S T A T E **O F** **T E N N E S S E E**

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(Rev. 5-13-19)

Supplemental Specifications - Section 600

of the

Standard Specifications for Road and Bridge Construction

January 1, 2015

Subsection 602.17 (pg.459-477), 12-2-16; Entire Subsection: Replace all references to AASHTO M164 and AASHTO M253 with ASTM F3125, Grade A325 and A490

Subsection 602.17 (pg. 459) 12-2-16; modify the first paragraph of A.:

> "All high strength bolts, or equivalent fasteners, tightened to a high tension shall be coated with permitted coatings in accordance with ASTM F3125 for their respective grade. Use the bolts in holes conforming to 602.06, 602.07, and 602.08. All Grade A325 and A490 bolts, except Type 3 bolts used in weathering steel, shall be coated. Permitted coatings for Grade A325 and Grade A490 bolts are listed in ASTM F3125, Annex A1."

Subsection 602.17 (pg. 465–469), 12-2-16; Update Tables:

Bolt Diameter (inches)	Bolt Tension (pounds)	
	(GradeA325)	GradeA490 Bolts
½	12,000	15,000
5/8	19,000	24,000
¾	28,000	35,000
7/8	39,000	49,000
1	51,000	64,000
1-1/8	64,000	80,000
1-1/4	81,000	102,000
1-3/8	97,000	121,000
1-1/2	118,000	148,000

(1) Equal to 70% of the specified minimum tensile strength of bolts.

Table 602.17-1: Minimum Bolt Tension [1]

Bolt Diameter (inches)	Grade A325 Snug Tension (kips)	Grade A490 Snug Tension (kips)
½	1	1
5/8	2	2
¾	3	4
7/8	4	5
1	5	6
1-1/8	6	8
1-1/4	8	10
1-3/8	10	12
1-1/2	12	15

Table 602.17-3: Minimum Installation Tension

Bolt Diameter (inches)	Grade A325 Tension (kips)	Grade A490 Tension (kips)
1/2	12	15
5/8	19	24
3/4	28	35
7/8	39	49
1	51	64
1-1/8	64	80
1-1/4	81	102
1-3/8	97	121
1-1/2	118	148

Table 602.17-4: Rotation from Snug Condition

Bolt Length (measured in Step 1)	Grade A325 Required Rotation	Grade A490 Required Rotation
Up to and including 4 diameters	2/3	2/3
Over 4 diameters, but not exceeding 8 diameters	1	5/6
Over 8 diameters to 12 diameters	1-1/6	1

Table 602.17-5: Turn Test Tension

Bolt Diameter (inches)	Grade A325 Tension (kips)	Grade A490 Tension (kips)
1/2	14	17
5/8	22	28
3/4	32	40
7/8	45	56
1	59	74
1-1/8	74	92
1-1/4	94	117
1-3/8	112	139
1-1/2	136	170

Table 602.17-6

Bolt Length (measured in Step 1)	Required Rotation (All Grades)
Up to and including 4 diameters	1/3
Over 4 diameters, but not exceeding 8 diameters	½

Table 602.17-7

Bolt Diameter (inches)	Grade A325 Torque (ft-lbs)	Grade A490 Torque (ft-lbs)
1/2	150	180
5/8	290	370
3/4	500	630
7/8	820	1020
1	1,230	1540
1-1/8	1,730	2160
1-1/4	2,450	3050
1-3/8	3,210	3980
1-1/2	4,250	5310

Table 602.17-8

Bolt Length (measured in Step 1)	Additional Required Rotation Grade A325	Additional Required Rotation Grade A490
Up to and including 4 diameters	1/3	¼
Over 4 diameters, but not exceeding 8 diameters	1/2	1/3

Table 602.17-9: DTI Requirements for A325 Bolts

Bolt Diameter (inches)	Verification Tension (kips)	Maximum Verification Refusals	DTI Spaces	Minimum Installation Refusals
½	13	1	4	2
5/8	20	1	4	2
¾	29	2	5	3
7/8	41	2	5	3
1	54	2	6	3
1-1/8	67	2	6	3
1-1/4	85	3	7	4
1-3/8	102	3	7	4
1-1/2	124	3	8	4

Table 602.17-11

Bolt Diameter (inches)	Bolt Tension (kips)	
	AASHTO M 164 Bolts (ASTM A325)	ASTM A490 Bolts
1/2	13	16
5/8	20	25
3/4	29	37
7/8	41	51
1	54	67
1-1/8	67	84
1-1/4	85	107
1-3/8	102	127
1-1/2	124	155

Table 602.17-12

Bolt Diameter (inches)	Number of Spaces	
	Bolts (GradeA325)	Grade A490 Bolts
1/2	4	N/A
5/8	4	N/A
3/4	5	6
7/8	5	6
1	6	7
1-1/8	6	7
1-1/4	7	8
1-3/8	7	8
1-1/2	8	N/A

Subsection 602.19 (pg. 478), 6-27-16; add the following as the 2nd paragraph:

"All welders shall be qualified in accordance with the AASHTO/AWS D1.5, Bridge Welding Code, current edition. Welders shall be certified for each weld process and position which they will be using."

Subsection 602.39 (pg.488), 6-27-16; revise the title as follows:

"CONSTRUCTION REQUIREMENTS – ERECTION – REMOVAL"

Subsection 602.42 (pg.489), 6-27-16; revise as follows:

"All contractors and subcontractors directly engaged in the erection or removal of structural steel, precast prestressed or mild steel reinforced concrete bridge beams or girders over active highway traffic lanes, on any route, railroad or any stream deemed navigable to commercial or pleasure water craft, shall submit an erection or removal plan prepared and stamped by a Professional Engineer licensed in the State of Tennessee. Include the following in these plans: the sequences of erection or removal, the generalized location of all pick points, and the plan to adequately stabilize the structure throughout the erection or removal process. Submit this plan to the Engineer at least 30 days before starting erection. At each stopping point in the erection or removal sequence, have a competent contractor's representative inspect the beams to ensure adequate stability.

Do not begin any erection or removal work without the Engineer's approval. The Engineer's approval does not relieve the Contractor of the responsibility for the safety of its method or equipment or from carrying out the work in accordance with the Plans and Specifications."

Subsection 604.02 (pg. 517-518), 5-15-17; A. General, add Class DS Concrete to the index:

604.02 Materials

A. General

Provide materials as specified in:

Hydraulic cement[1] **901.01**
Fine Aggregate, (all Classes of concrete)..... **903.01**
Coarse Aggregate
For Class A Concrete: Size No. 57 ..... **903.03**
For Class D Concrete: Size No. 57 ..... **903.03**
For Class DS Concrete: Size No. 57 ..... **903.03**
For Class L Concrete..... **903.19**
Joint Filler, Preformed Type **905.01**
Steel Bar Reinforcement **907.01**
Welded Steel Wire Fabric **907.03**
Structural Steel..... **908.01**
Permanent Steel Bridge Deck Forms **908.03**
Steel Castings..... **908.05**
Gray Iron Castings **908.07**
Bronze Bearing Plates, Plain..... **908.09**
Bronze Bearing Plates, Self-Lubricating..... **908.10**

[1]Use Type I, Type IL, or Type IS unless otherwise specified or permitted, or Type I or Type IL cement with either fly ash and/or ground granulated blast furnace slag as a partial cement replacement unless otherwise specified or permitted. When using Type I or Type IL cement with either fly ash and/or ground granulated blast furnace slag as a partial cement replacement, comply with the requirements of **604.03**.

Subsection 604.02 C. (pg. 519), 11-6-17; Precast Box Sections, remove mylar reference in second paragraph:

"Submit shop drawings of the proposed precast box section and design calculations for approval before construction. As a minimum, the shop drawings shall include a plan and elevation view of the box culvert showing all precast sections, a typical precast box section showing dimensions and reinforcing, and notes and details required for construction. After obtaining the necessary approval, furnish the Structures Division a reproducible design file. . The Department will pay the Contractor for the precast box based on the price bid for the quantity of the items in the cast-in-place structure it replaces. Manufacture the precast reinforced box sections in accordance with Departmental procedures."

Subsection 604.03 (pg. 519-525), 5-13-19; **Classification, Proportioning and Quality Assurance of Concrete:** Combined supplemental specifications from 5-15, 11-15, 12-16, 5-17, 11-17, and 5-18; Replace entire subsection with the following:

A. Classification and Proportioning and Quality Assurance

1a. Design and Production Parameters. Proportion the concrete based on a pre-determined minimum cement content, and a water-cement ratio that does not exceed the maximum shown in Table 604.03-1. Below this limit, adjust the quantity of water to meet the slump requirements. The fine aggregate shall not exceed 44% by volume calculation of the total aggregate, with the exception of slip formed Class A concrete incorporated into parapets and median barriers.

For slip formed parapet and median barriers exclusively, the percentages of fine and coarse aggregate in an approved concrete mix design may be adjusted plus or minus 2%, such that the maximum percent by volume of fine aggregate does not exceed 46%.

Document mixture adjustments in the field book and daily concrete report. Ensure that the adjusted mix complies with all of the performance criteria specified in Table 604.03-1.

Table 604.03-1: Composition of Various Classes of Concrete

Class of Concrete	Min 28-Day Compressive Strength (psi)	Min Cement Content (pound per cubic yard)	Maximum Water/Cement Ratio (pound/pound)	Air Content % (Design ± production tolerance)	Slump (inches)
A	3,000	564	0.45	6 ± 2	3 ± 1 [(1)]
D, DS[(2, 3)]	4,000	620	0.40	7 [(3)]	8 max [(4)]
L [(3, 5)]	4,000	620	0.40	7 [(3)]	8 max [(4)]
S (Seal) [(6)]	3,000	682	0.47	6 ± 2	6 ± 2
X [(7)]					

[(1)] For slip forming, the slump shall range from 0 to 3 inches.

[(2)] Use Class DS concrete in riding surfaces as described in 903.03 and in accordance to Specification 903.24 requirements. Use Class D concrete in all other bridge decks except box and slab type structures unless otherwise shown on the Plans.

[(3)] Design Class D, Class DS. and Class L concrete at 7% air content. Acceptance range for pumping and other methods of placement is 4.5-7.5%. Sampling will be at the truck chute.

[(4)] Water reducing admixtures are acceptable; however, do not exceed the maximum water/cement ratio in order to achieve the required slump.

[(5)] The unit weight of air dried Class L concrete (lightweight concrete) shall not exceed 115 pounds per cubic foot as determined according to ASTM C567.

[(6)] The use of fly ash as a cement replacement will be allowed in Class S (Seal) concrete.

[(7)] Plan specific requirements.

Include chemical admixtures in the concrete mixture as specified in Table 604.03-2 based on the ambient air temperature and expected weather conditions.

Table 604.03-2: Use of Chemical Admixtures

Class of Concrete	Temperature less than 85 °F and falling	Temperature 85 °F or greater and rising
A	Type A or F	Type D or G or A and B
D, DS	Type A or F	Type A or F and B or G
L	Type F	Type F and B or G
S	Type D or G or A and B	Type D or G or A and B

If using a Type A, F, or G water reducer, then the allowable slump shall be a maximum of 8 inches.

Admixtures to be incorporated into the concrete shall all be from the same manufacturer, shall be compatible, and shall be incorporated into the concrete in accordance with the manufacturer's recommendations.

The fine aggregate in all Class L concrete shall be natural sand meeting **903.01.**

Do not use fine aggregate manufactured from limestone or other polishing aggregates in concrete to be used as a riding surface in traffic lanes.

1b. Self-Consolidating Concrete (SCC) Design and Production Parameters.
Proportion the concrete based on a pre-determined minimum cement content, and a water-cement ratio that does not exceed the maximum shown in Table 604.03-4. The fine aggregate shall not exceed 50% by volume calculation of the total aggregate volume. Maximum size of coarse aggregate shall not exceed a No. 67 stone. The Contractor may elect to use SCC as an alternate/option in replacement of Class A concrete.

Document mixture adjustments in the field book and daily concrete report. Ensure that the adjusted mix complies with all of the performance criteria specified in Table 604.03-4.

Table 604.03-4: Composition of Self-Consolidating Concrete

Class of Concrete	Min 28-Day Compressive Strength (psi)	Min Cement Content (pound per cubic yard)	Maximum Water/Cement Ratio (pound/pound)	Air Content % (Design ± production tolerance)	Slump Flow (inches)
SCC (2,3,4,5)	3,000(1)	564	0.45	6 ± 2	26 ± 5
SH-SCC (2,3,4,5,6)	4,500	620	0.45	6 ± 2	26 ± 5

(1) Or as shown on the Plans or approved shop drawings.

(2) Acceptance range for the T50 test in accordance with ASTM C1611 shall be between 2-7 seconds.

(3) Passing ability in accordance with ASTM C1621 shall be less than 2 inches for acceptance.

(4) Visual Stability Index (VSI) shall not exceed 1.0 as per ASTM C1611 for acceptance.

(5) Static segregation as measured by ASTM C 1610 shall not exceed 20%.

(6) Air Content may be reduced if placed under water or underground if approved by the Engineer

Include chemical admixtures in the self-consolidating concrete mixture as specified in Table 604.03-5 based on the ambient air temperature and expected weather conditions. Approved viscosity modifying admixtures (VMA) may be used as part of the chemical admixtures if they are shown in the approved mixture design.

Table 604.03-5: Use of Chemical Admixtures

Class of Concrete	Temperature less than 85 °F and falling	Temperature 85 °F or greater and rising
SCC, SH-SCC	Type A or F Type S (Viscosity Modifying)	Type D or G or A and B Type S (Viscosity Modifying)

Dosage rates for any admixtures incorporated into the concrete shall be stated during the mix design submittal process. All admixtures shall be compatible and from the same manufacturer.

2. **Mix Design Submittal.** Submit the proposed concrete design to the Engineer for approval. Develop the design using saturated surface dry aggregate weights and trial batches meeting the requirements of these Specifications. The concrete design shall be prepared by a TDOT certified Class 3 concrete technician or approved independent testing laboratory under the direction of a registered civil engineer licensed by the State of Tennessee. The concrete plant technician or the civil engineer shall certify that the information contained on the design is correct and is the result of information gained from the trial batches. The concrete design shall produce an average compressive strength to indicate that the specified 28-day strength can be obtained in the field. Make all strength determinations using equipment meeting the requirements of, and in the manner prescribed by, AASHTO T 22. Provide concrete of the design strength specified in all applicable Special Provisions, Plans, and Standard Specifications. Build trial batches for design no more than 90 days before submitting the concrete design. The approved mix design will expire after 6 months if it is not used on a Department funded project and meet the minimum 28-day strength requirements. Assume responsibility for all costs of concrete design, preparation, and submittal.

   As a minimum, include the following information in the proposed concrete design submittal:

   1. Source of all aggregates
   2. Brand and type of cement
   3. Source and class of fly ash (if used)
   4. Source and grade of ground granulated blast furnace slag (if used)
   5. Specific gravity of cement
   6. Specific gravity of the fly ash (if used)
   7. Specific gravity of the ground granulated blast furnace slag (if used)
   8. Admixtures (if used)
   9. Gradations of aggregates
   10. Specific gravity of aggregates (saturated surface dry)
   11. Air content (if air entrainment is used)

12. Percentage of fine aggregate of the total aggregate (by volume)
13. Slump
14. Weight per cubic yard
15. Yield
16. Temperature of plastic concrete
17. Water/cement ratio (pound/pound)
18. 7-day compressive strength (minimum of two 4-inch x 8-inch cylinders)
19. 14-day compressive strength (minimum of two 4-inch x 8-inch cylinders)
20. 28-day compressive strength (minimum of two 4-inch x 8-inch cylinders)
21. Weight of each material required to produce a cubic yard of concrete
22. Water – submit testing results per Tables 921.01-1 & 921.01-2

In addition to the above mentioned items, for self-consolidating concrete include as a minimum the following information in the proposed SCC design submittal:

23. Slump flow, VSI, and T50, in accordance with ASTM C1611, shall be required in place of the slump test.
24. Passing ability in accordance with ASTM C1621.
25. Static segregation in accordance with ASTM C1610.
26. 7-day compressive strength (minimum of two 4-inch x 8-inch cylinders), in accordance with ASTM C1758.
27. 14-day compressive strength (minimum of two 4-inch x 8-inch cylinders), in accordance with ASTM C1758.
28. 28-day compressive strength (minimum of two 4-inch x 8-inch cylinders), in accordance with ASTM C1758.

Self-consolidating concrete (Classes SCC, SH-SCC and P-SCC) shall be verified prior to placement either at the ready mix facility or prestressed plant. The submitted mix design shall be reviewed by Headquarters Materials and Tests for specification compliance. The concrete producer shall then perform a trial batch verification of the submitted mix design in the presence of Regional Materials and Tests. The trial batch will ensure that all batch quantities and target admixture dosage rates are acceptable and meet TDOT specification prior to full mix design approval. If using a previously approved SCC design additional verification of the trial batch is not required. All quantities and identified admixture target dosage rates shall meet the tolerances specified in **501.09**

Instead of the above mix design submittal, an existing design may be submitted for approval provided the design has been used on a state funded project within the last six (6) months. When submitting for the use of an existing mix design, the most current water testing results per 921.01 shall accompany the submittal. The approval of this concrete design submittal will not relieve the Contractor of the responsibility of providing concrete meeting the requirements of these Specifications. A temporary mix design may be issued if the 7-day or 14-day compressive strengths exceed the required 28-day strengths."

If proposing to use materials or admixtures from sources other than those shown on the approved mix design, submit a written request to the Regional Materials and Tests Engineer explaining the necessity for the change, and include a new mix design developed in accordance with the above provisions. Do not place any concrete until the new design is approved.

3. **Partial Cement Replacement with Fly Ash or Ground Granulated Blast Furnace Slag.** Do not use concrete with fly ash or ground granulated blast furnace slag as a partial cement replacement in concrete when high early strength is specified.

When choosing to replace a portion of Type I or Type IL cement with fly ash or ground granulated blast furnace slag, ensure that the following requirements will be met before producing any concrete:

1. Store fly ash or ground granulated blast furnace slag in silos separate from each other and separate from the hydraulic cement.

2. Add the fly ash or ground granulated blast furnace slag to the concrete using methods and equipment that are approved by the Engineer and capable of uniformly distributing the materials throughout the mix.

3. The fly ash or ground granulated blast furnace slag may be weighed cumulatively in the weigh hopper with the cement, provided the cement is added first. The temperature of the fly ash or the ground granulated blast furnace slag shall not exceed 160 °F at the time of introduction to the mix.

When designing Portland cement concrete with Type I or Type IL cement modified by the addition of fly ash and/or ground granulated blast furnace slag, meet the maximum cement replacement rates (by weight) and minimum substitution ratios (by weight) specified in Table 604.03-3 for the applicable type of modifier.

Table 604.03-3: Type I or Type IL Cement Modified by Fly Ash or Ground Granulated Blast Furnace Slag (GGBFS)

Modifier	Maximum Cement Replacement Rate % (by weight)	Minimum Modifier Cement Substitution Rates (by weight)
GGBFS (grade 100 or 120)	35.0	1:1
Class "F" Fly Ash	25.0	1:1
Class "C" Fly Ash	25.0	1:1

The Contractor may use ternary cementitious mixtures (mixtures with Portland cement, ground granulated blast furnace slag, and fly ash) for Class A, Class D, and Class DS concrete provided that the minimum Portland cement content is 50%. The maximum amount of fly ash substitution in a ternary cementitious mixture shall be 20%. The Department will allow Type IS cement with ternary cementitious mixtures. When using a Type IS cement, do not use any additional slag as a partial replacement for the hydraulic cement.

B. Quality Control and Acceptance of Concrete

Meet the requirements of **501.03.B**.

In addition, the Department will require an approved concrete design for non-critical items involving small quantities of concrete, but may accept these non-critical items at a reduced testing frequency in accordance with Department Procedures. This requirement applies to sidewalks, curbs and gutters, building foundations, slope paving, ditch paving, guardrail anchorages, small culvert headwalls 30 inches in diameter or less, fence posts, catch basins, manhole bases and inlets, small sign bases, and steel strain pole footings. The Contractor may use pre-approved, pre-packaged concrete mixtures for these applications if the quantity does not exceed 2 cubic yards per day, in which case no design will be required. If the quantity exceeds 2 cubic yards, prior approval must be obtained from the Engineer prior to placement.

Correct batch weights to compensate for surface moisture on the aggregate at the time of use. The Contractor may withhold some of the water from the mix at the plant and add it at the placement site as specified in **604.13**.

The Department will perform all acceptance testing and independent assurance sampling and testing in accordance with **501.03.B**.

C. High Early Strength

When the Plans for structural or pavement repairs, or other type work, require high early strength concrete, the Contractor may use Type I, Type IL, or Type III cement. If Type I or Type IL cement is used, the minimum cement content shall be 714 pounds per cubic yard. If Type III cement is used, the minimum cement content shall be 620 pounds per cubic yard. The Contractor may substitute high early strength concrete, meeting these requirements, for Class A concrete when approved in writing by the Engineer.

When electing to use high early strength concrete, use the same source and gradation of fine and coarse aggregates as that specified for the concrete being substituted. The Department will not make additional payment if the Contractor decides to substitute high early strength concrete for Class A concrete. The unit price for the class of concrete for which the substitution is made shall be full compensation for the concrete.

Subsection 604.03 A.1a (pg. 521), 5-13-19; **Design and Production Parameters**; Revise 6th paragraph:

Admixtures to be incorporated into the concrete shall ~~all be from the same manufacturer, shall be compatible, and shall be incorporated into the concrete in accordance with the manufacturer's recommendations~~ be compatible and incorporated into the concrete in accordance with the manufacturer's recommendations. Concrete mixtures utilizing multiple admixture manufacturers shall prove compatibility in accordance with the Department's Standard Operating Procedure 4-4.

Subsection 604.03 A.1.b (pg. 521), 5-13-19; **Self-Consolidating Concrete (SCC) Design and Production Parameters;** Revise 4th paragraph:

Dosage rates for any admixtures incorporated into the concrete shall be stated during the mix design submittal process. All admixtures shall be compatible ~~and from the same manufacturer.~~ and incorporated into the concrete in accordance with the manufacturer's recommendations. Concrete mixtures utilizing multiple admixture manufacturers shall prove compatibility in accordance with the Department's Standard Operating Procedure 4-4.

Subsection 604.03 A.2 (pg. 521-523), 5-13-19; **Mix Design Submittal**; Revise 1st and 3rd paragraphs:

Submit the proposed concrete design to the Engineer for approval. Develop the design using saturated surface dry aggregate weights and trial batches meeting the requirements of these Specifications. The concrete design shall be prepared by a TDOT Certified Concrete Mix Design Technician ~~certified Class 3 concrete technician~~ or approved independent testing laboratory under the direction of a registered civil engineer licensed by the State of Tennessee. The ~~concrete plant technician~~ TDOT Certified Concrete Mix Design Technician or the civil engineer shall certify that the information contained on the design is correct and is the result of information gained from the trial batches. The concrete design shall produce an average compressive strength to indicate that the specified 28-day strength can be obtained in the field. Make all strength determinations using equipment meeting the requirements of, and in the manner prescribed by, AASHTO T 22. Provide concrete of the design strength specified in all applicable Special Provisions, Plans, and Standard Specifications. Build trial batches for design no more than 90 days before submitting the concrete design. The approved mix

design will expire at the end of each calendar year or if it does not ~~after 6 months if it is not used on a Department funded project and~~ meet the minimum 28-day strength requirements. Assume responsibility for all costs of concrete design, preparation, and submittal.

Instead of the above mix design submittal, an existing design may be submitted for approval provided the design has been ~~used on a state funded project within the last six (6) months~~ approved by the Department within the current calendar year. When submitting for the use of an existing design, the most current water testing results per 921.01 shall accompany the submittal. The approval of this concrete design submittal will not relieve the Contractor of the responsibility of providing concrete meeting the requirements of these Specifications. A temporary mix design may be issued if the 7-day or 14-day compressive strengths exceed the required 28-day strengths.

Subsection 604.04 (pg. 525-527). 5-14-18; Remove the last 3 paragraphs from page 527 and insert the paragraphs as the 6th, 7th, and 8th paragraph of the subsection:

"**604.04 Equipment**

Obtain the Engineer's approval as to the design, capacity, and mechanical condition of equipment and tools used to handle materials and perform the work. Have the equipment on the jobsite sufficiently ahead of the start of construction operations to be examined and approved by the Engineer. Use equipment and construction processes that have sufficient capacity to accomplish the maximum continuous concrete placement, as governed by the construction joints shown on the Plans or as directed by the Engineer.

Meet the requirements for batching plants specified in **501.04.A**, except that when approved by the Engineer, the requirement for storage compartments in addition to weigh bins for fine and coarse aggregates may be waived, provided the batching tolerances specified in **501.09** are maintained.

Meet the requirements for mixers specified in **501.04.B**, except that the requirement for the boom-and-bucket attachment to the mixer will be waived.

Provide ample and satisfactory equipment for conveying concrete from the mixer to final position in the forms. Use closed chutes or pipes when concrete is to be dumped or dropped for a distance greater than 5 feet. Where steep slopes are required, equip the chutes with baffle boards, or use chutes in short lengths that will allow the direction of movement to be reversed.

Use vibrators of an approved type and design, and operate them under load at the rate recommended by the manufacturer and approved by the Engineer.

When placing concrete by pumping, do not use aluminum conduit.

Do not pour any concrete for bridge decks or slabs above grade before verifying the availability and operability of all necessary equipment, including finishing machines, continuous water source or portable tanks, water distribution equipment, two work bridges, vibrators, sprayers, a 12-foot straightedge, and appropriate backup items.

Provide at every concrete deck pour a portable, cold fogger capable of changing humidity and cooling air above fresh concrete. The fogger shall be designed to provide a maximum VMD (volume mean diameter) of 15 microns, and a throw distance of 60 feet.

The Contractor may mix concrete for minor structures, as identified in **604.11.B**, in a mobile volumetric continuous mixing plant.

Use a mobile mixing plant that is:

1. Designed to accurately batch aggregates and cement by volume based on weight.

2. Equipped to perform mixing by a continuous auger and/or paddles.

3. Capable of producing a uniform concrete mix meeting all requirements of the Specifications.

4. Capable of carrying in separate compartments all the necessary ingredients needed for the concrete mix.

5. Equipped with calibrated proportional devices for each material.

6. Equipped with proportioning controls that they may be set and secured for different materials and mixes.

7. Equipped with separate bins and gate openings for each type of material, including a watertight storage bin for cement. Cover the aggregate bins with tarpaulins or by other approved methods when required.

Ensure that a metal plate identifying the discharge speed and weight-calibrated constant of the machine is attached to each unit.

Make adequate standard volume measures, scales, and weights available for checking the accuracy of the proportioning mechanism.

Furnish a calibrated chart for the individual unit when required by the Engineer.

In the Engineer's presence, the producer or factory representative shall perform the calibration and gate settings according to the manufacturer's recommendations for the design to be used.

Provide a satisfactory method of setting the dosage for admixtures. If using admixtures other than air-entraining agents, add them in the manner and in the dosage recommended by the manufacturer.

Subsection 604.04 (pg. 525-527); 5-13-19; **Equipment**; Remove 5th-11th paragraphs, Add subsection A. title, and add subsection B:

A. General

Obtain the Engineer's approval as to the design, capacity, and mechanical condition of equipment and tools used to handle materials and perform the work. Have the equipment on the jobsite sufficiently ahead of the start of construction operations to be examined and approved by the Engineer. Use equipment and construction processes that have sufficient capacity to accomplish the maximum continuous concrete placement, as governed by the construction joints shown on the Plans or as directed by the Engineer.

Meet the requirements for batching plants specified in 501.04.A, except that when approved by the Engineer, the requirement for storage compartments in addition to weigh bins for fine and coarse aggregates maybe waived, provided the batching tolerances specified in 501.09 are maintained.

Meet the requirements for mixers specified in 501.04.B, except that the requirement for the boom-and-bucket attachment to the mixer will be waived.

Provide ample and satisfactory equipment for conveying concrete from the mixer to final position in the forms. Use closed chutes or pipes when concrete is to be dumped or dropped for a distance

greater than 5 feet. Where steep slopes are required, equip the chutes with baffle boards, or use chutes in short lengths that will allow the direction of movement to be reversed.

Use vibrators of an approved type and design, and operate them under load at the rate recommended by the manufacturer and approved by the Engineer.

When placing concrete by pumping, do not use aluminum conduit.

Do not pour any concrete for bridge decks or slabs above grade before verifying the availability and operability of all necessary equipment, including finishing machines, continuous water source or portable tanks, water distribution equipment, two work bridges, vibrators, sprayers, a 12-foot straightedge, and appropriate backup items.

Provide at every concrete deck pour a portable, cold fogger capable of changing humidity and cooling air above fresh concrete. The fogger shall be designed to provide a maximum VMD (volume mean diameter) of 15 microns, and a throw distance of 60 feet.

~~The Contractor may mix concrete for minor structures, as identified in 604.11.B, in a mobile volumetric continuous mixing plant.~~

~~Use a mobile mixing plant that is:~~

~~1. Designed to accurately batch aggregates and cement by volume based on weight.~~

~~2. Equipped to perform mixing by a continuous auger and/or paddles.~~

~~3. Capable of producing a uniform concrete mix meeting all requirements of the Specifications.~~

~~4. Capable of carrying in separate compartments all the necessary ingredients needed for the concrete mix.~~

~~5. Equipped with calibrated proportional devices for each material.~~

~~6. Equipped with proportioning controls that they may be set and secured for different materials and mixes.~~

~~7. Equipped with separate bins and gate openings for each type of material, including a watertight storage bin for cement. Cover the aggregate bins with tarpaulins or by other approved methods when required.~~

~~Ensure that a metal plate identifying the discharge speed and weight-calibrated constant of the machine is attached to each unit.~~

~~Make adequate standard volume measures, scales, and weights available for checking the accuracy of the proportioning mechanism.~~

~~Furnish a calibrated chart for the individual unit when required by the Engineer.~~

~~In the Engineer's presence, the producer or factory representative shall perform the calibration and gate settings according to the manufacturer's recommendations for the design to be used.~~

~~Provide a satisfactory method of setting the dosage for admixtures. If using admixtures other than air-entraining agents, add them in the manner and in the dosage recommended by the manufacturer.~~

B. Volumetric Continuous Mixers

Produce concrete specified in Table 604.03-1 in accordance with Section 604.03, in a volumetric continuous mixing plant provided that the manufacturer's equipment meets the tolerance requirements of Section 501.09. Use a volumetric continuous mixing plant that conforms to the following:

1. The unit shall be equipped with:

   a) Calibrated proportioning devices for each ingredient added to the concrete mix and perform mixing by a continuous auger and/or paddles.

   b) Equipped with proportioning controls that may be set and secured for different materials and mixes.

   c) A working recording meter that is visible at all times and furnishes a ticket printout with the calibrated measurement of the mix being produced.

   d) Separate bins and gate openings for each type of material, including a watertight storage bin for cement. Cover the aggregate bins with tarpaulins or by other approved methods when required.

2. The unit shall have a stamped plate from the Volumetric Mixer Manufacturers Bureau (VMMB) stating the equipment conforms to ASTM C685. The plate shall be attached in a prominent place and have the following plainly marked: the gross volume of the transportation unit in terms of mixed concrete, the discharge speed, and the mass calibrated constant of the machine in terms of volume.

3. The calibration will be performed in the presence of the Engineer by a Volumetric Mixer Operator certified by VMMB and holds a TDOT Concrete Mix Design Technician Certification. Perform the calibration of gate settings according to the manufacturer's recommendations for the mix design to be used. Inspections and calibrations shall be performed at a minimum of every 6 months, every 2500 cubic yards, or when a new mix design is to be used. The yield shall be maintained within a tolerance of ±1 percent and verified using a minimum 2 cubic feet container every 500 cubic yards or a minimum of once per week.

4. The volumetric mixing plant shall be operated by a Volumetric Mixer Operator certified by VMMB and holds a TDOT Concrete Plant Quality Control Technician Certification. Any equipment adjustment that would cause any deviation from the approved concrete mix design shall not be made during the on-site production of concrete.

If the mixer fails to discharge a uniform mix at any time, production of concrete shall halt until any problems are corrected.

Each load of concrete produced by a volumetric continuous mixing plant shall be accompanied by a Concrete Delivery Ticket. The ticket shall include as a minimum the following:

a. Date
b. Contract number
c. County
d. Class of concrete
e. Concrete design number
f. Number of cubic yards
g. Load number
h. Truck number
i. Maximum water allowed by design
j. Total water added
k. Time loaded
l. Time discharged
m. Signature of producer's TDOT Certified Concrete Plant Quality Control Technician.

The form shall be delivered to the Inspector at the site of the work. Loads that do not carry such information or do not arrive in satisfactory condition shall not be used.

Subsection 604.13 (pg. 541), 5-15-17; Mixing Concrete, add Class DS concrete to the 2nd paragraph, 3rd sentence:

D. **"**Do not retemper concrete by adding water or by other means. However, the Contractor may withhold a portion of the mixing water or chemical admixtures from transit mixers and add at the work site if all requirements of the approved mix design are met. Water added at the placement site for Class A, Class D, Class DS and Class L concrete shall not exceed 1 gallon per cubic yard. The total amount of water in the mix shall not exceed the maximum in the approved mix design. To achieve additional slump, use a water reducing admixture. If water, air entrainers, or chemical admixtures are added at the placement site, mix the concrete a minimum of 30 revolutions at mixing speed after making the additions. Do not use concrete that is not within the specified slump limits, air content limits, temperature limits, or time limits at the time of placement."

Subsection 604.13 (pg. 541), 5-14-18; Mixing Concrete, revise the 2nd and 3rd sentence of the 2nd paragraph:

"Do not retemper concrete by adding water or by other means. However, the Contractor may withhold a portion of the mixing water or chemical admixtures from transit mixers and add at the work site if all requirements of the approved mix design are met, provided the delivery ticket indicates the amount of water withheld. The total amount of water in the mix shall not exceed the

maximum in the approved mix design. To achieve additional slump, use a water reducing admixture. If water, air entrainers, or chemical admixtures are added at the placement site, mix the concrete a minimum of 30 revolutions at mixing speed after making the additions. Do not use concrete that is not within the specified slump limits, air content limits, temperature limits, or time limits at the time of placement."

Subsection 604.14 (pg. 542), 11-16-15; Consistency of Concrete, modify the following:

"The slump of the concrete when measured according to AASHTO T 119 shall meet 604.03 - **1A**. The slump flow of self-consolidating concrete when measured according to ASTM C1611 shall meet **604.03 1B**."

Subsection 604.15 (pg. 542-543), 11-16-15; B. Concrete Acceptance Cylinders, modify the following:

"The Department will test the specimens for compressive strength according to AASHTO T 22. Provide the necessary concrete for making test specimens and adequate curing and storage facilities at no additional cost to the Department.

Concrete cylinders submitted for testing beyond 28 days shall comply with the strength requirements specified in Table 604.15-1.

Table 604.15-1: Strength Requirements

Class of Concrete	**Compressive Strength (psi) at:**		
	Less than 31 days	**31 to 42 days**	**43 days to 56 days**
A, S, CP, SCC	3,000	3,300	3,500
D, L	4,000	4,400	4,600
X	Plans Requirement (Req)	Req. + Req. * (10%)	Req. + Req. * (15%)

If the acceptance cylinders fail to meet the specified strengths, the Contractor may drill core samples from the hardened concrete as verification of concrete strength instead of using the concrete cylinders. The Contractor must provide QC data from companion cylinders that meet or exceed the required strength, and TDOT Materials and Test shall perform a nondestructive test using a Swiss Hammer on the concrete to prove required strength is achieved. If the above mentioned requirements are met, the Contractor may then elect to drill a maximum of three core samples per set of cylinders from the hardened concrete. The Contractor shall obtain the cores in accordance with the Department's Standard Operating Procedure 4-2, and bear all costs of obtaining the cores and repairing the core holes."

Subsection 604.15 (pg. 543), 5-15-17; Table 604.15-1: Strength Requirements, Add Class DS to Table, update 2nd paragraph 3rd sentence to remove "cylinders and":

Table 604.15-1: Strength Requirements

Class of Concrete	Compressive Strength (psi) at:		
	Less than 31 days	31 to 42 days	43 days to 56 days
A, S, CP, SCC	3,000	3,300	3,500
D, DS, L	4,000	4,400	4,600
SH-SCC	4,500	4,950	5,175
X	Plans Requirement (Req)	Req. + Req. * (10%)	Req. + Req. * (15%)

If the acceptance cylinders fail to meet the specified strengths, the Contractor may drill core samples from the hardened concrete as verification of concrete strength instead of using the concrete cylinders. The Contractor must provide QC data from companion cylinders that meet or exceed the required strength, and TDOT Materials and Test shall perform a nondestructive test using a Swiss Hammer on the concrete to prove required strength is achieved. If the above mentioned requirements are met, the Contractor may then elect to drill a maximum of three core samples per set of cylinders from the hardened concrete. The Contractor shall obtain the cores in accordance with the Department's Standard Operating Procedure 4-2, and bear all costs of obtaining the cores and repairing the core holes.

Acceptance for payment may be based on cores provided by the Contractor at its expense. These cores shall meet the strength requirements specified in Table 604.15-1. The Engineer will not accept concrete cores submitted for testing beyond 56 days.

Subsection 604.15 (pg. 542-544) 5-14-18, Compressive Strength Tests of Concrete; revise the last sentence of A. and add subsection 604.15.C.:

"**604.15 Compressive Strength Tests of Concrete**

A. General

The Engineer will determine concrete strength by tests performed during the progress of the work, and will use these tests to determine the strength of the concrete for acceptance and pay

purposes. The frequency of testing will be as specified in the sampling and testing schedule of the Department's Standard Operating Procedures.

The frequency of testing for compressive strength to determine when forms may be removed, or when a structure may be put into service, shall be as requested by the Contractor or as deemed necessary by the Engineer in accordance with 604.15.C.

B. Concrete Acceptance Cylinders

The Department will test the specimens for compressive strength according to AASHTO T 22. Provide the necessary concrete for making test specimens and adequate curing and storage facilities at no additional charge to the Department.

Concrete cylinders submitted for testing beyond 28 days shall comply with the strength requirements specified in Table 604.15-1.

Table 604.15-1: Strength Requirements

Class of Concrete	Compressive Strength (psi) at:		
	Less than 31 days	31 to 42 days	43 days to 56 days
A, S, CP, SCC	3,000	3,300	3,500
D, DS, L	4,000	4,400	4,600
SH-SCC	4,500	4,950	5,175
X	Plans Requirement (Req)	Req. + Req. * (10%)	Req. + Req. * (15%)

If the acceptance cylinders fail to meet the specified strengths, the Contractor may drill core samples from the hardened concrete as verification of concrete strength instead of using concrete cylinders. The Contractor must provide QC data from companion cylinders that meet or exceed the required strength, and TDOT Materials and Tests shall perform a nondestructive test using a Swiss Hammer on the concrete to prove required strength is achieved. If the above mentioned requirements are met, the Contractor may then elect to drill a maximum of three core samples per set of cylinders from the hardened concrete. The Contractor shall obtain the cores in accordance with the Departments Standard Operating Procedure 4-2, and bear all costs of obtaining the cores and repairing the core holes.

Acceptance for payment may be based on cores provided by the Contractor its expense. These cores shall meet the strength requirements specified in Table 604.15-1. The Engineer will not accept concrete cylinders and cores submitted for testing beyond 56 days.

The average compressive strength of the two cores taken to represent the low test cylinders will be considered to be the acceptance strength of the in-place concrete, provided that the cores are obtained and tested within 56 days after concrete placement. In accordance with 603.31, the Engineer will accept at a reduced pay concrete that meets the required strengths specified in 604.03 for the respective class, but fails to meet the requirements in Table 604.15-1.

All concrete used shall undergo acceptance testing. The Department will determine the method to formally accept in-place concrete that is represented by acceptance cylinders that have been lost, damaged, or destroyed. These methods may include coring or non-destructive testing.

C. Early Break Cylinders

Make and cure all test specimens according to AASHTO T 23, and the applicable procedures therein defined for *Field Cured Specimens*, unless otherwise specified by the Engineer. The Department will test the specimens for compressive strength according to AASHTO T 22. Provide the necessary concrete for making test specimens at no additional charge to the Department.

Field Cured Specimens, as defined in AASHTO T 23, shall be cured in accordance with AASHTO T23- *Section 10.2. - Field Curing*. Cylinders shall be representative of the concrete placed and shall be cured in the same manner and method as the placed concrete. Specimens shall be protected from the elements in the same manner as the formed work. If specimens are to be used for determining when a structure is capable of being put into service the specimens should be removed from the molds at the time of removal of the form work.

Subsection 604.16 (pg. 545) 5-15-17; Placing Concrete, A. General – revise the 1st paragraph to add Class DS in the first sentence:

"Unless otherwise specified, before placing a bridge deck overlay of Class D , Class DS, or Class L concrete, machine scarify the surface to be covered to a minimum depth of 1 inch. In areas inaccessible to machine scarifying, and in areas of spalling where steel reinforcement is exposed, remove deteriorated concrete using hand tools or other methods approved by the Engineer. After scarifying, clean the deck of all deleterious material. Do not allow traffic on the scarified deck."

Subsection 604.19 (pg. 551-552), 5-14-18; Removal of Forms and Falsework, Revise the 3rd paragraph and 1. to incorporate references to subsection 604.15:

"The Contractor may release and remove falsework and supports under concrete structures when the following conditions are met:

1. Representative specimens of the concrete, made and cured in accordance with 604.15.C, attain a compressive strength of 3000 pounds per square inch."

Subsection 604.23 B (pg. 559), 5-13-19; **Water Method;** Revise 1st paragraph:

As soon as possible after applying curing compound to bridge decks and to other top slabs located above subgrade elevation, apply either a combination of damp burlap and white polyethylene sheeting or a white, co-polymer coated, absorbent, non-woven synthetic fabric, from a work bridge, taking care not to mar the surface of the deck., ~~or other sheet type materials~~ The sheeting material shall meet~~ing~~ the performance requirements of ~~AASHTO~~ ASTM ~~M~~ C171. ~~and approved by the Department, from a work bridge, taking care not to mar the surface of the deck.~~ Immediately cover all other concrete slabs with materials suitable for use with the water cure. After placing the protective cover, immediately apply a mist spray and keep the cover thoroughly wet with a continuously fed soaker hose system for 120 hours.

Subsection 604.27 (pg. 560), 11-16-15; Rideability of New or Resurfaced Bridge Decks and Roadway Approaches, A. General, revise the 1st paragraph to the following:

"On all highway sections with a posted speed greater than 40 miles per hour, the following rideability provisions shall apply to new or resurfaced bridge decks and roadway approaches."

Subsection 604.31 (pg. 567-568) 5-15-17; Basis of Payment, add Class DS to item and pay unit list:

604.31 Basis of Payment

The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Class A Concrete (Description)	Cubic Yard
Class D Concrete (Description)	Cubic Yard
Class DS Concrete (Description)	Cubic Yard
Class L Concrete (Description)	Cubic Yard
Class S Concrete (Description)	Cubic Yard
Steel Bar Reinforcement	Pound
Epoxy Coated Reinforcing	Pound
Scarifying	Square Yard
Applied Texture Finish	Square Yard
Hydro-demolition	Square Yard

Subsection 606.04.B.1(b) (pg. 578), 6-27-16; replace 1.b. with the following:

"(b) Except as provided in paragraph 2(b) below, develop an energy per blow in foot-pounds not less than 250 multiplied by R, where R is the required minimum bearing resistance of the pile in tons."

Subsection 606.07.A. (pg. 581), 6-27-16; revise the 1st paragraph:

"Construct cast-in-place concrete piles of the design shown on the Plans and that consist of concrete cast in drilled holes or in steel shells or pipes driven to the required bearing. Use Class A concrete meeting **604**, or use Class X concrete, as required by design, meeting **604**. Provide and place suitable casing when required to prevent caving of the hole before concrete is placed.

Subsection 611.02 (pg. 620), 11-6-17; Materials, revise the last sentence of the last paragraph to remove the mylar reference:

"After obtaining the necessary approval, furnish the Engineer an electronic reproducible design file.."

Subsection 613.02 (pg. 633), 6-27-16; add the following section:

"Brick Paving Units ……..912.05"

Subsection 615.09 (pg. 644), 10-8-18; Table 615.09-1: Class P Concrete, Revise Table and footnote (4):
Table 615.09-1: Class P Concrete, Revise Table 615.09-1 and footnote (3).

Table 615.09-1: Class P Concrete

Class of Concrete	Min 28-Day Compressive Strength (psi)	Min Cement Content (pound per cubic yard)	Maximum Water/Cement Ratio (pound/pound)	Air Content % (Design ± production tolerance)	Slump or Slump Flow (inches)
P	5,000(1)	658	0.45	0-8(2)	2 ± 1 (3)
P-SCC (4)	5,000(1)	658	0.45	0-6(2)	26 ± 5

(1) Or as shown on the Plans or approved shop drawings.
(2) Air entraining is optional with the Contractor, unless otherwise shown on the Plans or shop drawings.
(3) Not to exceed 3 inches before the addition of high range admixtures, and not to exceed 10 inches after the addition of high range admixtures. If water-cement ratio is equal to or less than 0.35 then the maximum slump is 10 inches. If the water-cement ratio is 0.36 – 0.45, the maximum slump is 8 inches.
(4) Maximum coarse aggregate size of a No. 67 stone.

Subsection 615.09 (pg. 644), 11-16-15; Proportioning and Mixing of Concrete, update Table 615.09-1 and add the 3rd paragraph below the table, modify the last paragraph:

Table 615.09-1: Composition of Prestress Concrete Classes

Class of Concrete	Minimum 28-Day Compressive Strength (psi)	Minimum Pounds Cement per Cubic Yard	Maximum Water/Cement Ratio (pound/pound)	Air Content %	Slump or Slump Flow (inches)
P	5,000 (1)	658	0.45	0-8 (2)	2 ± 1 (3)
P-SCC (4)	5,000 (1)	658	0.45	0-6 (2)	25 ± 4

(1) Or as shown on the Plans or approved shop drawings.

(2) Air entraining is optional with the Contractor, unless otherwise shown on the Plans or shop drawings.

(3) Not to exceed 3 inches before the addition of high range admixtures, and not to exceed 10 inches after the addition of high range admixtures. If water-cement ratio is equal to or less than 0.35 then the maximum slump is 10 inches. If the water-cement ratio is 0.36 – 0.45, the maximum slump is 8 inches.

(4) Maximum coarse aggregate size of a No. 67 stone.

Comply with all applicable provisions of **604.03** except as modified herein.

Submit a concrete design to the Department for review and approval. In addition to the proportions, identify in the design submittal the source or brand of all materials and the type of cement to be used. The Contractor may use Type I or Type III cement, unless otherwise specified. Do not use calcium chloride. Use a retardant admixture when the ambient temperature is 75 °F or higher. The slump of the concrete shall be 2 inches with a tolerance of ±1 inch at the time of placement. When an approved superplasticizer is to be used, the slump of the concrete shall be the same as above before the superplasticizer is added to the mix. After the addition of the superplasticizer, the slump may be increased to a maximum of 8 inches at the time of placement.

The slump flow of self-consolidating concrete shall be determined and within the design and production tolerances stated in **Table 615.09-1**. Include chemical admixtures in the self-consolidating concrete mixture as specified in **Table 604.03-5** based on the ambient air temperature and expected weather conditions. Approved viscosity modifying admixtures (VMA) may be used as part of the chemical admixtures if they are shown in the approved mixture design.

Handle, measure, and batch materials; mix concrete; and comply with the limitations of mixing as specified in **501.09**, **501.10**, and **501.11**, respectively.

Make concrete test specimens for Class P and Class P-SCC, in accordance with AASHTO T 23 and ASTM C1758 respectively, to determine the adequacy of the concrete design and the minimum time at which the stress may be applied to the concrete. Cure the test specimens used to determine the time at which stress may be applied in the same manner and under the same conditions as the bridge members. The initial curing of specimens to determine the design strength of the concrete shall be as specified above with additional curing water, as provided in AASHTO…

Subsection 615.17 (pg. 652), 5-18-15; Table 615.17-1: Manufacturing Tolerances in Standard Sections, Update Table 615.17-1:

Table 615.17-1: Manufacturing Tolerances in Standard Sections

Description	Tolerance	
	I-Sections	**Box Sections**
Nominal Depth	± 1/2 inch	± 1/2 inch
Nominal Width	± 1/2 inch	± 1/2 inch
Nominal Length	Computed Elastic Shortening ±1/2 inch	Computed Elastic Shortening ±1/2 inch
Variation in Straightness, inches	1/4 inch x (Total Length in feet)/10	1/4 inch x (Total Length in feet)/10
Variation in Camber, inches	Beams in any 1 span not more than: 1/8 inch x (Total Length in feet)/10	Beams in any 1 span not more than: 1/8 inch x (Total Length in feet)/10
Location of Voids	---------	Length ± 1/2 in Wall Thickness ± 1/2 in
Bearing	Full Bearing - Full Width of Beam	Full Bearing on at Least 2/3 of Width of Beam
Tendon Placement	± 1/2 inch	± 1/2 inch
Reinforcing Steel Placement	± 1/2 inch	± 1/2 inch
Reinforcing Steel Concrete Cover	± 1/2 inch	± 1/2 inch
Reinforcing Steel Splice Lengths	Minus 1-1/2 inches	Minus 1-1/2 inches

Subsection 622.03 (pg. 686) 12-2-16; Add the following paragraph at the beginning of the section:

"Same-as designs shall not be submitted for Shotcrete."

Subsection 622.03 (pg, 686-688) 5-14-18; Add subsection C: Placement of Shotcrete:

"**C. Placement of Shotcrete**

An ACI-certified Shotcrete Nozzleman shall be utilized to properly place shotcrete."

Subsection 622.03 (pg. 687) 10-8-18; Proportioning and Quality Assurance of Shotcrete, Modify Table 622.03-2, add a sentence to the end of the paragraph between tables 622.03-1 and 622.03-2:

Table 622.03-1: Shotcrete Performance Requirements

Parameter	Value
3-Day Compressive Strength (psi)	2000
28-Day Compressive Strength (psi)	4000
Minimum Cementitious per cubic yard	660
Maximum Water/Cement (pound/pound)	0.45
Air Content (%)	7-10 (1)
7-Day Maximum Absorption (%)	8

(1) Air content acceptance range shall be between 7-10%, with sampling at the truck chute. Air entrainment is required for wet-mix shotcrete but not for dry-mix shotcrete.

Aggregate for shotcrete shall meet the strength and durability requirements of AASHTO M6/M80 and the gradation requirements specified in Table 622.03-2. An intermediate size aggregate may also be used as an additional component if needed to meet gradation. Aggregates failing to comply with Table 622.03-2 may be used if preconstruction testing as specified in **622.04** proves satisfactory results.

Table 622.03-2: Gradation Requirements

Sieve Size	Percent Passing by Weight
3/4 inch	100
1/2 inch	98-100
3/8 inch	90-100
No. 4	70-85
No. 8	50-70
No. 16	35-60
No. 30	20-50
No. 50	8-20
No. 100	0-10