

Construction Specification 732—Concrete

1. Scope

The work shall consist of furnishing, forming, placing, finishing, and curing Portland cement concrete as required to build the structures identified in the drawings.

2. Design of the Concrete Mix

The concrete manufacturer shall design a concrete mix with a minimum 5.5 bags of cement per cubic yard. The concrete mix shall have a 28-day compressive strength of 3,000 psi. Portland cement shall be Type I, IA, II or IIA. Fly ash may be used as a partial substitution for Portland cement in an amount not greater than 25 percent (by weight) of cement in the concrete mix.

The proportions of the aggregate shall be such as to produce a concrete mixture that will work readily into corners and angles of the forms and around reinforcement when consolidated but will not segregate or exude free water during consolidation. The maximum size of coarse aggregate shall be 1½ inches.

The slump shall be 3 to 5 inches. The air content by volume shall be 4 to 7 percent.

When specified or approved by the NRCS representative, a water-reducing, set-retarding, or other admixture shall be used.

Synthetic fibers may be added to the concrete mix. The fibers shall be polypropylene and added per manufacturer's recommendation. Synthetic fibers are not a substitute for steel reinforcement.

The contractor shall supply a letter from the concrete supplier to the NRCS representative certifying that the concrete mix design will provide the required compression strength. The mix design will be accompanied by test results verifying the compression strength.

3. Materials, Proportioning, Mixing, and Delivery

The concrete shall be delivered to the forms in accordance with the provisions of ASTM C 94.

Before unloading at the site, the contractor shall furnish the NRCS representative a batch ticket that includes 1) the name of the ready-mix company and batch plant, or batch plant number, 2) serial number of ticket, 3) date, 4) truck number, 5) name of purchaser, 6) specific class or designation of the concrete, 7) amount of concrete in cubic yards, 8) time loaded or of first mixing of cement and aggregates, 9) amount of water added by the purchaser or purchaser's representative and his initials, 10) type, brand and amount of cement, 11) class, brand and amount of coal fly ash, 12) type, brand and amount of admixtures, 13) type, brand and amount of fiber reinforcement, 14) source and amount of each metered or weighed water, 15) information necessary to calculate the total mixing water. Total mixing water includes free water on aggregates, batch water (metered or weighed) including ice batched at the plant, wash water retained in the mixing drum and water added by the truck operator from the mixer truck. 16) maximum size of aggregate, 17) mass (amount) of fine and coarse aggregate.

All materials used in concrete construction shall meet the applicable ASTM standards and/or ACI specifications.

4. Forms

Forms shall be of wood, plywood, steel, or other approved material and shall be mortar tight. The forms shall be substantial and unyielding and shall be constructed so that the finished concrete will conform to the specified dimensions and contours. Form surfaces shall be smooth and free from holes, dents, sags, or other irregularities. Forms shall be coated with a non-staining form release agent before being set into place.

5. Preparation of forms and subgrade

Prior to placement of concrete, the forms and subgrade shall be free of chips, sawdust, debris, water, ice, snow, extraneous oil, mortar, or other harmful substances or coatings. The temperature of all surfaces to be in contact with the new concrete shall not be less than 40 degrees Fahrenheit (°F). Any oil on the reinforcing steel or other surfaces required to be bonded to the concrete shall be removed.

Rock surfaces shall be cleaned by air-water cutting, wet sandblasting, or wire brush scrubbing, as necessary, and shall be wetted immediately before placement of concrete. The earth surface shall be firm and damp. Placement of concrete on mud, dried earth, or uncompacted fill or frozen subgrade is not permitted.

Items to be embedded in the concrete shall be positioned accurately and anchored firmly.

6. Conveying

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. In hot weather or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes.

The NRCS representative may allow a longer time, provided the setting time of the concrete is increased a corresponding amount by the addition of an approved set-retarding admixture. In any case, concrete shall be conveyed from the mixer to the forms as rapidly as practicable by methods that prevent segregation of the aggregates and assure no loss of mortar occurs.

7. Placing

Concrete shall not be placed until the subgrade, forms, steel reinforcement, and embedded items have been inspected and approved by NRCS. Reasonable notice shall be given to this person each time concrete is to be placed. Such notice shall provide sufficient time before the concrete is delivered for placing to give adequate time to inspect the subgrade, forms, steel reinforcement, and other preparations for compliance with the specifications.

The concrete shall be deposited as closely as possible to its final position in the forms. Slab concrete shall be placed to design thickness in one continuous layer. Formed concrete shall be placed in horizontal layers not more than 20 inches deep. Where a superplasticized concrete mix is used, formed concrete may be placed in horizontal layers not more than 5 feet deep. It shall be worked into the corners and angles of the forms and around all reinforcement and embedded items in a manner to prevent segregation of aggregates or excessive laitance. There shall be no excessive lateral movement of concrete by the use of a vibrator in the forms. Concrete shall not be dropped more than 5 feet vertically. When a superplasticized concrete mix is used, concrete shall not be dropped more than 12 feet vertically.

Immediately after the concrete is placed in the forms, it shall be consolidated by spading, hand tamping, or vibration as necessary to ensure a smooth surface and dense concrete.

If placing is discontinued when an incomplete horizontal layer is in place, the unfinished end of the layer shall be formed by a vertical bulkhead.

8. Construction joints

Construction joints are placed in a slab where concreting operations are concluded for the day, generally in conformity with a predetermined joint layout. If at any time concreting is interrupted long enough for the placed concrete to harden, a construction joint must be used.

Construction joints shall be made at the locations shown on the drawings. If construction joints are needed that are not shown on the drawings, they shall be placed in locations approved by the NRCS representative. Construction joints on unformed surfaces shall have a rough surface, and shall be moist cured for seven (7) days or until the adjoining concrete is placed.

The surface of construction joints shall be cleaned of all unsatisfactory concrete, laitance, coatings, or debris by washing and scrubbing with a wire brush or wire broom or by other means approved by the NRCS representative. The surface shall be kept moist for at least one (1) hour before the new concrete is placed, if the initial curing period has passed.

9. Isolation, Expansion and Contraction Joints

Joints shall be made only at locations shown on the drawings or approved by the NRCS representative. Isolation and expansion joints require the use of an expansion joint material. Preformed expansion joint filler shall be bituminous fiber-type material, cork or rubber. Expansion joint material shall be ½ inch thick, unless otherwise specified.

Exposed concrete edges at expansion and isolation joints shall be carefully tooled or chamfered, and the joints shall be free of mortar and concrete. Joint filler shall be left exposed for its full length with clean and true edges. Preformed expansion joint filler shall be held firmly in the correct position as the concrete is placed.

Reinforcing steel will not extend across joints. Contraction (control) joints may be formed, hand tooled, or sawed within 12 hours of concrete placement. Tooled or sawn joints will be to a depth of ¼ of the slab thickness.

10. Waterstops

Waterstops shall be fabricated of vinyl chloride polymer or copolymer, and shall be installed at locations shown on the drawings.

Waterstops shall be a minimum of 4 inches wide and web thickness shall be a minimum of 1/8 inches. The webs will be serrated or have “dumbbell” ends for anchorage into the concrete. Waterstops shall be held firmly in the correct position as the concrete is placed. Joints in rubber or plastic waterstops shall be cemented, welded or vulcanized as recommended by the manufacturer.

11. Removal of forms

Removal of forms, braces and supports shall be done so that the concrete surface is not damaged and sudden or excessive stresses are not induced. Forms for slabs shall not be loosened or removed for at least 12 hours after placing concrete. Concrete slabs will not be subjected to

design surface loads (vehicular traffic) for a period of 14 days.

12. Finishing formed surfaces

Immediately after the forms are removed, the surfaces shall be kept wet until all defects, holes and other irregularities have been repaired. All fins and irregular projections shall be removed from exposed surfaces.

Holes produced on all surfaces by the removal of form ties, con-bolts, she-bolts, and other items shall be cleaned, wetted, and filled with a dry-pack mortar, consisting of one part Portland cement, three parts sand that will pass a No. 16 sieve, and sufficient water to produce a consistency such that the filling is at the point of becoming rubbery when the material is solidly packed. An NRCS representative must approve other patching material and procedures prior to their use.

13. Finishing unformed surfaces

All exposed surfaces of the concrete shall be accurately screeded to grade and then float finished, unless specified otherwise. Excessive floating or troweling of surfaces while the concrete is soft is not permitted. Joints and edges on unformed surfaces that will be exposed to view shall be chamfered or finished with molding tools. Adding dry cement or water to the surface of the screeded concrete to expedite finishing is not allowed.

14. Curing

Concrete shall be prevented from drying for a curing period of at least seven (7) days after it is placed. Exposed surfaces shall be kept continuously moist for the entire period, or until curing compound is applied as specified below. Moisture shall be maintained by sprinkling, flooding, or fog spraying, or by covering with continuously moistened canvas, cloth mats, straw, sand, or other approved material. Wood forms left in place during the curing period shall be kept continuously wet. A formed surface shall be thoroughly wetted immediately after forms are removed and shall be kept wet until patching and repairs are completed. Water or covering shall be applied in such a way that the concrete surface is not eroded or otherwise damaged.

Concrete, except at construction joints, may be coated with the approved curing compound instead of continued application of moisture. Curing compound shall be Type 2 (white pigmented) and meet the requirements of ASTM C 309 and be applied according to the manufacturer's recommendations. The compound shall be sprayed on the moist concrete surface 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. The compound shall be applied to form a continuous membrane over the entire surface. Curing compound shall be thoroughly mixed before applying and continuously agitated during application. Curing compound shall not be applied to a surface requiring a bond to subsequently placed concrete, such as construction joints, shear plates, reinforcing steel, and other embedded items. If the membrane is damaged during the curing period, the damaged area shall be resprayed at the rate of application specified above.

15. Removal, Replacement or Repair

Concrete that is honey combed, damaged, or otherwise defective shall be repaired or removed and replaced. The NRCS representative will determine the required extent of removal, replacement, or repair. The plan for repair work must be approved by the NRCS representative prior to beginning the repair work.

16. Concreting in cold weather

Concrete shall not be mixed nor placed when the daily minimum atmospheric temperature is less than 40 °F or when predicted lows are below 32 °F in the following 72 hours of placement unless facilities are provided to prevent the concrete from freezing. The use of accelerators or antifreeze compounds is not allowed. The contractor shall submit a written plan to the NRCS representative for approval prior to placement detailing how the contractor will meet the requirements of the specification. No concrete placement will be permitted until a plan is approved.

Concrete shall be protected against freezing during the first 24 hours after placement whether or not the average weather conditions specified above for cold weather concreting exist. The following provisions also shall apply unless otherwise specified:

- a. The temperature of concrete shall be maintained between 55 °F and 75 °F at the time of placement.
- b. When the cement is added to the mix, the temperature of the mixing water shall not exceed 140 °F nor shall the temperature of the aggregate exceed 150 °F.
- c. The temperature of the adjacent air shall be maintained between 50°F and 90°F for a period of seven (7) days. Time starts at the time of concrete placement. Concrete structures shall be immediately protected after placement by covering, housing, insulating, or heating that will be sufficient to maintain the minimum temperature adjacent to the concrete surface.
- d. At the end of the protection period, the concrete shall be allowed to cool gradually. The maximum decrease at the concrete surface in a 24-hour period shall not exceed 40 °F.

17. Concreting in hot weather

Methods for concreting in hot weather shall be in accordance with the requirements set forth below.

For the purpose of this specification, hot weather concreting is defined when climatic conditions are such that the temperature of the concrete may reasonably be expected to exceed 90 °F at the time of delivery to the worksite or during the placement operations. For concreting in hot weather, the following provisions shall apply:

- a. The contractor shall maintain the temperature of the concrete below 90 °F during mixing, conveying, and placing. Concrete shall be placed within 45 minutes after mixing if the temperature of the concrete is 85 °F or above.
- b. Exposed concrete surfaces that tend to dry or set too rapidly shall be continuously moistened using fog sprays or other means to maintain adequate moisture during the time between placement and finishing. Water shall not be sprinkled or added directly to the surface of the concrete before finishing.
- c. Finishing of slabs and other exposed surfaces shall be started as soon as the condition of the concrete allows and shall be completed without delay. Water shall not be sprinkled or added to the surface of the concrete during the darbying, bull floating, floating, or other finishing operations to facilitate finishing.
- d. Exposed and unformed concrete surfaces, especially flat work placed with large areas of surface, shall be kept completely and continuously wet for the duration of the curing period or until curing compound is applied. The concrete shall be protected against thermal shock from rapid cooling (5 °F per hour or more than 40 °F per 24-hour period) of the concrete by application of curing water or temperature changes during the first 24 hours of the curing period.
- e. When any single or combination of conditions results in very rapid setting or drying of the

concrete, the NRCS representative may:

- (1) restrict placement to the most favorable time of the day,
- (2) restrict the depth of layers to ensure coverage of the previous layer while it will still respond readily to vibration,
- (3) suspend placement until conditions improve, and
- (4) restrict the removal of forms, repair, and patching to small areas, which can be protected with curing compound.