

UNITED STATES DEPARTMENT OF AGRICULTURE  
NATURAL RESOURCES CONSERVATION SERVICE

---

CONSTRUCTION SPECIFICATION  
CS-41: "REINFORCED CONCRETE"

---

41.1 SCOPE

The work shall consist of furnishing, forming, placing, finishing, and curing Portland cement concrete. The structures shall be constructed at the location and to the line and grades as shown in the plan.

41.2 MATERIALS

The materials required for reinforced concrete are detailed in material specification MS-201, Concrete Aggregates; MS-202, Portland Cement; MS-203, Concrete; and MS-213, Steel Reinforcement.

41.3 HANDLING AND STORAGE

Materials shall be stored and handled in a manner that will minimize degradation, segregation, contamination or intermixing of materials.

41.4 MIXERS AND MIXING

Mixers shall be capable of thoroughly mixing the concrete ingredients into a uniform mass within the specified mixing time and discharge without segregation. Each mixer or agitator shall bear a manufacturer's rating plate indicating the rated capacity and recommended speeds of rotation, and shall be operated in accordance with the manufacturer's recommendations.

Concrete shall be uniform and thoroughly mixed when placed.

Water in excess of the amount specified in the mix design shall not be permitted. This includes any water added at the site.

41.5 TRUCK-MIXED CONCRETE

When concrete is mixed in a truck mixer loaded to its maximum capacity, the number of revolutions of the drum or blades at mixing speed shall not be less than 70 nor more than 100 RPM.

The resultant concrete mix must produce a dense and durable concrete during curing. The ready-mix concrete shall be mixed and delivered in accordance to ASTM C-94, "Standard Specification for Ready-Mix Concrete".

#### 41.6 SITE PREPARATION

Prior to placement of concrete, the forms, reinforcing steel, and subgrade shall be free of chips, sawdust, debris, water, ice, snow, extraneous oil, mortar, rust or other harmful substances and/or coatings. Rock surfaces shall be cleaned by wire brushing, wet sand-blasting, air water jets or other means satisfactory to the technical representative. Earth surfaces shall be firm and damp before placing concrete. Placement of concrete on mud, dried earth, uncompacted fill or frozen subgrade will not be permitted.

#### 41.7 SUBGRADE PREPARATION

The foundation area shall be cleared of all vegetation, organic material and rocks with a dimension greater than 2 inches. If fill material is required, it shall be placed in horizontal layers with a maximum lift of 4 inches before compaction. The moisture content of the earth fill material shall be controlled so that a firm dense foundation can be achieved. Earth fill sections with a height of 2 feet or greater will be constructed using the compaction requirements of NRCS Construction Specification CS-14, Earth Fill Class A or CS-15, Earth Fill Class S.

#### 41.8 FORMS

Forms shall be wood, plywood, steel or other approved materials and shall be mortar tight. The forms and associated falsework shall be substantial and unyielding conforming to dimensions of the finished grade. Form surfaces shall be smooth and free from holes, dents, sags, or other irregularities. Forms shall be coated with a nonstaining form release agent before being set into place.

All permanently exposed concrete edges shall be chamfered 3/4" unless otherwise indicated on the drawings.

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

Metal ties or anchorages within the forms shall be equipped with cones, she-bolts or other devices that permit their removal without injury to the concrete. Ties designed to break off below the surface of the concrete shall have removable cones.

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

#### 41.9 STEEL REINFORCEMENT

The steel reinforcement shall be grade 40 deformed steel bars unless otherwise specified on the drawings. The steel shall be securely tied and positioned to prevent movement during the placement of concrete. The reinforcing steel in slabs on grade shall be supported on blocks or

chairs. All blocks shall have a strength equal to or greater than the 28-day compressive strength of the concrete.

The length of splices shall be 30 diameters of the steel bar unless otherwise specified on the drawings. Welded splices are not permitted.

The bends shall be standard bends with the length and radius as specified by the Concrete Reinforcing Steel Institute, CRSI, and/or the Portland Cement Association, PCA.

#### 41.10 CONVEYING

The maximum length of time between introduction of the cement to the aggregates and placement of the concrete in the forms shall not exceed 1-1/2 hours for concrete temperatures below 85° F or 45 minutes for concrete temperatures above 85°F.

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

#### 41.11 PLACING

Concrete shall not be placed until the subgrade, forms, and steel reinforcement have been inspected and approved by the technical representative.

The person responsible for construction shall have all equipment and materials required for proper consolidation and curing, available at the site ready for use before placement of concrete begins.

The technical representative shall be notified a minimum of 24 hours prior to placement to inspect the reinforcing steel, forms, subgrade, curing preparation, vibrating equipment and plans for placement.

The depositing of concrete shall be regulated so that concrete may be consolidated with a minimum of lateral movement, segregation, laitance, or honey-combing. Hoppers and chutes shall be used as necessary to prevent segregation and the splashing to mortar on the forms and reinforcing steel above the placing level. Temporary stays and braces can be removed when no longer needed.

#### 41.12 LAYERS

Slab concrete shall be placed to design thickness in one continuous layer. Formed concrete in walls and columns shall be placed in horizontal layers not to exceed 20 inches.

Successive layers shall be placed at a fast enough rate to prevent the formation of “cold joints”. If a successive layer cannot be placed in a timely manner, a standard type construction joint shall be used between layers.

#### 41.13 CONSOLIDATION

Each concrete layer shall be completely consolidated by spading, hand tamping, or mechanical

vibrators as necessary to ensure smooth, dense concrete along form surfaces, in corners and around embedded items without segregation or laitance. Vibration shall extend into the previously placed layers of fresh concrete and laterally to ensure effective bond between layers.

The use of vibrators to transport concrete in the forms shall not be permitted.

Vibration shall not be applied directly to the reinforcement steel, forms, or to concrete that has begun to set.

#### 41.14 CONSTRUCTION JOINTS

Construction joints shall be made at locations with the dimensions shown on the drawings.

Surfaces of construction joints shall be cleansed of all unsatisfactory concrete, laitance, coatings, stains, or debris by washing and scrubbing with a wire brush or wire broom and kept moist for at least one hour prior to placement of new concrete.

In addition, the top surfaces of walls and columns shall be immediately and carefully protected from any condition that might adversely affect curing of concrete.

Where lap joints are used on horizontal slabs, the width on each side of the joint shall not be less than 6 inches and the depth shall be equal to one-half the slab thickness.

#### 41.15 EXPANSION AND CONTRACTION JOINTS

Expansion and contraction joints shall be made only at locations shown on the drawings. Exposed edges on these joints shall be carefully tooled, chamfered and free of mortar and concrete spillage.

Preformed expansion joint filler shall be held firmly in the correct position as the concrete is placed and shall be left exposed for its full length with clean and true edges.

#### 41.16 REMOVAL OF FORMS

Forms shall not be removed before the expiration of the following minimum time intervals after placement of the concrete, exclusive of days when the minimum temperature of air adjacent to the concrete is below 40 degrees Fahrenheit.

<u>Element</u>	<u>Time</u>
Beams, arches - supporting forms and shoring	14 days
Conduits, deck slabs - supporting (inside forms) and shoring	7 days
Conduits, (outside forms), side of beams, small structures	24 hours
Columns, walls, spillway riser - with side or vertical load	7 days
Concrete supporting not more than 20 feet of wall in place above it	24 hours

Age of stripped concrete shall be at least 7 days before any load is applied other than the weight of forms, scaffolds and succeeding lifts.

#### 41.17 FINISHING FORMED SURFACES

The following shall be done immediately after removal of forms.

- a. Removal of all fins and other surface irregularities which affect appearance or function.
- b. Removal all form bolts and ties to the depth of their cone.
- c. All cavities, holes and honey-combing shall be thoroughly cleaned, wetted and filled with dry pack mortar.
  1. The area to be patched shall be kept damp for three hours immediately prior to patching.
  2. The patching mortar shall be one part cement to three parts sand passing the number 16 sieve.
- d. The patching mortar shall be compacted to form a dense, well-bonded unit that is free from shrinkage cracks.
- e. All patched areas shall be cured as specified in paragraph 41.19.

#### 41.18 FINISHING UNFORMED SURFACES

All exposed surfaces of the concrete shall be accurately screened to grade and then wood float finished, except slip form lining which is finished by travel of the form.

All exposed concrete edges and joints shall be chamfered or finished with molding tools.

Excessive floating or toweling while the concrete is soft shall not be permitted. The addition of dry cement or water to the surface of the screened concrete shall not be permitted.

#### 41.19 CURING

Concrete shall be prevented from drying for a period of at least 7 days after placement.

Exposed surfaces shall be kept continuously moist for the entire period or until curing compound is applied. Formed surfaces shall be kept wet until patching or repairs are made. Curing compound shall not be used on areas that are to be bonded to other concrete or mortar. Curing compound when used shall be sprayed on the moist concrete structure 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 meet the minimum requirements of ASTM C-309, Type 2, unless otherwise specified on the drawing.

The curing compound shall be thoroughly mixed immediately before applying, and shall be applied at a uniform rate of not less than one gallon per 150 square feet of surface. It shall form a uniform, continuous, adherent film over the entire surface.

Curing compound shall not be applied to surfaces requiring bond with concrete remaining to be placed, construction joints, reinforcing steel, and embedded items. These areas shall be wet cured.

Concrete surfaces subjected to heavy rainfall, running water and/or other moisture damage within 3 hours after curing compound has been applied shall receive a second application.

#### 41.20 REMOVAL OR REPAIR

Concrete that is honeycombed, damaged, or otherwise defective, shall be removed or repaired and approved by the technical representative.

#### 41.21 CONCRETING IN HOT WEATHER

The temperature of the concrete shall be less than 90°F during mixing, conveying and placing. Concrete surfaces exposed to the air shall be kept continuously wet for the first 24 hours of the curing period, or until curing compound is applied. White pigmented coloring compound shall be used when the air temperature exceeds 90°F.

#### 41.22 CONCRETING IN COLD WEATHER

- a. Prior to placement of concrete, all ice, snow and frost shall be completely removed from all surfaces to be in contact with the concrete.
- b. The temperature of the concrete at the time of placement shall not be less than 50°F, nor more than 90°F. Heated water of 140°F, or less may be used when cement is added to the mix.
- c. The use of antifreeze or accelerator compounds is not allowed.
- d. When the daily minimum ambient air temperature at the site is less than 40°F, the concrete shall be protected for a minimum of three days following placement with insulated blankets or housing and heating.

#### 41.23 DELIVERY TICKETS

The delivery tickets for the mix delivered to the site shall identify all ingredients by weight except water and admixtures which may be measured by volume.

Delivery Tickets for each load of Ready-Mix concrete shall be furnished to the technical representative.