

## SECTION 801 GENERAL STATEMENT

### 801.01 ACCEPTANCE OF MATERIAL.

Acceptance of all material shall be as specified in Section 106.

### 801.02 SPECIFICATION OR SPECIAL PROVISION REQUIREMENTS.

Where the Department's Specifications or Special Provisions require that materials meet AASHTO, ASTM, AWPA or other Specification, the latest Specifications together with all interim Specifications which have been printed and distributed before the date of the invitation for bids shall apply.

## SECTION 802 PORTLAND CEMENT CONCRETE

### 802.01 DESCRIPTION.

- A. **General.** Portland Cement Concrete shall be composed of Portland Cement, aggregates, water, and any required or permitted admixtures or fly ash proportioned and mixed according to these Specifications.
- B. **Classification.**
1. **Classes.** These Specifications divide concrete into 3 general classes by cement (including fly ash when allowed) and water content as follows:

#### CEMENT CONTENT\*

CLASS OF CONCRETE	Sacks (94 lb.) per Cu. Yd.	MAXIMUM WATER CONTENT Gals. per Sack of Cement*
AA or AAE	6.5	5.00
A or AE	6.0	5.35
Y or YE	5.5	5.75

\*Cement content includes fly ash when allowed.

The class of concrete to be used for any item of work shall be as designated in the Contract.

2. **Air-Entrainment Designation.** The letter “E” following the alphabetical designation indicates air-entrained concrete.
3. **Coarse Aggregate Designation.** Section 816.02 A divides coarse aggregate into 3 size numbers based on gradation. The size of coarse aggregate to be used in the mix is designated by the numeral following the alphabetical designation for the class of concrete.

If the coarse aggregate size is not designated in the Contract, Size No. 3, 4, or 5 coarse aggregate may be used, subject to satisfactory results.

### C. Composition of Concrete.

1. **General.** The concrete mix will be designed by the Engineer according to the requirements for cement, water, aggregate, and for air content. Adjustments to the aggregate and water content may be made to produce a mix with the required composition, workability, and consistency. No adjustments in compensation will be made because of any increase or decrease in costs which may result from adjustments in aggregate proportions or water content.
2. **Cement Content.** The mix proportions will be adjusted as necessary to maintain the required cement content within a tolerance of  $\pm 2\%$  by weight. The cement content for the class of concrete being mixed shall be as shown in Section 802.01 B.1 except as follows:
  - a. If the concrete produced in the field does not meet the desired design strength, the cement content shall be increased until the strength requirements are met.
  - b. The Contractor will be reimbursed for additional cement required for the Department’s benefit according to Section 602.05 C.
3. **Water Content and Consistency.** The water content of the mixed concrete includes the quantity of mixing water measured into the batch plus any free water on the surface of the aggregates, but does not include water absorbed by the aggregates. The water content shall be the minimum required to produce a workable, plastic mix having a consistency which permits a satisfactory rate of discharge, proper placement, and consolidation of the concrete. For vibrated placing, the slump of the concrete should not exceed 3 inches before addition of admixtures. Where concrete is pumped from the mixer or truck, the slump shall be adjusted at the mixer to give the proper consistency at the point of deposit in the forms.

The maximum water content per sack of cement shall not exceed the quantity shown in Section 802.01 B.1 for the class of concrete being mixed.

4. **Aggregate Content.** The aggregate content of the concrete mix will be based on a saturated surface-dry condition of the aggregates. The Engineer will determine the relative proportions of fine and coarse aggregates and adjust the batch quantity of each aggregate as necessary to compensate for any free water on the surface of the aggregate or for any water that will be absorbed by the aggregate.

5. **Admixtures.** Substances other than cement, water, aggregates, and air-entraining agents shall not be used in the concrete except when a water reducing and retarding admixture is required by the Contract or approved by the Engineer. No reduction will be made in the specified cement content of the concrete mixture when admixtures are used. Admixtures containing calcium chloride and admixtures which interfere with proper control of the entrained air content of concrete shall not be used. Permission to use any admixtures may be withdrawn if the properties of the admixture are not uniform or if satisfactory results are not being obtained.

Should the Contractor request and obtain permission to use admixtures, no additional compensation will be allowed for the cost of furnishing and incorporating the admixture into the concrete mixture.

Specified admixtures will not be paid for directly but are considered an incidental item to the cost of the concrete.

A retarding admixture shall be required in Class AAE-3 concrete for bridge decks whenever the temperature of the concrete or the ambient air temperature at the time of placement exceeds 75°F. The proposed admixture shall be submitted for approval before use.

6. **Fly Ash.**

Fly ash replacement of cement is allowed on a 1:1 ratio, up to a maximum of 30% by weight.

Fly ash will not be allowed as a cement substitute when high-early-strength concrete is used.

#### D. **Air-Entrained Concrete.**

1. **Air Content.** The air content for air-entrained concrete shall not be less than 5% nor more than 8% of the volume of the freshly-mixed concrete.
2. **Method of Entraining Air.** Air may be entrained in the concrete by use of air-entraining cement, by an approved admixture, or by a combination of air-entraining cement and an approved admixture. The method used shall be at the option of the Contractor.

When air-entrained cement is used, an approved air-entraining admixture in the quantity required to maintain the air content within specified limits shall be furnished at the Contractor's expense.

Air-entraining admixtures shall be dispensed into the batch according to the requirements of Section 802.04 C.

#### E. **High-Early-Strength Concrete.**

1. **Methods.** High-early-strength concrete may be obtained by either of the following methods:
  - a. When Type I, IA, or II cement is used, the cement content shall be increased to 7.2 sacks of cement per cubic yard. The maximum water con-

tent shall be the same as the water content shown in Table 802.01 B.1. for the class of concrete specified.

- b. When high-early-strength cement Type III or IIIA is used, the cement content shall be as shown in Table 802.01 B.1 for the class of concrete being mixed.

- 2. **Conditions for Use.** High-early-strength concrete shall be used when specified in the Contract.

If not specified and high-early-strength concrete is ordered, the Contractor will be reimbursed for the extra cost of the high-early-strength cement (Type III or III A) or of the additional cement (Type I, IA, or II) used. Reimbursement will be according to Section 602.05.

When the Contractor requests and obtains permission to use high-early-strength concrete, no additional payment will be made for any extra costs incurred in producing and placing the high-early-strength concrete. High-early-strength concrete shall not be used on bridge decks.

**F. Tests on Concrete.**

- 1. **General.** Any concrete tests which are necessary to ensure proper control of the mix and compliance with the Specifications will be made according to the *Department of Transportation Field Sampling and Testing Manual*. The Contractor shall furnish the concrete necessary for these tests and provide suitable facilities for curing and storing test specimens.

Concrete will be sampled for testing when the concrete is discharged at the site of placement.

- 2. **Slump.** Consistency will be measured by slump tests according to AASHTO T-119.
- 3. **Air Content.** The air content of air-entrained concrete will be measured according to AASHTO T-152.
- 4. **Weight Per Cubic Foot.** The weight per cubic foot of concrete, batch volume, and cement content will be determined according to AASHTO T-121.
- 5. **Tests for Uniformity.** Uniformity will be tested by comparing the slump, air content, and coarse aggregate content of 2 individual samples taken from approximately the 1/6 and 5/6 points of the batch as discharged at the site of placement. The uniformity will be considered satisfactory if the results of the 2 samples do not differ by more than the following:
  - a. Slump . . . . . 3/4 inch or 25% of the average of the 2 samples, whichever is greater
  - b. Air Content . . . . . 1% by volume of concrete; and
  - c. Coarse Aggregate Content 6% by weight of the respective samples (portion of each sample retained when washed through a No. 4 sieve)

If the test results are not within the ranges specified above, the mixing time, batch size, or equipment methods used to proportion, mix, and transport the concrete shall be changed to produce concrete meeting all specified requirements.

6. **Strength Tests.** Concrete test specimens for compression and flexural strength tests will be made and cured according to AASHTO T-23. Concrete cylinders will be tested for compressive strength according to AASHTO T-22. Concrete beams will be tested for flexural strength according to AASHTO T-97.

## 802.02 MATERIALS.

- A. **General.** Unless otherwise specified, Type I, IA, or II cement shall be used.
- B. Materials shall meet the following:

<b>Item</b>	<b>Section</b>
Fine Aggregate	816.01
Coarse Aggregate	816.02
Cement	804.01
Water	812.01
Air-Entraining Admixture	808.01
Chemical Admixtures	808.02
Curing Materials	810.01
Fly Ash	820.01

## 802.03 EQUIPMENT.

Equipment shall meet the following:

<b>Item</b>	<b>Section</b>
General	151.01
Batching and Weighing Equipment	153.01
Mixer	153.02
Concrete-Transporting Equipment	153.03

## 802.04 CONSTRUCTION REQUIREMENTS.

- A. **Handling and Storing Materials.**
  1. **Handling and Storing Cement or Fly Ash.** Cement or fly ash of different types, brands, or sources shall be handled and stored separately. Cement or fly ash shall not be inter-mixed during use or used alternately in any one unit. Storage that protects the cement or fly ash against dampness shall be provided. Cement which contains caked lumps or is salvaged from spillage shall not be used.
  2. **Handling and Storing Aggregates.** Each separate aggregate component of different source or grading shall be handled and stockpiled separately. Adequate equipment and material shall be provided to assure a continuous batching operation. Changes in the source of aggregates during the progress of the work shall not be made unless authorized.

Aggregate hauling units shall not be operated on the stockpile. The provisions of Section 106.06 shall govern in constructing and handling of stockpiled material.

Aggregates which become intermixed with aggregates of different source or grading, or become contaminated by foreign materials shall be rejected and removed from the work site.

Aggregate will be rejected if segregation is found in any component unless the aggregate is uniformly remixed to meet the specified gradation.

Each stockpile site shall be cleared of vegetation and extraneous matter; and the ground shall be smooth, firm, and well drained. The bottom one foot of any stockpile shall not be used.

Washed aggregates shall be drained for at least 8 hours before use to ensure a stable and uniform moisture content. The moisture content shall not be considered stable if there is evidence of gravity drainage in the weigh hoppers or truck boxes. The moisture content shall not be considered uniform if the variations in moisture content of any aggregate component causes fluctuations in the consistency of successive batches of the mixed concrete. Freshly washed aggregates shall be stored separately from the drained aggregates in use.

## B. Batching of Concrete Materials.

### 1. Batching by Weight.

- a. **General.** When directed by the Engineer, the Contractor shall test the batching operation accuracy. The batched ingredient shall be weighed on a platform scale certified by the Department of Weights and Measures (North Dakota Public Service Commission) or a certified scale service. The Contractor shall bear all expenses and fees incurred in the accuracy tests.
- b. **Batching Cement.** Bulk cement shall be measured by weight with equipment meeting Section 153.01. The bulk cement batch weight shall not vary from the designated weight by more than  $\pm 1\%$ . Sacked cement furnished shall be considered to weigh 94 pounds per sack. Fractional sacks of cement shall not be used unless weighed.
- c. **Batching Fly Ash.** Bulk fly ash shall be measured by weight with equipment meeting Section 153.01. The bulk fly ash batch weight shall not vary from the designated weight by more than  $\pm 1\%$ .
- d. **Batching Aggregate.** Each separate aggregate component shall be measured by weight with equipment meeting Section 153.01. The aggregate batch weight of each aggregate component shall not vary from the designated weight by more than  $\pm 2\%$ .
- e. **Batching Water.** The mixing water for each batch may be measured by volume or by weight with equipment meeting Section 153.01 A. The designated quantity of mixing water shall be added to each batch, within a tolerance of  $\pm 1\%$ .

2. **Batching by Volume.** If a mobile mixer is used, it shall meet Section 153.02 C.

C. **Measuring and Dispensing Admixtures.** Any admixtures used in the concrete shall be accurately measured and dispensed using the manufacturer's recommendations to give a uniform distribution. Equipment and methods for measuring admixtures, the quantity of admixture used, and the time the admixture and water are placed in the batch shall be approved by the Engineer. The dispensing device shall repetitively control the batching of the admixture within an accuracy of  $\pm 5\%$  of the required volume of material or  $\pm 1$  fluid ounce, whichever is greater. Dispensing equipment shall be arranged to permit convenient, visual observation of the volume of admixture dispensed or the admixture may be dispensed by other approved mechanical or manual methods. Dispensing equipment shall be periodically checked and cleaned.

Where more than one admixture is used in the same batch, the admixtures shall be added separately to prevent contact in their concentrated form.

The Contractor may be required to produce trial batches of the concrete mix with the admixture before use to determine if the water reduction, set retardation, air content, and strength of the concrete mixture meets requirements. The same equipment, batch size, materials, etc., proposed for the work shall be used in preparation of these trial batches. If all test requirements are met, the trial batches may be incorporated into the work.

D. **Mixing and Transporting Concrete.**

1. **General.** The concrete may be mixed at the site of placement or by approved ready-mix methods. All concrete shall be mixed in approved, mechanically operated mixers meeting Section 153.02.

The concrete shall be mixed in the quantity required to provide continuous placement and finishing operations. Addition of water to retemper concrete is not permitted.

The mixer shall be operated so successive batches of concrete do not become merged or intermixed during the mixing cycle.

All concrete shall be mixed until the cement, water, aggregates, and admixtures are uniformly distributed. The concrete shall meet all requirements for slump, air content, and uniformity at the point of placement.

2. **Mixing in Stationary Mixers.** Stationary mixed concrete is concrete mixed completely in a central mixing plant.

The batch volume may exceed the rated capacity of the mixer by 10%, provided that concrete test data for strength and uniformity are satisfactory and the batch can be mixed without spillage.

The mixing time shall be measured from the time all solid materials are in the drum until discharge of that batch begins. The drum shall be charged so a portion of the mixing water enters in advance of the aggregates and cement. All remaining water shall be added after charging the aggregate and cement and

before 1/4 of the mixing time has elapsed. Transfer time in multiple-compartment mixers shall be included in mixing time. The mixing time per batch shall be a minimum of 60 seconds, except that: (1) when the concrete is used in pavement, the Engineer may give written permission to reduce the mixing time to a minimum of 50 seconds if concrete test data for strength and uniformity meet specifications; and (2) if the mixer is temporarily operated under manual timing control or has a rated capacity of less than 10 cubic feet, the concrete shall be mixed for a minimum of 90 seconds.

Concrete shall be delivered to the site of placement in an agitating truck, in a truck mixer operated at agitating speed, or in approved non-agitating equipment. The interval of time between introducing the cement to the mixture and the time the concrete has been completely discharged, shall not exceed 30 minutes in non-agitating equipment and 60 minutes in agitating equipment. These time limits shall be reduced if weather conditions affect the concrete adversely.

3. **Truck-Mixed Concrete.** Truck-mixed concrete is concrete proportioned at a central plant and mixed and delivered to the site of placement in a truck-mixer (known as ready-mixed concrete).

Truck-mixed concrete shall not be produced until all equipment, facilities, and methods for handling and storing materials and for proportioning, mixing, and transporting the concrete have been approved. If the concrete is not delivered to the site of placement at the times and rates necessary for continuous placement and finishing; or if the consistency, air content, or other properties of the concrete do not conform to specified requirements the use of truck mixed concrete shall be discontinued.

Equipment for transporting concrete shall meet Section 153.02 B. The volume of concrete placed in the truck-mixer shall not exceed the maximum capacity shown on the manufacturer's rating plate. The truck-mixer shall be cleaned at periodic intervals to prevent accumulation of hardened concrete, and shall be emptied of all free water before receiving any batch ingredients. The interval between the time cement has been placed in contact with the aggregates or the water and the time the concrete has been completely discharged shall not exceed 60 minutes. The maximum discharge time limit may be reduced if weather conditions affect the concrete adversely during the specified time interval.

Mixing shall not be less than 70 revolutions nor more than 100 revolutions after all ingredients are charged in the truck-mixer. If the batch volume is 90% or less than the rated mixing capacity, mixing may be reduced to a minimum of 50 revolutions. After mixing is completed, additional revolutions shall be at agitating speed. If water is added, the mixing drum shall be run an additional 30 revolutions at mixing speed after mixing has begun or been completed. Mixing and agitating speeds used shall follow the manufacturer's recommendations within the limits specified in Section 153.02 B.

Transit-mixed concrete shall be completely discharged at the site of placement within 60 minutes after the cement has been placed in contact with either the aggregate or the water. The 60-minute time limit may be extended by the Engineer to a maximum of 90 minutes if the ambient air and the con-

crete mix temperature at the time of mixing is less than 80°F., and if the mixed concrete meets the specified requirements for maximum water content and air content when discharged at the site of the work. The mix must be completely discharged within the 90 minutes. Addition of water to concrete will not be permitted after the 60-minute time limit.

## **SECTION 804 CEMENT AND LIME**

### **804.01 CEMENT.**

Cement shall meet the following:

<b>Type</b>	<b>Specifications</b>
Portland Cement	AASHTO M-85
Blended Hydraulic Cement	AASHTO M-240

Cement shall be stored and protected against dampness and contamination. Cement which has become partially set or which contains lumps or caked cement shall not be used.

### **804.02 LIME.**

Hydrated lime shall meet AASHTO M-216.

## **SECTION 806 GROUTS AND MORTAR**

### **806.01 RAPID-HARDENING CEMENTITIOUS MATERIALS.**

This material shall meet ASTM C-928. If no type is specified, the material shall meet Type R1.

### **806.02 EPOXY RESIN ADHESIVES.**

This material shall meet AASHTO M-235 Type IV Grade III.

## **SECTION 808 CONCRETE ADMIXTURES**

### **808.01 AIR-ENTRAINING ADMIXTURES.**

Air-entraining admixtures shall meet AASHTO M-154.