum compressive strength of 3,400 psi.
6. The bolts connecting the precast concrete panels to their foundation shall be tightened to "snug-tight" as defined in Section 6-03.3(32).
7. After erection, the precast concrete panels shall not exceed the joint space tolerances shown in the Plans. The panels shall not exceed $^3/_8$-inch out of plumb in any direction.

   The Contractor shall seal the joints between precast concrete panels with a backer rod and sealant system as specified. The Contractor shall seal both sides of the joint full length.

The top of precast concrete panels shall conform to the top of wall profile shown in the Plans. Where a vertical step is constructed to provide elevation change between adjacent panels, the dimension of the step shall be 2-feet. Each horizontal run between steps shall be a minimum of 48-feet.

6-13 STRUCTURAL EARTH WALLS

6-13.3 Construction Requirements

6-13.3(4) Precast Concrete Facing Panel and Concrete Block Fabrication

Concrete for precast concrete facing panels shall meet the following requirements:

1. Have a minimum 28 day compressive strength of 4,000 pounds per square inch, unless otherwise specified in the Special Provisions for specific proprietary wall systems. If Self Consolidating Concrete is used the concrete shall conform to Sections 6-02.3(27)B and 6-02.3(27)C.

~~. If the Contractor elects to use Class ____SCC concrete for structural earth wall precast concrete facing panels in accordance with Section 6-02.3(27)A, the concrete shall conform to Sections 6-02.3(27)B and 6-02.3(27)C~~.

2. Contain a water-reducing admixture meeting AASHTO M 194 Type A, D, F, or G.
3. Be air-entrained, 6 percent $\pm$ $1^1/_2$ percent.
4. Have a maximum slump of four inches, or six inches if a Type F or G water reducer is used.

Concrete for dry cast concrete blocks shall meet the following requirements:

1. Have a minimum 28 day compressive strength of 4,000 psi.
2. Conform to ASTM C 1372, except as otherwise specified.
3. The lot of blocks produced for use in this project shall conform to the following freeze-thaw test requirements when tested in accordance with ASTM C 1262. Minimum acceptable performance shall be defined as weight loss at the conclusion of 150 freeze-thaw cycles not exceeding one percent of the block's initial weight for a minimum of four of the five block specimens tested.
4. The concrete blocks shall have a maximum water absorption of one percent above the water absorption content of the lot of blocks produced and successfully tested for the freeze-thaw test specified in item 3 above.

Precast concrete facing panels and concrete blocks will be accepted based on successful compressive strength tests, WSDOT "Approved for Shipment" stamp or tag, and visual inspection at the jobsite. The precast concrete facing panels and concrete blocks shall be considered acceptable regardless of curing age when compressive test results indicate that the compressive strength conforms to the 28-day requirements and when the visual inspection is satisfactorily completed. Fabrication of precast concrete facing panels and blocks shall conform to Section 6-02.3(28). Testing of dry cast concrete blocks shall conform to ASTM C 140.

All precast concrete facing panels shall be five feet square, except:

1. for partial panels at the top, bottom, and ends of the wall, and
2. as otherwise shown in the Plans.

All precast concrete facing panels shall be manufactured within the following tolerances:

1. All dimensions $\pm$ $^3/_{16}$-inch.
2. Squareness, as determined by the difference between the two diagonals, shall not exceed $^1/_2$-inch.
3. Surface defects on smooth formed surfaces measured on a length of 5-feet shall not exceed $^1/_8$-inch. Surface defects on textured-finished surfaces measured on a length of five feet shall not exceed $^5/_{16}$-inch.

All concrete blocks shall be manufactured within the following tolerances:

1. Vertical dimensions shall be $\pm$ $^1/_{16}$-inch of the plan dimension, and the rear height shall not exceed the front height.
2. The dimensions of the grooves in the top and bottom faces of the concrete blocks shall be formed within the tolerances specified by the proprietary wall manufacturer, for the fit required for the block connectors.
3. All other dimensions shall be $\pm$ $^1/_4$-inch of the plan dimension.

Tie attachment devices, except for geosynthetic reinforcement, shall be set in place to the dimensions and tolerances shown in the Plans prior to casting.

The forms forming precast concrete facing panels, including the forms for loop pockets and access pockets, and the forms forming the concrete blocks, shall be removed in accordance with the recommendations of the wall manufacturer, without damaging the concrete.

The concrete surface for the precast concrete facing panel shall have the finish shown in the Plans for the front face and an unformed finish for the rear face. The rear face of the precast concrete facing panel shall be roughly screeded to eliminate open pockets of aggregate and surface distortions in excess of $^1/_4$-inch.

The concrete surface for the front face of the concrete block shall be flat, and shall be a conventional "split face" finish in accordance with the wall manufacturer's specifications. The concrete surface of all other faces shall be Class 2 in accordance with Section 6-02.3(14)B. The finish and appearance of the concrete blocks shall also conform to ASTM C 1372. The color of the concrete block shall be concrete gray, unless otherwise shown in the Plans.

The date of manufacture, production lot number, and the piece-mark, shall be clearly marked on the rear face of each precast concrete facing panel, and marked or tagged on each pallet of concrete blocks.

All precast concrete facing panels and concrete blocks shall be handled, stored, and shipped in accordance with Sections 6-02.3(28)G and 6-02.3(28)H to prevent chipping, cracks, fractures, and excessive bending stresses.

Precast concrete facing panels in storage shall be supported on firm blocking located immediately adjacent to tie strips to avoid bending the tie strips.

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