

**NATURAL RESOURCES CONSERVATION SERVICE
CONSTRUCTION SPECIFICATION**

IA-31 CONCRETE

1. SCOPE

The work shall consist of furnishing, forming, placing, finishing, and curing Portland cement concrete including steel reinforcement.

2. MATERIALS

Portland Cement shall conform to ASTM C 150 and shall be Type I or Type II.

Fine Aggregates shall conform to ASTM C 33 and shall be composed of clean, uncoated grains of material.

Coarse Aggregates shall be gravel or crushed stone conforming to ASTM C 33 and shall be clean, hard, durable and free from clay or coating of any character. The maximum size of coarse aggregate shall be 1 1/2 inches or as shown on the drawings.

Water shall be clean and free from injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances.

Air entraining agent shall conform to ASTM C 260.

Fly ash may be used as a partial substitution for Portland cement and shall be in strict compliance with ASTM C 618, Class F or C. The loss by ignition shall not exceed 4.0 percent.

Blast-furnace slag may be used as a partial substitution for Portland cement and shall be in conformance with ASTM C 989 for ground granulated blast-furnace slag (GGBF slag).

Water-reducing admixtures shall conform to ASTM C 494 and may be the following types:

1. Type A - Water-reducing admixture
2. Type D - Water-reducing and retarding admixture
3. Type F - Water-reducing, high range admixture (superplasticizer).
4. Type G - water-reducing, high range, and retarding admixture (superplasticizer).

Type D or G admixture may be used when the air temperature is over 80 degrees F. at the time of mixing and/or placement.

Calcium Chloride or other antifreeze compounds or accelerators will not be allowed.

Preformed expansion joint filler shall be a commercially available product made of bituminous, sponge rubber or closed cell foam materials with a minimum thickness of 1/2 inch.

Reinforcing steel shall be free from loose rust, oil, grease, paint, or other deleterious matter. Reinforcing steel shall conform to one or more of the following:

1. Reinforcing Bars - ASTM A 615 or A 996 , Grade 40 or greater, deformed.
2. Welded Wire Fabric - ASTM A 185 or A 497.

Waterstops shall be either metallic or nonmetallic. Metallic waterstops shall be fabricated from sheets of copper or galvanized steel. Nonmetallic waterstops shall be made of natural or synthetic rubber or vinyl chloride polymer or copolymer. Rubber, polymer and copolymer waterstops shall have ribbed or bulb-type anchor flanges and a hollow tubular center bulb, unless otherwise shown on the drawings. All waterstops shall be of the sizes shown on the drawings.

Curing compound shall be a liquid membrane-forming compound suitable for spraying on the concrete surface. The curing compound shall meet the requirements of ASTM C 309 Type 2 (white pigmented).

3. CONCRETE DESIGN MIX

The contractor will be responsible for the determining the design mix proportions in accordance with the requirements included in this paragraph and shall provide a copy of the mix to the NRCS Engineer at least 3 days prior to placing any concrete. The concrete mix shall be of such proportions as to provide a minimum strength of 3500 p.s.i. in 28 days, unless otherwise shown on the drawings. The air content shall be 4 to 8 percent of the volume of the concrete at the time of placement. The slump shall be 2 to 5 inches except when superplasticizer is used. The slump shall be 3 inches or less prior to the addition of superplasticizer admixture and shall not exceed 7 1/2 inches following addition and mixing. The fine aggregate shall be 30-50 percent of the total combined aggregate based on oven dry weights. The contractor shall provide tests to verify that the design mix meets the requirements. In lieu of this, one of the following mix proportions per cubic yard may be used:

<u>Mix Number</u>	<u>Minimum Cement, Pounds</u>	<u>Fly Ash, Pounds</u>	<u>GGBF Slag, Pounds</u>	<u>Maximum ** Water, Gallons</u>
1	564	0	0	33
2	470	45-90	0	31-34
3	517	129	0	31 *
4	366	114	91	31 *
5	259	103	155	31 *

** Total of available aggregate moisture, mixing water added at the plant and mixing water added at the job site (one gallon equals 8.33 pounds).

* Requires water reducing admixture.

4. MIXTURES AND MIXING

Ready-mixed concrete shall be batched, mixed and transported in accordance with ASTM C 94. Concrete shall be uniform and thoroughly mixed when delivered to the forms. No mixing water in excess of the amount shown for the design mix or in an amount that would cause the maximum slump to be exceeded shall be added to the concrete during mixing, hauling or after arrival at the point of delivery. The concrete shall be batched and mixed so that the temperature of the concrete at the time of placing shall be between 50 and 90 degrees F.

5. BATCH TICKET

The contractor shall obtain from the supplier a delivery ticket for each batch of concrete before unloading at the site. The following information shall be included on the ticket: name of concrete supplier, job name or location, date, truck number, amount of concrete, time loaded or time of first mixing cement, aggregate, and mixing water added at the plant, type and amount of cement, type and amount of admixtures, oven dry weights of fine and coarse aggregate, and moisture content(%) or weight of water contained in the aggregates.

The following information shall be added to the batch ticket on site: mixing water added on site, time concrete arrived on site and time concrete was unloaded.

Upon completion of the concrete placement, copies of all batch tickets shall be provided to NRCS.

6. REINFORCING STEEL

Before reinforcement is placed, the surfaces of the bars or mesh shall be cleaned to remove any loose, flaky rust, mill scale, oil, grease, or other foreign substances. After placement, the reinforcement shall be maintained in a clean condition until it is completely embedded in the concrete.

Reinforcing bars shall be cut and bent according to ACI Standard 315.

Tack welding of bars shall not be permitted. Reinforcement shall be accurately placed as shown on the drawings and secured in position in a manner that will prevent its displacement during placement of concrete. Metal chairs, metal hangers, metal spacers or concrete chairs shall be used to support reinforcement. Precast concrete chairs shall be manufactured from concrete equal in quality to the concrete being placed. Precast concrete chairs shall be moist at the time concrete is placed

Splices of reinforcing bars shall be made only at the locations shown on the drawings, unless otherwise approved by the NRCS Engineer. All reinforcing splices and placement shall be in accordance with ACI 318 and shown on the drawings.

After placement of the reinforcement, concrete shall not be placed until the reinforcement has been inspected and approved by NRCS.

7. PREPARATION OF FORMS AND SUBGRADE

Prior to placement of concrete, the forms and subgrade shall be free of woodchips, sawdust, debris, water, ice, snow, extraneous oil, mortar, or other harmful substances or coatings. Any oil on the reinforcing steel or other surfaces required to be bonded to the concrete shall be removed. All surfaces shall be firm and damp prior to placing concrete. Placement of concrete on mud, dried earth, uncompacted fill, or frozen subgrade will not be permitted.

The forms and associated false-work shall be substantial and unyielding and shall be constructed so that the finished concrete will conform to the specified dimensions and elevations. Forms will be mortar tight. Forms with torn surfaces, worn edges, dents or other defects will not be used. Forms shall be coated with a nonstaining form release agent before being set into place. Excess form coating material shall not stand in puddles in the forms or come in contact with the steel reinforcement or hardened concrete against which fresh concrete is to be placed.

Form accessories to be partially or wholly embedded in the concrete, such as ties and hangers, shall be of a commercially manufactured type. Non fabricated wire shall not be used. Form ties shall be constructed so that the ends or end fasteners can be removed without causing spalling at the surface of the concrete.

Metal form ties used within the forms on structures with a total volume of concrete exceeding fifteen cubic yards shall be equipped with cones or other devices that permit their removal to a depth of at least one inch without damage to the concrete. The holes resulting from cones and other devices shall be patched in accordance with Section 9.

Form ties except those specifically covered by the preceding paragraph shall be broken off flush with the formed surface. Any surface areas which have been spalled or otherwise damaged shall be repaired in accordance with Section 9.

Steel tying and form construction adjacent to new concrete shall not be started until concrete has cured at least 12 hours.

Concrete joints shall be of the type and at the locations shown on the drawings.

Splices in metal waterstops shall be brazed, welded or overlapped and bolted. Splices in nonmetallic waterstops shall be cemented or joined as recommended by the manufacturer.

8. PLACING CONCRETE

Concrete shall not be placed until the subgrade, forms, and steel reinforcement have been inspected and approved by the NRCS Inspector. Any deficiencies are to be corrected before the concrete is delivered for placement.

Concrete shall be delivered to the site and discharged into the forms within 1 1/2 hours after the introduction of the cement to the aggregates. When a superplasticizer is used, the concrete shall be discharged within the manufacturer's recommended time limit for discharge after addition of the admixture. In hot weather or under conditions contributing to quick setup of the concrete, discharge of the concrete shall be accomplished in 45 minutes unless a set-retarding admixture is used, in which case the manufacturer's recommended time limit will apply.

Addition of water at the job site may be done at the beginning of placement of each load of concrete in order to obtain allowable slump, provided that the maximum water content and water/cement ratio in the design mix is not exceeded. Addition of water will not be permitted after placement of the load has started.

The concrete shall be deposited as closely as possible to its final position in the forms and shall be worked into corners and around reinforcement and other embedded items in a manner which prevents segregation. Formed concrete shall be deposited in layers 24 inches or less in depth and shall be continuously deposited so that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of "cold joints". Concrete containing superplasticizer shall be placed in lifts not exceeding 5 feet in depth. If the surface layer of concrete sets during placement to the degree that it will not flow and merge with the succeeding layer when tamped or vibrated, the contractor shall discontinue placing concrete and install a construction joint. Construction joints shall be completed as shown on the drawings or by one of the following methods:

1. The joint shall be constructed using a 6 inch wide by 1/4 inch steel plate. The surfaces of the construction joint shall be prepared by washing and scrubbing with a wire brush or wire broom to expose coarse aggregate. The steel plate shall be embedded 3" in the concrete.
2. The joint surface shall be cleaned to expose coarse aggregate by sandblasting or air-water cutting after the concrete has gained sufficient strength to prevent displacement of the coarse aggregate or cement fines. The surface of the concrete shall not be cut so deep as to undercut the coarse aggregate. The joint shall be washed to remove all loose material after cutting.

The surfaces of all construction joints shall be kept continuously moist for at least 1 hour prior to placement of the new concrete. The new concrete shall be placed directly on the cleaned and washed surface. New concrete shall not be placed until the hardened concrete has cured at least 12 hours.

Concrete shall not be dropped more than 5 feet vertically unless suitable equipment is used to prevent segregation. Concrete containing superplasticizer shall not be dropped more than 12 feet vertically.

Immediately after the concrete is placed in the forms, it shall be consolidated by vibration, spading or hand tamping as necessary to insure smooth surfaces and dense concrete. Care should be taken not to over-vibrate concrete containing superplasticizer. Vibration shall not be supplied directly to the reinforcing steel, the forms or concrete which has hardened to the degree that it does not insure a monolithic bond with the preceding layer. The use of vibrators to transport concrete in the forms or conveying equipment will not be permitted.

9. FORM REMOVAL AND FINISHING

Forms shall be left in place for at least 24 hours after placing concrete. Forms shall be removed in such a way as to prevent damage to the concrete. Supports shall be removed in a manner that will permit concrete to take the stresses due to its own weight uniformly and gradually.

Immediately after removal of the forms, concrete which is honey combed, damaged or otherwise defective shall be repaired or replaced. All cavities or depressions resulting from form tie removal shall be patched with a non-shrink grout, mortar mix or epoxy-type sealer. Non-shrink grout consists of 1 part cement and 2-1/2 parts sand that will pass a No. 16 sieve. Only enough water shall be added to produce a filling which is at the point of becoming rubbery when the material is solidly packed.

All repaired and patched areas shall be cured as required in Section 10.

10. CURING

Concrete shall be cured for a period of not less than 7 consecutive days by one of the following approved methods:

- A. Membrane Curing: Concrete shall be cured with white pigmented curing compound. The compound shall be sprayed on moist concrete as soon as free water has disappeared, but shall not be applied to any surface until patching, repairs and finishing of that surface are completed. Curing compound shall not be applied to surfaces requiring bond to subsequently placed concrete, such as construction joints, shear plates, reinforcing steel, and other embedded items. Surfaces subjected to heavy rainfall or running water within 3 hours after curing compound has been applied or surfaces damaged by subsequent construction operations during the curing period, shall be reapplied in the same manner as the original application.
- B. Moist Curing: Concrete shall be cured by maintaining all surfaces continuously wet for the entire curing period.
- C. Cover: Adequately cover an exposed structure with burlap mats, or other material and continually soak with water.

11. BACKFILLING

Backfilling may begin when the curing period has ended. Backfill against the structure will be placed in no more than 4-inch layers and compacted by hand tamping or with manually directed power tampers or plate vibrators. Layers compacted in this manner shall extend not less than 2 feet from any part of the concrete structure.

12. HOT AND COLD WEATHER CONCRETING

When the atmospheric temperature may be expected to drop below 40^o F. at the time concrete is delivered to the work site, during placement, or at any time during curing period, concrete shall be mixed, placed and protected in accordance with ACI Standard 306, "Recommended Practice for Cold Weather Concreting."

When climatic or other conditions are such that the temperature of the concrete may reasonably be expected to exceed 90^o F. at the time of delivery to the work site, during placement or during the first 24 hours after placement, concrete shall be mixed, placed and protected in accordance with ACI Standard 305, "Recommended Practice for Hot Weather Concreting."

13. SPECIAL SPECIFICATIONS