

**NATURAL RESOURCES CONSERVATION SERVICE
CONSTRUCTION SPECIFICATION**

CONCRETE CONSTRUCTION

1. SCOPE

This specification covers concrete construction for reinforced structures, plain concrete for waste storage pond liners, and other slabs.

2. PREPARATION OF FORMS AND SUBGRADE

Unless otherwise indicated on the construction drawings, concrete shall be placed on a smoothly graded soil or sand subgrade compacted, as necessary, to a uniform density throughout. Plain concrete, where vehicle traffic is expected, shall be placed on a minimum 100 millimeters (4 inches) of sand. Over-excavation shall be corrected by a procedure approved by the NRCS Engineer or the designated representative.

Concrete shall not be placed until the subgrade, forms and steel reinforcement have been inspected and approved by the NRCS Engineer or the designated representative. The Engineer shall be notified far enough in advance to provide time for the inspection.

Prior to placement of concrete, the forms and subgrade shall be free of chips, sawdust, debris, standing water, ice, snow, extraneous oil, mortar or other harmful substances or coatings.

Surfaces against which concrete is to be placed shall be firm and damp. Placement of concrete on plastic, mud, dried earth, or uncompacted fill or frozen subgrade will not be permitted.

3. FORMS

Forms shall be of wood, plywood, steel or other approved material and shall be mortar tight. The forms and associated falsework shall be substantial and unyielding and shall be constructed so that the finished concrete will conform to the specified dimensions and contours.

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

Tolerance on formed concrete is +10 millimeters (3/8 inch). Tolerance on concrete formed in earth is -25 millimeters to +152 millimeters (-1 inch to +6 inches).

4. CONCRETE MIX

Portland cement shall be Type I, IA, II or IIA (Type I with an added air entrainment admixture is preferred). If Type IA or IIA cement is used, additional air entrainment admixture shall be the same type that was used in the cement. Cement that is partially hydrated (hardened), or otherwise damaged, shall not be used. Air entrainment shall be 4 to 7 percent.

Aggregates shall consist of clean, hard, strong and durable particles that are free of silt, clay or any other material that may effect bonding of the cement paste.

Fine aggregate shall meet the requirements of INDOT fine aggregate number 23. Maximum coarse aggregate size shall be 3/4 inch.

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

Concrete shall have a minimum 28-day compressive strength of 24 MPa (3,500 psi). In lieu of strength tests, a mix containing an acceptable aggregate, 6 bags of cement per cubic yard and no more than 20.8 liters or 20.8 kilograms (5.5 gallons or 46 pounds) of water per bag of cement (including moisture in the aggregate) may be accepted.

The slump of the concrete shall be 75 to 125 millimeters (3 to 5 inches).

5. MIXING AND PLACING CONCRETE

Concrete shall be uniform and thoroughly mixed when delivered to the job sites.

Concrete shall be discharged into the forms, vibrated and spaded within 90 minutes after the cement has been introduced into the aggregates. When air temperatures are above 29°C (85°F), this time must be reduced to 45 minutes.

The Inspector may allow a longer time if an approved set retarding admixture is used.

Concrete shall be deposited as close as possible in its final position. It shall not be allowed to drop more than 1.5 meters (5 feet) in forms and must not be required to flow laterally more than 2.5 meters (8 feet).

If concrete must be dropped more than 1.5 meters (5 feet), hoppers and chutes, "elephant trunks", etc., shall be used to prevent segregation.

If concrete must be moved laterally more than 2.5 meters (8 feet), it shall be moved by shoveling, chutes, conveyors, wheelbarrows or similar equipment. Vibration must not be used to make concrete flow in the forms.

Immediately after placement, concrete shall be consolidated by spading and vibrating, or spading and hand tamping. It shall be worked into corners and angles of the forms and around all reinforcement and embedded items in a manner which prevents segregation or the formation of "honeycomb". Excessive vibration which results in segregation of materials will not be allowed. The vibrator head shall be kept vertical when inserted into the concrete and shall penetrate at least 6" into the previously placed layer.

Slab concrete shall be placed at design thickness in one layer, but walls should be placed in essentially horizontal layers not more than 0.6 meters (24 inches) high. Successive layers shall be placed and consolidated fast enough to ensure a good bond between layers and to prevent "cold joints".

If the surface of a layer in place will develop its initial set before more concrete is placed on it, a construction joint (of the type shown in the plan) shall be made.

If freshly mixed concrete is to be placed against hardened concrete, the hardened concrete must be clean, sound, fairly level and roughened with some coarse aggregate particles exposed. Any dirt, form oil, wood chips or other foreign material shall be removed.

Concrete surfaces shall be smooth and even. Careful screeding (striking-off) and/or wood or magnesium float finishing are required.

The addition of dry cement or water to the surface of screeded concrete to expedite finishing will not be allowed.

6. REINFORCING STEEL

Reinforcing steel shall be deformed bars manufactured specifically for concrete reinforcement and shall be 300 MPa (Grade 40) or higher (more details can be found in ASTM-A-615, A-616 or A-617).

Reinforcing steel shall be free from loose rust, concrete, oil, grease, paint or other deleterious coatings.

Reinforcement shall be accurately placed and secured in position in a manner that will prevent its displacement during the placement of concrete. This shall be accomplished by tying reinforcing steel or special tie bars to the form "snap ties" or by other methods of tying. No welding of either stress steel or temperature and shrinkage steel will be permitted. Reinforcing steel shall not be heated to facilitate bending.

In slabs, steel shall be supported by precast concrete bricks (not clay bricks), corrosion resistant metal chairs or plastic chairs.

The following tolerances will be allowed in the placement of reinforcing bars.

- a. Where 38 millimeters (1.5 inches) clear distance is shown between reinforcing bars and forms, allowable clear distance is 28 to 38 millimeters (1.125 to 1.5 inches).
- b. Where 50 millimeters (2 inches) clear distance is shown between reinforcing bars and forms, allowable clear distance is 40 to 50 millimeters (1.625 to 2 inches).
- c. Where 76 millimeters (3 inches) clear distance is shown between reinforcing bars and earth or forms, allowable clear distance is 63 to 76 millimeters (2.5 to 3 inches). Overexcavation backfilled with concrete shall not count toward clear distance.
- d. Maximum variation from indicated reinforcing bar spacing: 1/12th of indicated spacing, but no reduction in amount of bars specified.

Unless otherwise indicated on the drawings, splices of reinforcing bars shall provide a lap of not less than 30 diameters of the smaller bar but not less than 300 millimeters (12 inches). Bars will not be spliced by welding. Welded wire fabric shall be lapped at least one mesh width.

The ends of all stress or temperature and shrinkage bars shall be covered with at least 50 millimeters (2 inches) of concrete.

7. CURING

Concrete shall be prevented from drying for at least 7 days after it is placed. Exposed surfaces shall be kept continuously moist during this period by covering with moistened canvas, burlap, straw, sand or other approved material, unless they are sprayed with a curing compound or covered with a 4 mil or thicker polyethylene. Forms left in place during the curing period shall be kept wet.

Concrete, except at construction joints, may be coated with a curing compound in lieu of continued application of moisture. The compound shall be sprayed on moist concrete surfaces 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 be applied in a uniform layer over all surfaces requiring protection at a rate of not less than 1 liter per 3.7 square meters (1 gallon per 150 square feet) of surface or to manufacturer's recommendation, whichever is greater.

8. FORM REMOVAL AND CONCRETE REPAIR

Forms for structure walls shall not be removed until 24 hours or more after concrete placement. When forms are removed in less than 7 days, the concrete shall be sprayed with a curing compound or be kept wet continuously by methods allowed in Section 7 of this specification.

Forms shall be removed in such a way as to prevent damage to the concrete. Forms shall be removed before walls are backfilled.

Where minor areas of the concrete surface is "honeycombed", damaged or otherwise defective, it shall be removed, the area wetted and then filled with a dry-pack mortar.

Dry-pack mortar shall consist of one part portland cement and three parts sand, with just enough water to produce a workable consistency.

9. CONCRETING IN COLD WEATHER

Concrete shall not be mixed nor placed when the daily atmospheric low temperature is less than 4°C (40°F) unless facilities are provided to prevent the concrete from freezing.

Facilities for cold weather concreting shall consist of:

- a. Use of warm concrete with temperatures from 13^o to 18^oC (55^o to 65^oF).
- b. Adequate protection from the weather, including the use of artificial heat, to prevent the temperature of the concrete from falling below 10^oC (50^oF) for a period of 3 days, and the relative humidity of the air near the concrete from falling below 40 percent.
- c. Accelerators such as calcium chloride may not be used to speed the hardening of concrete.
- d. The contractor shall furnish to NRCS for approval, a written plan that shows how the contractor will meet the requirements of this specification. The plan must also show how the requirements of ACI Specification 306 will be met.

10. CONCRETING IN HOT WEATHER

Hot weather precautions should be taken when air temperatures are at or above 29^oC (85^oF).

Concrete temperature shall be less than 32^oC (90^oF) during mixing, conveying and placing.

11. BACKFILLING NEW CONCRETE WALLS

Heavy equipment may not be operated within 1 meter (3 feet) of the new concrete wall.

Compaction within 1 meter (3 feet) of the wall will be by means of hand tamping or small hand-held tamping or vibrating equipment.

Backfilling and compaction of fill adjacent to new concrete walls shall not begin in less than 10 days after placement of the concrete or until the concrete strength at the site has been tested to be at least 20 MPa (3,000 psi). Backfill material shall be the type indicated on the drawings and shall be free of large stones or debris.

12. ADDITIONAL ITEMS WHICH APPLY TO THIS JOB