KANSAS DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION TO THE
STANDARD SPECIFICATIONS 1990 EDITION

NOTE: This special provision is generally written in the imperative mood. The subject, "the *Contractor*" is implied. Also implied in this language are "*shall*", "*shall be*", or similar words and phrases. The word "*will*" generally pertains to decisions or actions` of the Kansas Department of Transportation.

Section 402. Delete the Section and replace with this:

SECTION 402

CONCRETE

402.1 DESCRIPTION

Provide the grades of concrete specified in the Contract Documents.

402.2 MATERIALS

Provide materials that comply with the applicable requirements.

Coarse, fine, and mixed aggregates .....**Section 1100**
Admixtures .....**Section 1400**
Cement, Fly Ash, and Ground Granulated Blast Furnace Slag .....**Section 2000**
Water for concrete .....**Section 2400**

402.3 CONCRETE MIX DESIGN

a. General. The Contractor (or a prospective bidder) may contact the District Materials Engineer for any available information to help determine approximate proportions which will produce concrete having the required characteristics for any given project.

The Contractor is responsible for the actual proportions of the concrete mix. If the Contractor requests (in writing), the Engineer will assist in the design of the concrete mix.

Design the concrete mixes specified in the Contract Documents.

Design concrete mixes that complies with:

b. Air-Entrained Concrete for Pavement. Design air-entrained concrete for pavement according to **TABLE 402-1**.

TABLE 402-1, Air-Entrained Concrete for Pavement

Type of Aggregate (Section 1100)	lb. (kg) of Cement per cu yd (cu m) of Concrete, minimum	lb. (kg) of Water per lb. (kg) of Cement, maximum*	Percent of Air by Volume
Coarse and Fine	602 (357)	0.49	**
MA-2	602 (357)	0.49	**
MA-1	620 (367)	0.49	**

*Maximum limit of lb. (kg) of water per lb. (kg) of cement includes free water in aggregates, but excludes water of absorption of the aggregates.
** Provide a target air content with a minimum air content by volume of 5.0%, and a maximum air void spacing factor of 0.01 inch (0.25 mm). The Engineer will determine the air void spacing factor using the Air Void Analyzer (AVA) in accordance with the manufacturer's instructions using fresh concrete. Prequalify mixtures by either the laboratory option or the field option as stipulated in Appendix 1. Notify the engineer to arrange testing by the AVA.

c. Optimized, Air-Entrained Concrete for Pavement. Improvements in concrete strength, workability, and durability are possible if the combined aggregate grading is optimized. The Shilstone or other mix design techniques may prove useful in optimizing the mix design.

It is the Contractor's option to use either Air-Entrained Concrete for Pavement or Optimized, Air-Entrained Concrete for Pavement. If the Optimized option is selected, provide the Project Engineer written notification of the selection as soon as practicable after award of the Contract.

Design optimized, air-entrained concrete for pavement according **TABLE 402-2**.

TABLE 402-2, Optimized, Air-Entrained Concrete for Pavement

Type of Aggregate (Section 1100)	lb. (kg) of Cement per cu yd (cu m) of Concrete, minimum*	lb. (kg) of Water per lb. (kg) of Cement, maximum**	Percent of Air by Volume	28-Day Compressive Strength psi (MPa)
MA-3	521 (309)	0.49	***	4000 (28)

*The Contractor is cautioned that the amount of cement listed is the designated minimum. It may be necessary to add additional cement or otherwise adjust the mix proportions as permitted by the specifications to provide a mix design that complies with the compressive strength requirement.
**Maximum limit of lb. (kg) of water per lb. (kg) of cement includes free water in aggregates, but excludes water of absorption of the aggregates.
*** Provide a target air content with a minimum air content by volume of 5.0%, and a maximum air void spacing factor of 0.01 inch (0.25 mm). The Engineer will determine the air void spacing factor using the Air Void Analyzer (AVA) in accordance with the manufacturer's instructions using fresh concrete. Prequalify mixtures by either the laboratory option or the field option as stipulated in Appendix 1. Contact the Engineer to arrange testing by the AVA.

Submit the optimized concrete mix design and provide the Engineer with the necessary materials to enable the Engineer to test the mix properties at least 6 weeks before the anticipated date of using the design on the project.

Submit a single point grading for the combined MA-3 aggregates along with a plus/minus tolerance for each sieve to the Engineer. Use the plus/minus tolerances to perform quality control checks and for the Engineer to perform aggregate grading verification testing. The tests may be performed on the combined materials or on individual aggregates, and then theoretically combined to determine compliance.

Submit laboratory 28-day compressive strength test results on a minimum of 1 set of 3 cylinders produced from the proposed mix design, utilizing the actual materials proposed for use on the project. Design compressive strength should be a minimum of 2 of the Contractor's normal standard deviations for this type of mix above 4000 psi (28 MPa) (cylinders). Submit historical mix production data for the plant that will be used on the Contract to substantiate the standard deviation selected. If such historical data is not available, or is unacceptable to the Engineer, use 5000 psi (35 MPa) for design strength.

The Engineer will provide an initial review of the design within 5 working days following submittal, and then will perform any testing necessary to verify the design.

To verify the mix design in the field, perform compressive strength tests on cylinders made from samples taken from concrete produced at the project site before or during the first day

that concrete pavement is placed on the project. If the compressive strength tests indicate noncompliance with minimum design values, then add additional cement to the mix or make other appropriate mix design changes at no additional cost to KDOT.

d. Concrete for Structures. Design concrete for structures according **TABLE 402-3**.

TABLE 402-3, Concrete for Structures

Grade of Concrete: **Type of Aggregate (Section 1100)**	**lb. (kg) of Cement per cu yd (cu m) of Concrete, minimum***	**lb. (kg) of Water per lb. (kg) of Cement, maximum**
Grade 5.0 (Grade 35):		
Mixed aggregate with 30% or more (by weight) on the No. 4 (4.75 mm) sieve	639 (379)	0.36
Coarse and Fine Aggregate	602 (357)	0.36
MA-2 with 45% or more (by weight) on the No. 4 (4.75 mm) sieve	602 (357)	0.36
Grade 4.5 (Grade 31):		
Mixed aggregate with less than 30% (by weight) on the No. 4 (4.75 mm) sieve	696 (413)	0.42
Mixed aggregate with 30% or more (by weight) on the No. 4 (4.75 mm) sieve	639 (379)	0.42
Coarse and Fine Aggregate	602 (357)	0.42
MA-2 with 45% or more (by weight) on the No. 4 (4.75 mm) sieve	602 (357)	0.42
Grade 4.0 (Grade 28):		
Mixed aggregate with less than 30% (by weight) on the No. 4 (4.75 mm) sieve	696 (413)	0.46
Mixed aggregate with 30% or more (by weight) on the No. 4 (4.75 mm) sieve	639 (379)	0.46
Coarse and Fine Aggregate	602 (357)	0.46
MA-2 and MA-5 with 45% or more (by weight) on the No. 4 (4.75 mm) sieve	602 (357)	0.46
Grade 3.0 (Grade 21):		
Mixed aggregate with less than 30% (by weight) on the No. 4 (4.75 mm) sieve	639 (379)	0.48
Mixed aggregate with 30% or more (by weight) on the No. 4 (4.75 mm) sieve	602 (357)	0.48
Coarse and Fine Aggregate	564 (334)	0.48
MA-2 with 45% or more (by weight) on the No. 4 (4.75 mm) sieve	564 (334)	0.48
Grade 2.5 (Grade 17):		
All Aggregates	526 (312)	0.55

*Maximum limit of lb. (kg) of water per lb. (kg) of cement includes free water in aggregates, but excludes water of absorption of the aggregates.

e. Air-Entrained Concrete for Structures. Design air-entrained concrete for structures according to **TABLE 402-4**.

TABLE 402-4, Air-Entrained Concrete for Structures

Grade of Concrete **Type of Aggregate (Section 1100)**	**lb. (kg) of Cement per cu yd (cu m) of Concrete, minimum**	**lb. (kg) of Water per lb. (kg) of Cement, maximum *****	**Percent of Air by Volume**
Grade 5.0(35) (AE), Grade 5.0(35) (AE)(SW)*, Grade 5.0(35) (AE)(SA), Grade 5.0(35) (AE)(AI)***, and Grade 5.0(35) (AE)(PB)****:**			
Mixed aggregate with 30% or more (by weight) on the No. 4 (4.75 mm) sieve	639 (379)	0.35	6.5±1.5#
Coarse and Fine Aggregate	602 (357)	0.35	6.5±1.5#
MA-2 with 45% or more (by weight) on the No. 4 (4.75 mm) sieve	602 (357)	0.35	6.5±1.5#

Grade of Concrete Type of Aggregate (Section 1100)	lb. (kg) of Cement per cu yd (cu m) of Concrete, minimum	lb. (kg) of Water per lb. (kg) of Cement, maximum *****	Percent of Air by Volume
Grade 4.5(31) (AE), Grade 4.5(31) (AE)(SW)*, Grade 4.5(31) (AE)(SA), and Grade 4.5(31) (AE)(AI)***:**			
Mixed aggregate with less than 30% (by weight) on the No. 4 (4.75 mm) sieve	696 (413)	0.40	6.5±1.5#
Mixed aggregate with 30% or more (by weight) on the No. 4 (4.75 mm) sieve	639 (379)	0.40	6.5±1.5#
Coarse and Fine Aggregate	602 (357)	0.40	6.5±1.5#
MA-2 with 45% or more (by weight) on the No. 4 (4.75 mm) sieve	602 (357)	0.40	6.5±1.5#
Grade 4.0(28) (AE), Grade 4.0(28) (AE)(SW)*, Grade 4.0(28) (AE)(SA), and Grade 4.0(28) (AE)(AI)***:**			
Mixed aggregate with less than 30% (by weight) on the No. 4 (4.75 mm) sieve	696 (413)	0.44	6.5±1.5#
Mixed aggregate with 30% or more (by weight) on the No. 4 (4.75 mm) sieve	639 (379)	0.44	6.5±1.5#
Coarse and Fine Aggregate	602 (357)	0.44	6.5±1.5#
MA-2 with 45% or more (by weight) on the No. 4 (4.75 mm) sieve	602 (357)	0.44	6.5±1.5#
Grade 3.0(21)(AE):			
Mixed aggregate with less than 30% (by weight) on the No. 4 (4.75 mm) sieve	639 (379)	0.46	6.5±1.5#
Mixed aggregate with 30% or more (by weight) on the No. 4 (4.75 mm) sieve	602 (357)	0.46	6.5±1.5#
Coarse and Fine Aggregate	564 (334)	0.46	6.5±1.5#
MA-2 with 45% or more (by weight) on the No. 4 (4.75 mm) sieve	564 (334)	0.46	6.5±1.5#
Grade2.5(17)(AE):			
All Aggregates	526 (312)	0.53	6.5±1.5#

*Grade xx (AE)(SW) - Structural concrete with select coarse aggregate for wear
**Grade xx (AE)(SA) - Structural concrete with select coarse aggregate for wear and absorption.
***Grade xx (AE)(AI) - Structural concrete with select coarse aggregate for wear and acid insolubility.
****Grade xx (AE)(PB) - Structural concrete with select aggregate for use in prestressed concrete beams.
*****Maximum limit of lb. (kg) of water per lb. (kg) of cement includes free water in aggregates, but excludes water of absorption of the aggregates.
- The air content is not to exceed 10%. Take immediate steps to get the air down whenever the air content exceeds the maximum value shown in Table 402-4.

f. Portland Cement and Blended Hydraulic Cement. Unless specified otherwise in the Contract Documents select the type of Portland cement or blended hydraulic cement according to **TABLE 402-5**.

TABLE 402-5, Portland Cement and Blended Hydraulic Cement

Concrete for:	Type of Cement Allowed
Bridge Deck Wearing Surface and Concrete Pavement	Type IP Portland-Pozzolan Cement Type I(PM) Pozzolan Modified Portland Cement Type IS Portland-Blast Furnace Slag Cement Type I(SM) Slag Modified Portland Cement Type II Portland Cement
All Structures other than Bridge Deck Wearing Surface and Concrete Pavement	Type I Portland Cement Type IP Portland-Pozzolan Cement Type I(PM) Pozzolan Modified Portland Cement Type IS Portland-Blast Furnace Slag Cement Type I(SM) Slag Modified Portland Cement Type II Portland Cement

Concrete for:	Type of Cement Allowed
High Early Strength Concrete	Type III Portland Cement Type I, IP, II, or I/II Cement may be used if strength and time requirements are met.

g. Design Air Content. With the exception of concrete for PCCP, use the middle of the specified air content range for the design of air-entrained concrete. For PCCP concrete, provide a target air content that complies with these 2 criteria:

- a minimum air content by volume of 5.0%, and
- a maximum air void spacing factor of 0.01 inch (0.25 mm).

h. Admixtures: Accelerators, Air-Entrainers, Water-Reducers, Set Retarders, and Plasticizers. Use the dosages recommended by the admixture manufacturers. Incorporate and mix the admixtures into the concrete mixtures according to the manufacturer's recommendations.

Determine the quantity of each admixture for the concrete mix design.

Redosing is permitted to accomplish slump control or air content in the field. If approved by the Engineer, time and temperature limits are not exceeded, and at least 30 mixing revolutions remain, redose with up to 50% of the original dose.

If another admixture is added to an air-entrained concrete mixture, determine if it is necessary to adjust the air-entraining admixture dosage to maintain the specified air content.

(1) Accelerators. If specified in the Contract Documents, or in situations that involve contact with reinforcing steel and require early strength development to expedite opening to traffic, a non-chloride accelerator may be appropriate. The Engineer may approve the use of a Type C or E accelerators.

(2) Air-Entraining Admixture. If specified, use an air-entrainer in the concrete mixture. If the concrete mixture also contains a plasticizer or a high-range water-reducer, use only vinsol resins or tall oil based air-entrainers.

(3) Water-Reducers and Set-Retarders. If unfavorable weather or other conditions adversely affect the placing and finishing properties of the concrete mix, the Engineer may allow the use of water-reducers and set-retarders. If the Engineer approves the use of water-reducers and set-retarders, their continued use depends on their performance. It is the Contractor's responsibility to verify that the admixtures will work as intended without detrimental effects. If at any point, a water-reducer is used to produce a slump equal to or greater than 7 ½ inches (190 mm), then comply with the requirements in Plasticizer Admixture.

(4) Plasticizer Admixture. Include a batching sequence in the concrete mix design. Consider the location of the concrete plant in relation to the job site, and identify when and at what location the plasticizer is added to the concrete mixture. Do not add water after the plasticizer is added to the concrete mixture.

NOTE: A plasticizer is defined as an admixture that produces flowing concrete, without further addition of water, and/or retards the setting of concrete. Flowing concrete is defined as having a slump equal to or greater than 7 ½ inches (190 mm). Use plasticizers that comply with S**ubsection 1402**.

Manufacturers of plasticizers may recommend mixing revolutions beyond the limits specified in **subsection 402.8**. If necessary, address the additional mixing revolutions (the Engineer will allow up to 60 additional revolutions) in the concrete mix design.

Before the concrete mixture with a slump equal to or greater than 7 ½ inches (190 mm) is used on the project, conduct tests on at least 1 full trial batch of the concrete mix design to determine the adequacy of the dosage and the batching sequence of the plasticizer to obtain the desired properties. Determine the air content of the trial batch both before and after the addition of the plasticizer. Monitor the slump, air content, temperature, and workability at regular intervals of the time period from when the plasticizer is added until the estimated time of completed placement. At the discretion of the Engineer, if all the properties of the trial batch remain within the specified limits, the trial batch may be used in the project.

The Engineer will allow minor adjustments to the dose rate to compensate for environmental changes during placement without a new concrete mix design or trial batch.

i. Slump. Designate a slump for each concrete mix design that is within these limits:

TABLE 402-6, Slump

Application	Maximum Allowable Slump
Concrete Pavement	2½ inch(1)(2) (65 mm)(1)(2)
Concrete for Structures & Air-Entrained Concrete for Structures	That required for satisfactory placement of the respective parts of the structure.(2)
Bridge Subdecks or Decks without Water-Reducers	3 inch(2) (75 mm)(2)
Concrete with Water-Reducers for Structures, Bridge Subdecks or Decks, Air-Entrained Concrete with Water-Reducers for Structures, & Concrete with Water-Reducers for Prestressed Beams	7 Inch(3) (175 mm)(3)
Concrete with Plasticizers for Drilled Shafts	(4)

(1)If the Engineer approves, slumps in excess of 2½ inch (65 mm) are allowed for areas that are hand finished.
(2)If the designated slump is 3 inch (75 mm) or less, the tolerance is ±¾ inch (±20 mm), or limited by the maximum allowable slump for the individual type of construction. If the designated slump is greater than 3 inch (75 mm) (without water-reducers), the tolerance is ±25% of the designated slump.
(3)If the Engineer approves the use of water-reducers in the concrete, the tolerance from the designated slump is ±25% or ¾ inch (20 mm), whichever is larger, limited by the maximum allowable slump for the individual type of construction. Maintain the required geometry.
(4)The **target** slump just prior to being pumped into the drilled shaft is 9 inches (225 mm). If the slump is less than 8 inches (200 mm), then redose the concrete as permitted in **402.3 h**.

j. Fly Ash Modified Concrete. If approved by the Engineer, the concrete mix design may include fly ash from an approved source as a partial replacement for Portland cement or blended hydraulic cement. The substitution of fly ash for Type III cement is not allowed. The approved source of fly ash cannot be changed during the Project.

Substitute 1 pound (kg) of fly ash for 1 pound (kg) of cement. Substitution with Class C fly ash is limited to a maximum of 10% (by weight) of the specified amount of cement. Substitution with Class F fly ash is limited to a maximum of 25% (by weight) of the specified amount of cement. If fly ash is substituted for Type IP or Type I(PM) cement, the amount of pozzolan in the blended cement plus the amount of fly ash substituted can not exceed 30% of the total.

The maximum pound (kg) of water per pound (kg) of fly ash modified cement is the same as specified in **TABLE 402-3** for a pound (kg) of cement.

Fly ash modified concrete must equal or exceed the design strength requirements listed in **TABLE 402-7**.

Submit complete mix design data including proportions and sources of all mix ingredients, and the results of strength tests representing the mixes proposed for use. The strength data may come from previous KDOT project records or from a laboratory regularly inspected by Cement

and Concrete Reference Laboratory (CCRL), and must equal or exceed the strength requirements listed in **TABLE 402-7**. Prepare test specimens and perform flexural tests in accordance with **Section 2500**. Perform compressive strength tests according to the requirements of ASTM C 39.

Provide the results of mortar expansion tests of ASTM C1567 and/or ASTM C227 using the project's mix design concrete materials at their designated percentages.

Provide a mix that complies with one of the following criteria:

1.) ASTM C1567 with a maximum expansion of 0.10 % at 16 days after casting; or

2.) ASTM C227 with maximum expansions of 0.05% at 3 months and 0.10% at 6 months. Expansion greater than 0.05% at 3 months should not be considered excessive when the 6-month expansion remains below 0.10%

The results must be provided to the Engineer at least 15 days before placement of concrete on the project.

NOTE: After sufficient data has been collected, the strength test requirements may be waived, but only with the approval of the Chief, Bureau of Materials and Research.

k. Ground Granulated Blast Furnace Slag (GGBFS) Modified Concrete. The concrete mix design may include GGBFS from an approved source as a partial replacement for Portland cement or blended hydraulic cement. The substitution of GGBFS for Type III cement is not allowed. The approved source of GGBFS can not be changed during the Project.

GGBFS is considered a field blended cement and is subject to the requirements of **Section 2000**, except for the optional physical requirements.

Substitute 1 pound (kg) of GGBFS for 1 pound (kg) of cement. Substitution with GGBFS is limited to a maximum of 35% (by weight) of the specified amount of cement. If GGBFS is substituted for Type IS or Type I(SM) cement, the amount of GGBFS in the blended cement plus the amount of GGBFS substituted can not exceed 35% of the total.

The maximum pound (kg) of water per pound (kg) of GGBFS modified cement is the same as specified in **TABLE 402-3** for a pound (kg) of cement.

GGBFS modified concrete must equal or exceed the design strength requirements listed in **TABLE 402-7**.

Submit complete mix design data including proportions and sources of all mix ingredients, and the results of strength tests representing the mixes proposed for use. The strength data may come from previous KDOT project records or from a laboratory regularly inspected by a CCRL, and must equal or exceed the strength requirements listed in **TABLE 402-7**. Prepare test specimens and perform flexural tests in accordance with **Section 2500**. Perform compressive strength tests according to the requirements of ASTM C 39.

Provide the results of mortar expansion tests of ASTM C1567 and/or ASTM C227 using the project's mix design concrete materials at their designated percentages.

Provide a mix that complies with one of the following:

1.) ASTM C1567 with a maximum expansion of 0.10 % at 16 days after casting; or

2.) ASTM C227 with maximum expansions of 0.05% at 3 months and 0.10% at 6 months. Expansion greater than 0.05% at 3 months should not be considered excessive when the 6-month expansion remains below 0.10%

The results must be provided to the Engineer at least 15 days before placement of concrete on the project.

NOTE: After sufficient data has been collected, the strength test requirements may be waived, but only with the approval of the Chief, Bureau of Materials and Research.

TABLE 402-7, Design Strength Requirements for Fly Ash Modified & GGBFS Modified Concrete

Grade of Concrete	Specimen Age	Unit Strength psi (MPa)
Grade 5.0 (Grade 35)	28 days	6500 (45) Compressive
Grade 5.0(AE) ((Grade 35 (AE))	28 days	6500 (45) Compressive
Grade 4.5 (Grade 31)	28 days	5700 (39) Compressive
Grade 4.5(AE) (Grade 31 (AE))	28 days	5700 (39) Compressive
Grade 4.0 (Grade 28)	28 days	5200 (36) Compressive
Grade 4.0(AE) (Grade 28 (AE))	28 days	5200 (36) Compressive
Grade 3.0 (Grade 21)	28 days	4100 (28) Compressive
Grade 3.0(AE) (Grade 21 (AE))	28 days	4100 (28) Compressive
Pavement	7 days	600 (4) Flexural (third point loading)
Grade 2.5 (Grade 17) or Grade 2.5(AE) (Grade 17 (AE))	- - -	Not required

l. High Early Strength Concrete. Design the high early strength concrete mix to comply with strength and time requirements specified in the Contract Documents.

Submit complete mix design data including proportions and sources of all mix ingredients, and the results of time and strength tests representing the mixes proposed for use. The strength and time data may come from previous KDOT project records or from an independent laboratory, and must equal or exceed the strength and time requirements listed in the Contract Documents.

m. Approval of Concrete Mix Designs. Submit all concrete mix designs to the Engineer for review and approval. Submit completed volumetric mix designs on KDOT Form No. 694 (or other forms approved by the District Materials Engineer).

Do not place any concrete on the Project until the Engineer approves the concrete mix designs. Once the Engineer approves the concrete mix design, do not make changes without the Engineer's approval.

402.4 MORTAR.

Proportion mortar for laying stone for grouted stone rip-rap, grouted slope protection, or grouted stone ditch lining at 1 part of Portland cement and 3 parts of fine aggregate by volume with sufficient water to make a workable and plastic mix.

Proportion mortar for laying brick, concrete blocks, or stone masonry at ½ part masonry cement, ½ part Portland cement, and 3 parts fine aggregate, either commercially produced masonry sand or FA-M, by volume with sufficient water to make a workable and plastic mix.

Do not use air-entraining agents in mortar for masonry work.

The Engineer may visually accept the sand used for mortar. The Engineer may visually accept any recognized brand of Portland cement or masonry cement that is free of lumps.

402.5 COMMERCIAL GRADE CONCRETE.

If the Contract Documents allow the use of commercial grade concrete for designated items, the Contractor may use a commercial grade mixture from a ready-mix plant approved by the Engineer.

The Engineer must approve the commercial grade concrete mixture. Approval of the commercial grade mixture is based on these conditions:

- All materials are those normally used for the production and sale of concrete in the vicinity of the project.
- The mixture produced is that normally used for the production and sale of concrete in the vicinity of the project.
- The mixture produced contains a minimum cement content of 6 sacks, 564 lbs (336 kg), of cement per cubic yard (cu m) of concrete.
- The water-cement ratio is as designated by the Engineer. The maximum water-cement ratio permitted may not exceed 0.55 pounds (kgs) of water per pound (kg) of cement including free water in the aggregate.
- Type I, II, III, IP or I(PM) cement may be used unless otherwise designated. Fly ash or GGBFS may be substituted for the required minimum cement content as specified in **402.03**. No additives other than air entraining agent will be allowed. The Contractor will not be required to provide the results of strength tests when submitting mix design data to the Engineer.
- In lieu of the above, approved mix designs (including optimized) for all other grades of concrete, Grade 3.0 (Grade 21) or above, are allowable for use as commercial grade concrete, at no additional cost to KDOT.

Exercise good engineering judgement in determining what equipment is allowed for use in proportioning, mixing, transporting, placing, consolidating, and finishing the concrete.

Construct the items with the best current industry practices and techniques.

Before unloading at the site, provide a delivery ticket for each load of concrete containing this information:

- Name and location of the plant.
- Time of batching concrete.
- Mix proportions of concrete (or a mix designation approved by the Engineer).
- Number of cubic yards (cu m) of concrete batched.

Cure the various items placed the length of time stipulated in **Section 701**.

The Engineer may test commercial grade concrete by molding sets of 3 cylinders. This is for informational purposes only. No slump or unit weight test is required.

402.6 CERTIFIED CONCRETE.

If KDOT inspection forces are not available on a temporary basis, the Engineer may authorize the use of concrete from approved concrete plants. Approval for this operation is based on certification of the plant and plant personnel according to KDOT standards. KDOT's approval may be withdrawn any time that certification procedures are not followed.

The Engineer will not authorize the use of certified concrete for major structures such as bridges, RCB box bridges, RCB culverts, permanent main line and ramp pavement, or other structurally critical items.

Each load of certified concrete must be accompanied by a ticket listing mix proportions, time of batching and setting on revolution counter, total mixing revolutions and signed by certified plant personnel.

402.7 REQUIREMENTS FOR COMBINED MATERIALS.

a. Measurements for Proportioning Materials.

(1) Cement. Measure cement as packed by the manufacturer. A sack of cement is considered as 0.04 cubic yards (0.03 cu m) weighing 94 pounds (42.6 kg) net. Measure bulk cement by weight. In either case, the measurement must be accurate to within 0.5% throughout the range of use.

(2) Fly Ash. Fly ash proportioning and batching equipment is subject to the same controls as required for cement. Insure that the fly ash cut off valve provides positive cut off with no leakage. Fly ash may be weighed accumulatively with the cement or separately. If weighed accumulatively, weigh the cement first.

(3) Water. Measure the mixing water by weight or by volume. In either case the measurement must be accurate to within 1% throughout the range of use.

(4) Aggregates. Measure the aggregates by weight. The measurement must be accurate to within 0.5% throughout the range of use.

(5) Admixtures. Measure liquid admixtures by weight or volume. If liquid admixtures are used in small quantities in proportion to the cement as in the case of air-entraining agents, use readily adjustable mechanical dispensing equipment capable of being set to deliver the required quantity and to cut off the flow automatically when this quantity is discharged. The measurement must be accurate to within 3% of the quantity required.

b. Testing of Aggregates.

(1) Production of Class I Aggregate. If Class I aggregate is required, notify the Engineer in writing (include the source of the aggregate and the date production will start) at least 2 weeks in advance of producing the Class I aggregate. Failure to notify the Engineer, as required, may result in rejection of the aggregate as Class I aggregate. Maintain separate stockpiles at the quarry for Class I aggregate and mark them accordingly.

(2) Testing Aggregates at the Batch Site. Provide the Engineer with reasonable facilities at the batch site for obtaining samples of the aggregates. Provide adequate and safe laboratory facilities at the batch site that will allow the Engineer to test the aggregates for compliance with the specified requirements.

KDOT will sample and test aggregates from each source to determine their compliance with the Contract Documents. Batching of the concrete mixture is not permitted until the Engineer has determined that the aggregates comply with the Contract Documents. KDOT will conduct the sampling at the batching site, and test the samples according to the Frequency Testing Chart in Part V of the KDOT Construction Manual. For QC/QA Contracts, the Contractor will determine testing intervals within the specified minimum frequency.

After initial testing is complete and the Engineer has determined that the aggregate process control is satisfactory, use the aggregates concurrently with sampling and testing as long as tests indicate compliance with Contract Documents. During the batching operations, sample the aggregates as near the point of batching as feasible. Sample from the stream as the storage bins or weigh hoppers are loaded. If samples cannot be reasonably taken from the stream, take them from approved stockpiles. If test results indicate that an aggregate does not comply with Contract Documents, cease concrete production using that aggregate. Unless a tested and

approved stockpile for that aggregate is available at the batch plant, do not use any additional aggregate from that source and specified grading until subsequent sampling and testing of that aggregate indicate compliance with the Contract Documents. When tests are completed and the Engineer is satisfied that process control is again adequate, production of concrete using aggregates sampled and tested concurrently with production may resume.

c. Handling of Materials.

(1) Approved stockpiles are permitted only at the batch plant and only for small concrete placements or for the purpose of maintaining concrete production. Mark the approved stockpile with an "Approved Materials" sign. Provide a suitable stockpile area at the batch plant so that aggregates are stored without detrimental segregation or contamination. Unless otherwise approved by the Engineer, no more than 250 tons (Mg) of coarse aggregate and no more than 250 tons (Mg) of fine aggregate tested and approved by the Engineer may be stockpiled at the plant. If mixed aggregate is used, limit the approved stockpile to 500 tons (Mg), the size of each being proportional to the amount of each aggregate to be used in the mix.

Load aggregates into the mixer in such a manner that no material foreign to the concrete or material capable of changing the desired proportions is included. In the event 2 or more sizes or types of coarse or fine aggregates are used on the same project, only 1 size or type of each aggregate may be used on 1 continuous concrete placement.

(2) Segregation. Do not use segregated aggregates until they are thoroughly re-mixed and the resultant pile is of uniform and acceptable grading at any point from which a representative sample is taken.

(3) Cement, Fly Ash and GGBFS. Protect cement, fly ash and GGBFS in storage or stockpiled on the site from any damage by climatic conditions which would change the characteristics or usability of the material.

(4) Moisture. If the moisture content of an approved aggregate remains constant within a tolerance of 0.5% plus or minus from the average of that day, they may be used. However, if the moisture content in the aggregate varies by more than the above tolerance, then take whatever corrective measures are necessary to bring the moisture to a constant and uniform quantity before any more concrete is placed. This may be accomplished by handling or manipulating the stockpiles to reduce the moisture content or by adding moisture to the stockpiles in a manner that will produce a uniform moisture content through all portions of the stockpile.

If plant equipment includes an approved accurate moisture-determining device which will make possible the determination of the free moisture in the aggregates and provisions are made for batch to batch correction of the amount of water and the weight of aggregates added, the above requirements relative to handling or manipulating the stockpiles for moisture control will be waived. However, any procedure used will not relieve the producer of the responsibility for delivery of concrete of uniform slump within the limits specified.

Do not use aggregate in the form of frozen lumps in the manufacture of concrete.

(5) Separation of Materials in Tested and Approved Stockpiles. Only use KDOT Approved Materials. Provide separate means for storing materials approved by KDOT. If the producer elects to use KDOT Approved Materials for other work for his own convenience, during the progress of a project requiring KDOT Approved Materials, he must so inform the Engineer and agree to pay all costs of having the additional materials tested.

Clean all conveyors, bins and hoppers of unapproved materials before starting to manufacture concrete for the work.

402.8 MIXING, DELIVERY, AND PLACEMENT LIMITATIONS.

a. Concrete Batching, Mixing, and Delivery. Batch and mix the concrete in a central-mix plant, in a truck mixer, or in a drum mixer at the work site. Provide plant capacity and delivery capacity sufficient to insure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations must provide for the proper handling, placing and finishing of the concrete.

The Engineer must approve the concrete plant/batch site before any concrete is produced for the project. The Engineer will inspect and review the equipment, the method of storing and handling of materials, the production procedures, and the transportation and rate of delivery of concrete from the plant to the point of use. The Engineer will grant approval of the concrete plant/batch site based on compliance with the specified requirements. The Engineer may, at any time, rescind permission to use concrete from a previously approved concrete plant/batch site upon failure to comply with the specified requirements.

The mixing drum must be clean before it is charged with the concrete mixture. Charge the batch into the mixing drum so that a portion of the water is in the drum before the aggregates and cement. The flow of water into the drum throughout the batching operation must be uniform, with all of the water in the drum by the end of the first 15 seconds of the mixing cycle. Keep the throat of the drum free of accumulations that restrict the flow of materials into the drum.

Do not exceed the rated capacity (cubic yards (cu m) shown on the manufacturer's plate on the mixer) of the mixer when batching the concrete. However, the Engineer will allow an overload of up to 10% above the rated capacity for central-mix plants and drum mixers at the work site, provided the concrete test data for strength, segregation, and uniform consistency are satisfactory, and no concrete is spilled during the mixing cycle.

Operate the mixing drum at the speed specified by the mixer's manufacturer (shown on the manufacturer's plate on the mixer).

Mixing time is measured from the time all materials, except water, are in the drum. If it is necessary to increase the mixing time to obtain the specified percent of air in air-entrained concrete, the Engineer will determine the mixing time.

If the concrete is mixed in a central-mix plant or a drum mixer at the work site, mix the batch at least 60 seconds, but not more than 5 minutes at mixing speed, with the total mixing revolutions not exceeding 60 revolutions. Mixing time begins after all materials, except water, are in the drum, and ends when the discharge chute opens. Transfer time in multiple drum mixers is included in mixing time. Mix time may be reduced for plants utilizing high performance mixing drums provided satisfactory evidence can be provided to the Engineer that thoroughly mixed and uniform concrete is being produced with the proposed mix time. Performance of the plant must comply with the requirements of Table A1.1, of ASTM C 94, Standard Specification for Ready Mixed Concrete. Five of the six tests listed in Table A1.1 must be within the limits of the specification to indicate that uniform concrete is being produced.

If the concrete is mixed in a truck mixer, mix the batch at least 70 revolutions, but not more than 100 revolutions of the drum or blades at mixing speed. After the mixing is completed, set the truck mixer drum at agitating speed. Unless the mixing unit is equipped with an accurate

and dependable device that will indicate and control the number of revolutions at mixing speed, perform the mixing at the batch plant and operate the mixing unit at agitating speed while travelling from the plant to the work site. Do not exceed 300 total revolutions (mixing and agitating).

If a truck mixer or truck agitator is used to transport concrete that was completely mixed in a stationary central mixer, agitate the concrete while transporting at the agitating speed specified by the manufacturer of the equipment (shown on the manufacturer's plate on the equipment). Do not exceed 200 total revolutions (additional re-mixing and agitating).

Provide a time slip, for each batch of concrete delivered at the work site, issued at the batching plant that bears the time of charging of the mixer drum with cement and aggregates. On paving projects and other high volume work, the Engineer will determine the haul time and thereafter make random checks, and tickets for every load are not required.

If non-agitating equipment is used for transportation of concrete, provide approved covers for protection against the weather when required by the Engineer.

Place non-agitated concrete within 30 minutes of adding the cement to the water.

TABLE 402-8, Ambient Air Temperature and Agitated Concrete Placement Time

T = Ambient Air Temperature at Time of Batching °F (°C)	Time limit agitated concrete must be placed within, after the addition of cement to water (hours)	Admixtures
T < 75 (24)	1 ½	None
75 (24) ≤ T < 90 (32)	1	None
75 (24) ≤ T < 90 (32)	1 ½	Set Retarder
90 (32) ≤ T	1	None

In all cases, if the temperature of the concrete at time of placement is 90°F (32ºC) or above, or under conditions contributing to quick stiffening of the concrete, place the concrete within 45 minutes of adding the cement to the water. Do not use concrete that has developed its initial set. Regardless of the speed of delivery and placement, the Engineer will suspend the concreting operations until corrective measures are taken if there is evidence that the concrete can not be adequately consolidated.

Adding water to concrete after the initial mixing is prohibited, with this exception:

- If the concrete is delivered to the work site in a truck mixer, the Engineer will allow water (up to 2 gallons per cubic yard (10 L/cu m)) be withheld from the mixture at the batch site, and if needed, added at the work site to adjust the slump to comply with the specified requirements. Determine the need for additional water as soon as the load arrives at the construction site. Use a calibrated water-measuring device to add the water, and add the water to the entire load. Do not add more water than was withheld at the batch site. After the additional water is added, turn the drum or blades an additional 20 to 30 revolutions at mixing speed. The Engineer will supervise the adding of water to the load, and will allow this procedure only once per load.

b. Placement Limitations

(1) Placing Concrete at Night. Do not mix, place or finish concrete without sufficient natural light, unless an adequate and artificial lighting system approved by the Engineer is provided.

(2) Placing Concrete in Cold Weather. Unless authorized otherwise by the Engineer, discontinue mixing and concreting operations when the descending ambient air temperature

reaches 40°F (4ºC), and do not resume until an ascending ambient air temperature reaches 35°F (2ºC).

If the Engineer permits placing concrete during cold weather, aggregates may be heated by either steam or dry heat before placing them in the mixer. Use an apparatus that heats the weight uniformly and is so arranged as to preclude the possible occurrence of overheated areas which might injure the materials. Do not heat aggregates directly by gas or oil flame or on sheet metal over fire. Aggregates that are heated in bins, by steam-coil or water-coil heating, or by other methods not detrimental to the aggregates may be used. The use of live steam on or through binned aggregates is not permitted. Unless otherwise authorized, the temperature of the mixed concrete must be at least 50°F (10ºC), but not more than 90°F (32ºC) at the time of placing it in the forms. Do not, under any circumstances, continue concrete operations if the ambient air temperature is less than 20°F (-7ºC).

If the ambient air temperature is 35°F (2ºC) or less at the time the concrete is placed, the Engineer may require that the water and the aggregates be heated to at least 70°F (21ºC), but not more than 150° F (66ºC).

Do not place concrete on frozen subgrade or use frozen aggregates in the concrete.

As a general rule, do not use fly ash, GGBFS or blended cement between the dates of October 1, and April 1. However, if weather conditions are unusually warm, the Engineer may waive this rule on a day by day basis. The Engineer will consider the nighttime temperatures, the extended weather forecast and the performance and setting of the mix when deciding whether or not to waive the restrictions.

402.9 INSPECTION AND TESTING.

Obtain samples of fresh concrete for the determination of slump, weight per cubic meter, and percent of air from the site the concrete is placed, directly from the mixer, or at other points designated by the Engineer.

The Engineer will cast, store, and test strength test specimens in sets of 3.

KDOT will conduct the sampling and test the samples according to **Section 2500** and the Frequency Testing Chart in Part V of the KDOT Construction Manual. For QC/QA Contracts, determine testing intervals within the specified minimum frequency.

The Engineer will reject concrete that does not comply with specified requirements.

The Engineer will permit occasional deviations below the specified cement content, if it is due to the air content of the concrete exceeding the designated air content, but only up to the plus 1.5% tolerance in the air content. Continuous operation below the specified cement content for any reason is not permitted.

As the work progresses, the Engineer reserves the right to require the Contractor to change the proportions if conditions warrant such changes to produce a satisfactory mix. Any such changes may be made within the limits of the Specifications at no additional compensation to the Contractor.

401.10 AIR-ENTRAINED CONCRETE PAVEMENT (NON-QC/QA APPROACH)

a. Air Content for Portland Cement Concrete Pavement. Provide a target air content that complies with the following 2 criteria:

- a minimum air content by volume of 5.0%, and
- a maximum air void spacing factor of 0.01 inch (0.25 mm).

The Engineer will determine the air void spacing factor using the Air Void Analyzer (AVA) in accordance with the manufacturer's instructions using fresh concrete. Prequalify mixtures by either the laboratory option or the field option as stipulated below. Notify the engineer to arrange testing by the AVA.

b. Field Prequalification. Previous data on air content and air void spacing factors can be submitted as a basis of prequalification for a mixture if the same materials, proportions, equipment and procedures are used. The only exception allowed is a change in coarse aggregate sources if the grading is similar. The new aggregate source is required to comply with the same qualifications as the previous aggregate source. Alternately, produce a trial batch at a minimum air temperature of 60°F (16°C) using the batch plant and project materials. Test for air content by the procedure specified under laboratory prequalification. Correlate this air content to the average of at least 2 valid AVA test results. Valid AVA results have a maximum range of 0.0025 inch (0.06 mm). Convert the valid test results to a target air content at an air void spacing factor of 0.01 inch (0.25 mm) by this formula:

Target percent air content at 0.01 inch = Percent air measured + (measured spacing factor – 0.01)/0.001.
(Target percent air content at 0.25 mm = Percent air measured + (measured spacing factor – 0.025)/0.026).

c. Laboratory Prequalification. Prepare a trial mix using a drum-type mixer according to AASHTO T 126 using all of the materials in the proportions, except the air entraining agent, contemplated for use in the field. Laboratory mixes require more air entraining agent than is needed in the field. Consolidate a sample in the unit weight bucket by vibration in accordance with KT-20. Obtain 2 samples from the unit weight bucket for testing by the AVA. Valid results must have a minimum of 2 spacing factor readings within a range of 0.0025 inch (0.06 mm). Determine the air content of the trial mix by KT-19 (Roll-a-meter) or KT-18 (pressure meter) calibrated to yield the same result. Calculate a target percent air content at a maximum air void spacing factor of 0.01 inch (0.25 mm) using the equation in the field prequalification option.

d. Field Verification. Notify the engineer so production samples may be obtained behind the paver to establish the target air content on the first paving day. Produce concrete using the same materials and proportions that were used in the prequalification mixture. However, adjustments will be permitted in the dosage of air entraining agent and a 5% adjustment will be permitted in the water-cement ratio. Samples will be taken both in the path of a vibrator and the gap between vibrators. Perform the test for air content at the delivery site of the concrete KT-19 (Roll-a-meter) or KT-18 (pressure meter), calibrated to yield the same result. Make adjustments in the proportions, types of material, or the operation to establish a satisfactory target air content.

e. Control of the Air Content During Paving Operations. Maintain an average daily measured air content that is greater than the 3-point moving average target air content at 0.01 inch (0.25 mm) air void spacing factor. Maintain all production parameters established during field verification. However, the dosage of air-entraining agent may be varied to control the air

content. Five percent adjustments will be permitted to the cement content and the water-cement ratio. With AVA testing, 5% adjustments will be permitted to the aggregate proportions, as well as any adjustment to the water reducer. Comply with all specifications regarding production of fresh concrete. Maintain a tolerance on air content from a negative 1.0% to positive 2.0% by volume. Typically, design the mix at the target air content plus 0.5% air content. For all mainline paving, test the concrete at the beginning of the day's operation and approximately every 2 hours thereafter for air content. For all other slip formed pavement, test for air content at the beginning of a day's operation and approximately every 4 hours thereafter. Test hand placements for air content at least once daily. Failure to maintain the average air content for the day above the target air content will result in suspension of operation and necessitate a **Field Prequalification** and a **Field Verification** before resumption of full paving operations. Perform the test for air content at the delivery site of the concrete KT-19 (Roll-a-meter) or KT-18 (pressure meter), calibrated to yield the same result. Other similar designs using higher cement contents and the same admixture types and dosage (with the same or lower water-cement ratio) may be used in limited areas such as crossovers, etc. Unauthorized changes in any aspect of production are cause for rejection of the pavement.

Random checks of the air void spacing factor of the concrete in the path and gap of the vibrators will be conducted by the engineer to verify a maximum spacing factor of 0.01 inch (0.25 mm) at the target air content. Variations of the calculated target air content of 1.0% greater than the established target air content will require a new target air content or production adjustments.

401.11 AIR-ENTRAINED CONCRETE PAVEMENT (QC/QA APPROACH)

Note: The Bureau of Materials and Research will certify the Contractor's equipment and personnel.

a. Air Content for Portland Cement Concrete Pavement. Provide a target air content that complies with the following two criteria:

- a minimum air content by volume of 5.0%, and
- a maximum air void spacing factor of 0.01 inch (0.25 mm).

Determine the air void spacing factor using the Air Void Analyzer (AVA) in accordance with the manufacturer's instructions using fresh concrete. Prequalify mixtures by either the laboratory option or the field option as stipulated below.

b. Field Prequalification. Previous data on air content and air void spacing factors can be submitted as a basis of prequalification for a mixture if the same materials, proportions, equipment and procedures are used. The only exception allowed is a change in coarse aggregate sources if the grading is similar. The new aggregate source is required to comply with the same qualifications as the previous aggregate source. Alternately, produce a trial batch at a minimum air temperature of 60°F (16°C) using the batch plant and project materials. Test for air content by the procedure specified under laboratory prequalification. Correlate this air content to the average of at least 2 valid AVA test results. Valid AVA results have a maximum range of 0.0025 inch (0.06 mm). Convert the valid test results to a target air content at an air void spacing factor of 0.01 inch (0.25 mm) by this formula:

Target percent air content at 0.01 inch = Percent air measured + (measured spacing factor – 0.01)/0.001.

(Target percent air content at 0.25 mm = Percent air measured + (measured spacing factor – 0.25)/0.026).

c. Laboratory Prequalification. Prepare a trial mix using a drum-type mixer according to AASHTO T 26 using all of the materials in the proportions contemplated for use in the field, except the air entraining agent. Consolidate a sample in the unit weight bucket by vibration in accordance with KT-20. Obtain 2 samples from the unit weight bucket for testing by the AVA. Valid results must have a minimum of 2 spacing factor readings within a range of 0.0025 inch (0.06 mm). Determine the air content of the trial mix by KT-19 (Roll-a-meter) or KT-18 (pressure meter), calibrated to yield the same result. Calculate a target percent air content at an air void spacing factor of 0.01 inch (0.25 mm) using the equation in the field prequalification option.

d. Initial Startup. Produce concrete using the same materials and proportions that were used in the prequalification mixture. However, adjustments will be permitted in the dosage of air entraining agent and a 5% adjustment will be permitted in the water-cement ratio. Obtain production samples from behind the paver to establish the target air content on the first paving day. Take samples both in the path of a vibrator and the gap between vibrators. Perform the test for air content at the delivery site of the concrete by KT-19 (Roll-a-meter) or KT-18 (pressure meter), calibrated to yield the same result. Make adjustments in the proportions, types of material, or the operation to establish a satisfactory target air content.

e. Control of the Air Content During Paving Operations. Maintain an average daily measured air content that is greater than the 3-point moving average target air content at 0.01 inch (0.25 mm) air void spacing factor. Maintain all production parameters established during Initial Start-up. However, the dosage of air-entraining agent may be varied to control the air content. Five percent adjustments will be permitted to the cement content and the water-cement ratio. With AVA testing, 5% adjustments will be permitted to the aggregate proportions, as well as any adjustment to the water reducer. Comply with all specifications regarding production of fresh concrete. Maintain a tolerance on air content from a negative 1.0% to positive 2.0% by volume. Typically, design the mix at the target air content plus 0.5% air content. For all mainline paving, test the concrete at the beginning of the day's operation and approximately every 2 hours thereafter for air content. For all other slip formed pavement, test for air content at the beginning of a day's operation and approximately every 4 hours thereafter. Test hand placements for air content at least once daily. Failure to maintain the average air content for the day above the target air content will result in suspension of operation and necessitate a **Field Prequalification** and an **Initial Startup** before resumption of full paving operations. Perform the test for air content at the delivery site of the concrete KT-19 (Roll-a-meter) or KT-18 (pressure meter), calibrated to yield the same result. Other similar designs using higher cement contents and the same admixture types and dosage (with the same or lower water-cement ratio) may be used in limited areas such as crossovers, etc.

Conduct random checks of the air void spacing factor of the concrete in the path and gap of the vibrators to verify a maximum spacing factor of 0.01 inch (0.25 mm) at the target air content. Variations of the calculated target air content of 1.0% greater than the established target air content will require a new target air content or production adjustments. Prior to making any

changes to the cement ratio or aggregate gradation, verify the air void spacing. After the change, verify that the air void spacing is maintained within 0.01 inch (0.25 mm).

f. Sampling and Testing Frequency for the QC/QA Approach Using the AVA.

(1) Contractor:

- Prequalification: At least 2 test results falling within a range of 0.0025 inch (0.06 mm).
- Field Production: 1 per week. If there is a cease in production for a prolonged period (> 1 month), reconfirm prior to proceeding. Reconfirmation requires at least 2 test results falling within a range of 0.0025 inch (0.06 mm).

(2) KDOT District/MRC:

- Field Production: 1 KDOT test for every 4 Contractor tests.

02-06-06 M&R (REK)

PCC000064	Conc Grade 2.5	cu. yd.	90P-156-R*	ACCP
PCC000065	Conc Grade 2.5 (AE)	cu. yd.	90P-156-R*	ACCP
PCC000066	Conc (MA) Grade 3.0	cu. yd.	90P-156-R*	ACCP
PCC000067	Conc (CF) Grade 3.0	cu. yd.	90P-156-R*	ACCP
PCC000068	Conc (MA) Grade 3.0 (AE)	cu. yd.	90P-156-R*	ACCP
PCC000069	Conc (CF) Grade 3.0 (AE)	cu. yd.	90P-156-R*	ACCP
PCC000073	Conc (MA) Grade 4.0	cu. yd.	90P-156-R*	ACCP
PCC000074	Conc (CF) Grade 4.0	cu. yd.	90P-156-R*	ACCP
PCC000075	Conc (MA) Grade 4.0 (AE)	cu. yd.	90P-156-R*	ACCP
PCC000076	Conc (CF) Grade 4.0 (AE)	cu. yd.	90P-156-R*	ACCP
PCC000080	Conc (MA) Grade 4.0 (AE)(SW)	cu. yd.	90P-156-R*	ACCP
PCC000081	Conc (CF) Grade 4.0 (AE)(SW)	cu. yd.	90P-156-R*	ACCP
PCC000082	Conc (MA) Grade 4.0 (AE)(SA)	cu. yd.	90P-156-R*	ACCP
PCC000083	Conc (CF) Grade 4.0 (AE)(SA)	cu. yd.	90P-156-R*	ACCP
PCC000084	Conc (MA) Grade 4.0 (AE)(AI)	cu. yd.	90P-156-R*	ACCP
PCC000085	Conc (CF) Grade 4.0 (AE)(AI)	cu. yd.	90P-156-R*	ACCP
PCC000043	Conc (MA) Grade 4.5	cu. yd.	90P-156-R*	ACCP
PCC000044	Conc (CF) Grade 4.5	cu. yd.	90P-156-R*	ACCP
PCC000045	Conc (MA) Grade 4.5 (AE)(SW)	cu. yd.	90P-156-R*	ACCP
PCC000046	Conc (MA) Grade 4.5 (AE)(SA)	cu. yd.	90P-156-R*	ACCP
PCC000047	Conc (MA) Grade 4.5 (AE)(AI)	cu. yd.	90P-156-R*	ACCP
PCC000048	Conc (MA) Grade 4.5 (AE)(PB)	cu. yd.	90P-156-R*	ACCP
PCC000049	Conc (CF) Grade 4.5 (AE)(SW)	cu. yd.	90P-156-R*	ACCP
PCC000050	Conc (CF) Grade 4.5 (AE)(SA)	cu. yd.	90P-156-R*	ACCP
PCC000051	Conc (CF) Grade 4.5 (AE)(AI)	cu. yd.	90P-156-R*	ACCP
PCC000062	Conc (MA) Grade 5.0	cu. yd.	90P-156-R*	ACCP
PCC000063	Conc (CF) Grade 5.0	cu. yd.	90P-156-R*	ACCP
PCC000071	Conc (MA) Grade 5.0 (AE)	cu. yd.	90P-156-R*	ACCP
PCC000072	Conc (CF) Grade 5.0 (AE)	cu. yd.	90P-156-R*	ACCP

PCC000054	Conc (MA) Grade 5.0 (AE)(SW)	cu. yd.	90P-156-R*	ACCP
PCC000055	Conc (MA) Grade 5.0 (AE)(SA)	cu. yd.	90P-156-R*	ACCP
PCC000056	Conc (MA) Grade 5.0 (AE)(AI)	cu. yd.	90P-156-R*	ACCP
PCC000057	Conc (MA) Grade 5.0 (AE)(PB)	cu. yd.	90P-156-R*	ACCP
PCC000058	Conc (CA) Grade 5.0 (AE)(SW)	cu. yd.	90P-156-R*	ACCP
PCC000059	Conc (CA) Grade 5.0 (AE)(SA)	cu. yd.	90P-156-R*	ACCP
PCC000060	Conc (CF) Grade 5.0 (AE)(AI)	cu. yd.	90P-156-R*	ACCP
PCC000061	Conc (CF) Grade 5.0 (AE)(PB)	cu. yd.	90P-156-R*	ACCP