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.

Page 246, Section 402. Delete this Section and replace with the following:

SECTION 402

CONCRETE

402.1 DESCRIPTION.

Provide the grades of concrete specified in the Contract Documents.

402.2 MATERIALS.

Provide coarse, fine, and mixed aggregates that comply with the requirements of **Section 1100**.

Provide admixtures that comply with the requirements of **Section 1400**.

Provide cement, fly ash, and ground granulated blast furnace slag that complies with the requirements of **Section 2000**.

Provide water for concrete that complies with the requirements of **Section 2400**.

402.03 CONCRETE MIX DESIGN.

a. Concrete Mix Designs. 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 comply with these requirements:

- **Air-Entrained Concrete for Pavement.** Design air-entrained concrete for pavement according to these requirements:

TABLE 402-1, Air-Entrained Concrete for Pavement

Type of Aggregate (Section 1100)	kg of Cement per m^3 of Concrete, minimum	kg of Water per kg of Cement, maximum*	Percent of Air by Volume
Coarse and Fine	357	0.49	6.5±1.5
MA-2	357	0.49	6.5±1.5
MA-1	367	0.49	6.5±1.5

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

- **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 the Contract is awarded.

  Design optimized, air-entrained concrete for pavement according to these requirements:

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

Type of Aggregate (Section 1100)	kg of Cement per m^3 of Concrete, minimum*	kg of Water per kg of Cement, maximum**	Percent of Air by Volume	28-Day Compressive Strength (Mpa)
MA-3	309	0.49	6.5±1.5	27

*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 kg of water per kg of cement includes free water in aggregates, but excludes water of absorption of the aggregates.

  Submit the optimized concrete mix design and supply 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. The plus/minus tolerances will be used by the Contractor to perform quality control checks and by 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 27 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 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 the Department.

- **Concrete for Structures.** Design concrete for structures according to these requirements:

TABLE 402-3, Concrete for Structures		
Grade of Concrete: Type of Aggregate (Section 1100)	**kg of Cement per m^3 of Concrete, minimum***	**kg of Water per kg of Cement, maximum**
Grade 35:		
Mixed aggregate with 30% or more (by mass) on the 4.75 mm sieve	379	0.36
Coarse and Fine Aggregate	357	0.36
MA-2 with 45% or more (by mass) on the 4.75 mm sieve	357	0.36
Grade 30:		
Mixed aggregate with less than 30% (by mass) on the 4.75 mm sieve	413	0.42
Mixed aggregate with 30% or more (by mass) on the 4.75 mm sieve	379	0.42
Coarse and Fine Aggregate	357	0.42
MA-2 with 45% or more (by mass) on the 4.75 mm sieve	357	0.42
Grade 28:		
Mixed aggregate with less than 30% (by mass) on the 4.75 mm sieve	413	0.46
Mixed aggregate with 30% or more (by mass) on the 4.75 mm sieve	379	0.46
Coarse and Fine Aggregate	357	0.46
MA-2 with 45% or more (by mass) on the 4.75 mm sieve	357	0.46
Grade 25:		
Mixed aggregate with less than 30% (by mass) on the 4.75 mm sieve	379	0.48
Mixed aggregate with 30% or more (by mass) on the 4.75 mm sieve	357	0.48
Coarse and Fine Aggregate	334	0.48
MA-2 with 45% or more (by mass) on the 4.75 mm sieve	334	0.48
Grade 20:		
All Aggregates	312	0.55

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

- **Air-Entrained Concrete for Structures.** Design air-entrained concrete for structures according to these requirements:

TABLE 402-4, Air-Entrained Concrete for Structures			
Grade of Concrete Type of Aggregate (Section 1100)	**kg of Cement per m^3 of Concrete, minimum**	**kg of Water per kg of Cement, maximum********	**Percent of Air by Volume**
Grade 35 (AE), Grade 35 (AE)(SW)*, Grade 35 (AE)(SA), Grade 35 (AE)(AI)***, and Grade 35 (AE)(PB)****:**			
Mixed aggregate with 30% or more (by mass) on the 4.75 mm sieve	379	0.35	6.5±1.5
Coarse and Fine Aggregate	357	0.35	6.5±1.5
MA-2 with 45% or more (by mass) on the 4.75 mm sieve	357	0.35	6.5±1.5
Grade 30 (AE), Grade 30 (AE)(SW)*, Grade 30 (AE)(SA), and Grade 30 (AE)(AI)***:**			
Mixed aggregate with less than 30% (by mass) on the 4.75 mm sieve	413	0.40	6.5±1.5
Mixed aggregate with 30% or more (by mass) on the 4.75 mm sieve	379	0.40	6.5±1.5
Coarse and Fine Aggregate	357	0.40	6.5±1.5
MA-2 with 45% or more (by mass) on the 4.75 mm sieve	357	0.40	6.5±1.5

TABLE 402-4 continued on the next sheet

TABLE 402-4 continued			
Grade 28 (AE)			
Mixed aggregate with less than 30% (by mass) on the 4.75 mm sieve	413	0.44	6.5±1.5
Mixed aggregate with 30% or more (by mass) on the 4.75 mm sieve	379	0.44	6.5±1.5
Coarse and Fine Aggregate	357	0.44	6.5±1.5
MA-2 with 45% or more (by mass) on the 4.75 mm sieve	357	0.44	6.5±1.5
Grade 25 (AE):			
Mixed aggregate with less than 30% (by mass) on the 4.75 mm sieve	379	0.46	6.5±1.5
Mixed aggregate with 30% or more (by mass) on the 4.75 mm sieve	357	0.46	6.5±1.5
Coarse and Fine Aggregate	334	0.46	6.5±1.5
MA-2 with 45% or more (by mass) on the 4.75 mm sieve	334	0.46	6.5±1.5
Grade 20 (AE):			
All Aggregates	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 35 (AE)(PB) - Structural concrete with select aggregate for use in prestressed concrete beams.
*****Maximum limit of kg of water per kg of cement includes free water in aggregates, but excludes water of absorption of the aggregates.

- **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 these requirements:

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
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.

- **Design Air Content.** Use the middle of the specified air content range for the design of air-entrained concrete.
- **Admixtures for Acceleration, Air-Entraining, Plasticizing, Set Retardation, and Water Reduction.** 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.

  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.

Accelerating Admixture. 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 accelerating admixture.

Air-Entraining Admixture. If specified, use air-entraining admixture in the concrete mixture. If the concrete mixture also contains a plasticizing or a water reducing, high range admixture, use only a vinsol resin or tall oil based air-entraining admixture.

Plasticizing 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 plasticizing admixture is added to the concrete mixture. Do not add water after the plasticizing admixture is added to the concrete mixture.

Manufacturers of plasticizing admixtures 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.

Accomplish slump control in the field by redosing. If time and temperature limits are not exceeded, and if at least 30 mixing revolutions remain, the Engineer will allow redosing with up to 50 percent of the original dose.

Before the concrete mixture with plasticizing admixture 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 plasticizing admixture to obtain the desired properties. Determine the air content of the trial batch both before and after the addition of the plasticizing admixture. Monitor the slump, air content, temperature, and workability at regular intervals of the time period from when the plasticizing admixture 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.

Water Reduction and Set Retardation. 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 reducing and set retarding admixtures. If the Engineer approves the use of water reducing and set retarding admixtures, their continued use depends on their performance. It is the Contractor's responsibility to ensure that the admixtures will work as intended without detrimental effects.

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

TABLE 402-6, Slump

Concrete for:	Maximum Allowable Slump
Concrete Pavement	60 mm[(1)(2)]
Concrete for Structures & Air-Entrained Concrete for Structures	That required for satisfactory placement of the respective parts of the structure.[(1)]
Bridge Subdecks or Decks	75 mm[(1)]
TABLE 402-6 continued on the next sheet	

TABLE 402-6 continued	
Concrete with Plasticizing Admixture for Structures, Air-Entrained Concrete with Plasticizing Admixture for Structures, & Concrete with Plasticizing Admixture for Prestressed Beams	175 mm[3]

[1]If the designated slump is 75 mm or less, the tolerance is ±20 mm, or limited by the maximum allowable slump for the individual type of construction. If the designated slump is greater than 75 mm (without plasticizing admixture), the tolerance is ±25 percent of the designated slump.
[2]If the Engineer approves, slumps in excess of 60 mm are allowed for areas that are hand finished.
[3]If the Engineer approves the use of plasticizing admixture in the concrete, the tolerance from the designated slump is ±25 percent or 20 mm, whichever is larger, limited by the maximum allowable slump for the individual type of construction.

- **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 IS or Type III cement is not allowed. Fly ash is only permitted in concrete for pavement and concrete for precast pipes. The approved source of fly ash can not be changed during the Project.

  Substitute 1 kg of fly ash for 1 kg of cement. Substitution with Class C fly ash is limited to a maximum of 10 percent (by mass) of the specified amount of cement. Substitution with Class F fly ash is limited to a maximum of 20 percent (by mass) 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 substituted can not exceed 30 percent of the total.

  The maximum kg of water per kg of fly ash modified cement is the same as specified in **TABLE 402-3** for a 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 an independent laboratory, 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 performed according to the requirements of ASTM C 441. Use Pyrex glass aggregate and the same fly ash and cement proposed for use on the project, at the job mix percentages. The expansion for the mixture may not exceed the maximum of 0.020% at 14 days.

  Laboratories performing these tests must be regularly inspected by CCRL. The results must be furnished 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.

- **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 kg of GGBFS for 1 kg of cement. Substitution with GGBFS is limited to a maximum of 50 percent (by mass) 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 50 percent of the total.

The maximum kg of water per kg of GGBFS modified cement is the same as specified in **TABLE 402-3** for a 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 an independent laboratory, 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 performed according to the requirements of ASTM C 441. Use Pyrex glass aggregate and the same GGBFS and cement proposed for use on the project, at the job mix percentages. The expansion for the mixture may not exceed the maximum of 0.020% at 14 days.

Laboratories performing these tests must be regularly inspected by CCRL. The results must be furnished 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.

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

Grade of Concrete	Specimen Age	Unit Strength (Mpa)
Grade 35	28 days	45 Compressive
Grade 35 (AE)	28 days	45 Compressive
Grade 30	28 days	39 Compressive
Grade 30 (AE)	28 days	39 Compressive
Grade 28	28 days	36 Compressive
Grade 28 (AE)	28 days	36 Compressive
Grade 25	28 days	32 Compressive
Grade 25 (AE)	28 days	32 Compressive
Pavement	7 days	4 Flexural (third point loading)
Grade 20 or 20 (AE)	- - -	Not required

- **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.

b. 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 7.85 sacks (335 kg) of cement per cubic meter of concrete.
- The water-cement ratio is as designated by the Engineer. The maximum water-cement ratio permitted may not exceed 0.55 kgs of water per 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 furnish 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 25 or above, are allowable for use as commercial grade concrete, at no additional cost to the Department.

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 meters 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 mass test is required.

402.6 CERTIFIED CONCRETE.

If Department 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 Department standards. The Department'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 0.03 m^3 weighing 42.6 kg net. Measure bulk cement by mass. In either case, the measurement must be accurate to within 0.5 percent throughout the range of use.

(2) Fly Ash. Fly ash proportioning and batching equipment is subject to the same controls as required for cement. Ensure 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 mass or by volume. In either case the measurement must be accurate to within 1 percent throughout the range of use.

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

(5) Admixtures. Measure liquid admixtures by mass 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 percent 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.

The Department will sample and test aggregates from each source to determine their compliance with specifications. Batching of the concrete mixture is not permitted until the Engineer has determined that the aggregates comply with the specifications. The Department 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 specifications. 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 specifications, 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 specifications. 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 Mg of coarse aggregate and no more than 250 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 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 percent 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 mass 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 the Department. 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 (m^3 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 percent 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 conform to 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, do 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 transporting 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.

If the ambient air temperature at the time of batching is 23°C or less, place agitated concrete within 1½ hours of adding the cement to the water. If the ambient air temperature at the time of batching is between 24°C and 31°C, place agitated concrete within 1 hour of adding the cement to the water. If the ambient air temperature at the time of batching is between 24°C and 31°C, and a set retarding admixture is used in the mixture (at the Contractor's option), place agitated concrete within 1½ hour of adding the cement to the water. If the ambient air temperature at the time of batching is 32ºC or above, place agitated concrete within 1 hour of adding the cement to the water.

In all cases, if the temperature of the concrete at time of placement is 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 10 L/m^3) 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 4ºC, and do not resume until an ascending ambient air temperature reaches 2ºC.

If the Engineer permits placing concrete during cold weather, the Contractor may heat the aggregates by either steam or dry heat before placing them in the mixer. Use an apparatus that heats the mass 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. The Contractor may use aggregates that are heated in bins, by steam-coil or water-coil heating, or by other methods not detrimental to the aggregates. 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 10ºC, but not more than 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 -7ºC.

If the ambient air temperature is 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 21ºC, but not more than 65ºC.

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, mass 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.

The Department 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, the Contractor will 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 one and one half percent tolerance in the air content. Continuous operation below the specified cement content for any reason is not permitted.

If the slump of concrete with a plasticizing admixture is too high, the Engineer will allow the truck be held until it comes into compliance, provided it is within the time and temperature limits, and revolutions are not exceeded.

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.

03-30-01 M&R (REK)

PCC000064	Conc Grade 20	m^3	90M-156-R*	ACCP
PCC000065	Conc Grade 20 (AE)	m^3	90M-156-R*	ACCP
PCC000066	Conc (MA) Grade 25	m^3	90M-156-R*	ACCP
PCC000067	Conc (CF) Grade 25	m^3	90M-156-R*	ACCP
PCC000068	Conc (MA) Grade 25 (AE)	m^3	90M-156-R*	ACCP
PCC000069	Conc (CF) Grade 25 (AE)	m^3	90M-156-R*	ACCP
PCC000073	Conc (MA) Grade 28	m^3	90M-156-R*	ACCP
PCC000074	Conc (CF) Grade 28	m^3	90M-156-R*	ACCP
PCC000075	Conc (MA) Grade 28 (AE)	m^3	90M-156-R*	ACCP

PCC000076	Conc (CA) Grade 28 (AE)	m^3	90M-156-R*	ACCP
PCC000043	Conc (MA) Grade 30	m^3	90M-156-R*	ACCP
PCC000044	Conc (CF) Grade 30	m^3	90M-156-R*	ACCP
PCC000143	Conc (MA) Grade 30 (AE)	m^3	90M-156-R*	ACCP
PCC000144	Conc (CF) Grade 30 (AE)	m^3	90M-156-R*	ACCP
PCC000045	Conc (MA) Grade 30 (AE)(SW)	m^3	90M-156-R*	ACCP
PCC000046	Conc (MA) Grade 30 (AE)(SA)	m^3	90M-156-R*	ACCP
PCC000047	Conc (MA) Grade 30 (AE)(AI)	m^3	90M-156-R*	ACCP
PCC000049	Conc (CF) Grade 30 (AE)(SW)	m^3	90M-156-R*	ACCP
PCC000050	Conc (CF) Grade 30 (AE)(SA)	m^3	90M-156-R*	ACCP
PCC000051	Conc (CF) Grade 30 (AE)(AI)	m^3	90M-156-R*	ACCP
PCC000062	Conc (MA) Grade 35	m^3	90M-156-R*	ACCP
PCC000063	Conc (CF) Grade 35	m^3	90M-156-R*	ACCP
PCC000071	Conc (MA) Grade 35 (AE)	m^3	90M-156-R*	ACCP
PCC000072	Conc (CF) Grade 35 (AE)	m^3	90M-156-R*	ACCP
PCC000054	Conc (MA) Grade 35 (AE)(SW)	m^3	90M-156-R*	ACCP
PCC000055	Conc (MA) Grade 35 (AE)(SA)	m^3	90M-156-R*	ACCP
PCC000056	Conc (MA) Grade 35 (AE)(AI)	m^3	90M-156-R*	ACCP
PCC000057	Conc (MA) Grade 35 (AE)(PB)	m^3	90M-156-R*	ACCP
PCC000058	Conc (CF) Grade 35 (AE)(SW)	m^3	90M-156-R*	ACCP
PCC000059	Conc (CF) Grade 35 (AE)(SA)	m^3	90M-156-R*	ACCP
PCC000060	Conc (CF) Grade 35 (AE)(AI)	m^3	90M-156-R*	ACCP
PCC000061	Conc (CF) Grade 35 (AE)(PB)	m^3	90M-156-R*	ACCP