

SECTION 704 -- CONCRETE CONSTRUCTION

704.01 -- Description

1. This work shall consist of falsework and form construction and the handling, placing, curing, and finishing of concrete for bridges, box culverts, arch culverts, headwalls, concrete seals, retaining walls and steps, foundations, substructures, and miscellaneous structures. All work shall be done in accordance with these *Specifications* and the plans.

2. Also included in this Section is all work necessary to adapt existing structures for extension or reconstruction.

704.02 -- Material Requirements

1. The class of concrete shall be shown in the plans or specified in the special provisions.

2. When the plans or special provisions allow the use of more than one class of concrete, the Contractor shall advise the Engineer of the class of concrete to be used before the date of beginning of concrete construction on any project. No change shall be made in the class of concrete during the progress of the work without the written permission of the Engineer.

3. Materials shall conform to the requirements in Table 704.01.

Table 704.01

Material Requirements		
<u>Applicable Materials</u>		<u>Section</u>
Anchor Bolts	1057, 1058	
Curing Materials	1010, 1011, 1012	
Deformed Metal Center Joints and Metal Keyway		1027
Dowel Bars	1022	
Galvanized Hardware	1059	
Joint Sealing Filler	1014	
Paint and Paint Materials	1077	
Portland Cement Concrete		1002
Preformed Joint Filler	1015	
Reinforced Steel	1020, 1023, 1024	
Epoxy Coated Reinforcing Steel	1021	
Structural Steel	708	

704.03 -- Construction Method

1. The Contractor shall construct concrete structures as prescribed in the plans.

2. Foundation Preparation:

- a. Foundation excavations shall be as dry as practicable before concrete is placed.
- b. The Contractor shall place concrete in one continuous operation.
- c. Concrete shall not be placed in the superstructure until the substructure forms have been stripped and the concrete inspected for defects. The load of the superstructure shall not be allowed to bear on the substructure until its concrete has attained a compressive strength of 14 MPa.
- d. In the event that the Contractor is required to excavate for spread footings to depths greater than those shown in the plans, the Engineer shall redesign the structure's outline and reinforcement and provide the Contractor the appropriate revised plans.

3. Rock Anchors for Spread Footings:

- a. The Contractor shall anchor spread footings resting on rock with reinforcing bars of the size, length, and number shown in the plans.
- b. In rock, the reinforcing hole diameters shall be at least 2 times the bar diameters and shall be drilled to the depth indicated in the plans.
- c. The bars shall be centered in the holes and grouted in place.
- d. The grout shall be composed of 1 part cement and 2 parts sand and shall be placed by an approved method which will insure that the hole is completely filled with grout.
- e. Reinforcing bar holes need not be pumped out when grouting the bars if the method that is used for placing the grout does not cause grout mix segregation.

4. Preparation of Bearing Areas and Setting Anchor Bolts:

- a. The Contractor shall prepare bridge seats for bearing devices and shall finish the bridge seats to the elevations shown in the plans. The top shall form a true continuous plane surface.
- b. Anchor bolts shall be set at the time of placing the concrete, or they may be placed and grouted in blocked out holes.
- c. Anchor bolts shall be set plumb and at the proper location and elevation with templets.
- d. Blocked out wells for grouted anchor bolts may be either round or square and shall be 40 mm larger than the bolt diameter. An approved non-shrink grout shall be placed and vibrated or tamped to completely fill the well.
- e. Drilling holes for anchor bolts is not allowed.

5. Concrete Seal Course:

a. When shown in the plans or when conditions are encountered which render it impossible or impracticable to dewater the foundation bed in a satisfactory manner before and during the concrete placement, the Contractor will be required to construct a concrete foundation seal course below the elevation of the footing of such dimensions as may be necessary.

b. Concrete for such seal course shall conform to the requirements for concrete placed in still water as prescribed in Paragraph 13 of this Subsection.

c. When the seal course has been in place for at least 72 hours after completing the final placement, the cofferdam shall be cleared of water. The seal shall be capable of excluding water from below so that the balance of the structure may be completed.

d. Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of the movement of water through the fresh concrete.

e. No pumping will be allowed while placing the concrete, or for 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a watertight wall or other effective means.

f. Pumping to dewater a sealed cofferdam shall not commence until the seal course has been in place for at least 72 hours after completing the final pour.

6. Reinforcement:

Reinforcing steel shall be placed as prescribed in Subsection 707.03.

7. Falsework:

a. The Contractor is responsible for the falsework and its design. The falsework shall be designed by a Professional Engineer registered in Nebraska.

b. The Contractor shall submit falsework plans when they are required by plans or special provisions and for the following construction requirements:

(1) Support of plastic concrete for concrete slab bridges with spans greater than 15.25 m in length.

(2) Cast-in-place concrete girders.

(3) Concrete arch bridges.

(4) Support of girders or other large structural elements when falsework is used.

(5) Unusual or complicated work indicated in the plans.

- (6) Support of girders over or under active railroad tracks.
 - (7) Support of girders carrying traffic or extending over highways or streets carrying traffic.
- c. Falsework plans will not be required for the deck forming of girder-type bridges, but will be required when the concrete deck cantilevers more than 1.5 m beyond the exterior girder.
- d.
 - (1) Detailed falsework plans shall be submitted to the Department, in triplicate, and for information only. The supporting calculations or evidence of adequacy are also required by the Department.
 - (2) Falsework plans and calculations shall bear the seal of a Professional Engineer registered in Nebraska.
 - (3) The design of the falsework shall meet the requirements in AASHTO's *Standard Specifications for Highway Bridges* and their *Guide Design Specification for Bridge Temporary Works*.
 - (4) The falsework plans must be submitted to the Department prior to erection of any falsework elements.
 - (5) The Department's request for falsework plans and calculations will in no way constitute review and approval, and the Contractor shall be solely responsible for the falsework and its design.
- e. All falsework shall be designed and constructed to support the loads without appreciable settlement or deformation. The Contractor shall use approved jacks, wedges, or other means to take up any settlement in the formwork falsework before and during the placing of concrete.
- f.
 - (1) Falsework may be supported by pilings which shall be spaced, driven, and removed in a manner satisfactory to the Engineer.
 - (2) Falsework may also be supported by beams hung from the bridge's permanent substructure with the written approval of the Engineer.
 - (3) Highway grade separation structure falsework may be supported by mudsills if they are large enough to provide necessary support of the load.
- g. Falsework construction shall not begin until authorization to proceed is given by the Engineer. The Engineer will check completed falsework for conformity with the plans and for their general condition. Special attention will be given to lateral stability, bracing, fasteners, wedges, connections, and jacks.

h. Falsework shall be set up to produce a finished structure at the elevations and grades indicated in the plans. The Contractor shall consider and compensate for deflections that his/her method of construction creates.

i. Materials for falsework may be either new or used. All materials are subject to inspection by the Engineer to determine if they are suitable for their intended use. All materials which the Engineer determines to be damaged, defective, or otherwise unsuitable for use will be rejected. When a material item is a proprietary accessory or commercially available form unit, the manufacturer, proprietary name, and rated capacity of the item shall be shown on the falsework plans.

j. Falsework and falsework supports shall be protected against impact and the effects of vibration by placement of barriers or limiting the access of construction equipment.

k. All falsework piles in the stream channel shall be pulled when no longer needed.

8. Forms:

a. Formwork shall be constructed in accordance with the AASHTO *Guide Design Specification for Bridge Temporary Works*.

b. (1) Forms for concrete shall conform to the dimensions, lines, and grades shown in the plans. They shall be substantial, unyielding, and constructed mortar tight. They shall be sufficiently rigid to prevent distortion due to pressures of concrete, vibration, and other loads incidental to the construction operations.

(2) Aluminum or other materials that react adversely with the concrete shall not be used in the forms.

(3) (i) Forms for concrete floor slabs on steel or precast concrete girders or beams shall be hung from adequate metal hangers.

(ii) Metal hangers shall be certified to carry the expected loads.

(iii) They shall be adjustable to vary the slab thickness.

(iv) They shall be of such substantial design that no measurable settlement of forms occurs when the concrete deck is placed.

(v) Tack welding of form hangers or other miscellaneous hardware to the flanges of girders is prohibited.

c. (1) Concrete for exposed surfaces shall be cast against form panels or surfaces capable of producing a uniform surface, texture, and appearance at least equal to that obtained by using plywood form panels of good condition.

(2) Forms not capable of producing such a surface shall be lined.

(3) Adjacent panels shall be oriented and aligned so that the joints and grain give a continuous, uniform appearance.

d. Form liners shall be made of plywood, water-resistant composition board, or other approved material. Only one type of liner shall be used throughout the structure. Liners shall be a uniform size and as large as practical. Joints shall be tight and smoothly cut.

e. Forms shall be filleted or chamfered approximately 20 mm at all exposed corners.

f. (1) Metal ties or anchorages within the forms shall be designed to allow their removal to a depth of at least 15 mm from the face without damaging the concrete.

(2) Tie and anchorage cavities shall be filled with cement mortar and the surface left sound, smooth, even, and uniform in color.

(3) Protruding ends of plastic ties shall be removed flush with the concrete surface.

g. Forms shall be set and maintained true to the line designated without the use of temporary internal bracing.

h. Form surfaces shall be treated with a nonstaining form oil or other approved material. No material which will adhere to or discolor the concrete shall be used.

i. (1) Twelve hours after placing concrete, the reinforcing steel and form work for the succeeding pours may be set on the curing concrete.

(2) It is recognized that for the forming to proceed, it will be necessary to remove the wet burlap from the specific areas where the forming will take place. The exposed area shall be kept to an absolute minimum and shall be kept damp.

(3) Typical items which may be constructed in this manner include box culvert walls on floors, pier columns on footings, bridge curbs, and concrete rails on bridge slabs.

j. Construction equipment will be allowed on bridge floors 5 days after placing concrete provided the compressive strength is at least 21 MPa.

9. Removal of Forms and Falsework:

a. Care shall be taken in the removal of all forms. Steel prying tools shall not bear directly on fresh concrete.

b. Falsework or bracing supporting concrete structures and forms supporting concrete floor slabs on girder bridges shall remain in place until tests show that the concrete has attained a compressive strength of at least 15 MPa. In the absence of such tests, the requirements in Table 704.02 shall govern the length of time the falsework shall

remain in place, exclusive of the time during which the air temperature is below 4°C and the concrete is not protected.

Table 704.02

Minimum Formed Time	
Floor slabs	7 Days
Walls.....	14 Days
Columns	7 Days
Box Culvert Slabs	7 Days

c. (1) Supports shall be removed gradually so as to allow the concrete to support its own mass uniformly.

(2) Falsework supports shall be released near the center of the span and progress toward the end supports.

d. All falsework piles shall be removed in accordance with the requirements of Subsection 203.02, Paragraph 21.

10. Placing Concrete:

a. (1) The Contractor shall give the Engineer 1 NDR work day's advance notice before starting to place concrete in each unit of the structure.

(2) The forms and the reinforcement for a structure shall be set before any concrete is placed.

(3) Concrete shall not be placed in structures bearing on the soil until all pile driving within a radius of 8 m has been completed. If concrete pours must be made within this area before completion of pile driving, such concrete shall cure at least 3 days before further driving is allowed.

(4) All dirt, sawdust, and other extraneous materials shall be removed from the forms before concrete is placed.

b. (1) Concrete shall not be placed when weather conditions may damage the concrete or prevent proper construction.

(2) Mixing and concreting operations shall be discontinued when the descending ambient air temperature reaches 4°C and shall not be resumed until an ascending ambient air temperature reaches 2°C.

(3) Concrete shall not be placed on frozen material. When concrete is being placed and the air temperature may be expected to drop below 2°C, the concrete shall be protected.

c. The maximum allowable interval for placing successive concrete batches into forms shall be 30 minutes.

- d. The sequence of placing concrete shall be as shown in the plans.
- e. If any section of concrete is found defective, it shall be repaired or replaced, as directed by the Engineer, at no additional cost to the Department.
- f.
 - (1) Depositing and consolidating the concrete shall be done so that voids are not induced and the concrete is uniform and has smooth faces on all surfaces.
 - (2) Material segregation and displacement of the reinforcement shall be avoided.
 - (3) Concrete in girders shall be deposited uniformly for the full length of the girder and brought up in horizontal layers.
 - (4) Concrete placement shall be regulated to control fluid pressures.
 - (5) Special care shall be taken to work the coarse aggregate back from the face of the forms and to force the concrete under and around the reinforcement bars without displacing them.
 - (6) After the concrete has taken its initial set, care shall be exercised to avoid jarring the forms or placing any strain on the ends of projecting bars.
- g.
 - (1) When authorized by the Engineer, chutes and pipes may be used for conveying concrete to the forms.
 - (2) Equipment shall be arranged so that segregation does not occur.
 - (3) When steep chutes are necessary, the chutes shall be equipped with baffle boards or shall be in short sections that reverse the direction of the concrete's movement.
- h.
 - (1) After placing concrete in the forms, the concrete shall not be moved laterally more than 2 m.
 - (2) The forms shall be filled uniformly.
- i.
 - (1) All chutes and pipe shall be metal, metal lined plastic, rubber, or other nonreactive material.
 - (2) Chutes shall be kept clean and free from concrete coatings.
 - (3) Aluminum or aluminum alloys that react with the concrete shall not be used for chutes.
- j.
 - (1) Concrete free fall distance shall not exceed 1.5 m. This includes free fall in a discharge pipe.

(2) The concrete shall be discharged in a continuous stream free of air pockets so that a constant pressure head is maintained.

k. (1) Concrete shall be placed in continuous horizontal layers not more than 450 mm thick.

(2) Each layer shall be placed and consolidated before the preceding layer has taken an initial set.

(3) When a monolithic layer cannot be completed in one operation, it shall be terminated in a vertical bulkhead.

l. (1) When concrete placement is temporarily discontinued, the concrete shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete.

(2) To avoid visible joints at exposed faces, the top surface of the concrete adjacent to the forms shall be smoothed with a trowel.

(3) If a "concrete wedge" might be produced at a construction joint, as in the sloped top surface of a wingwall, an insert shall be placed in the form to block out the wedge layer so that the placed concrete thickness is never less than 150 mm.

m. (1) Immediately after placing concrete, all accumulations of mortar splashed on the reinforcement steel and the surfaces of forms shall be removed.

(2) Dried mortar chips and dust shall be kept out of the plastic concrete.

(3) Care shall be exercised in order not to injure or break the concrete-steel bond at and near the surface of the concrete while cleaning the reinforcement steel.

n. Cast-in-place concrete railings shall not be placed on concrete slab bridges until the falsework supporting the roadway slab has been removed.

o. Successive concrete pours can be made after the preceding pour is complete if the concrete compressive strength of the preceding pour has reached 14 MPa.

11. Pumping:

a. Concrete that is pumped into a form shall be in a continuous stream and free of air pockets. The concrete in the pipeline shall be ejected in such a manner that there will be no contamination or segregation of the concrete.

b. Pump discharge pipes shall be designed to maintain a positive pressure head on concrete, and the free fall distance shall not exceed 1.5 m at discharge.

c. Air tests, slump tests, and fabrication of concrete test cylinders shall be performed at the final discharge point.

12. Consolidation of Concrete:

a. The Contractor shall consolidate all concrete to a uniform density. Consolidation shall be accomplished by mechanical vibration during and immediately after being placed as prescribed in this Subsection.

b. Internal vibration shall be used.

c. (1) Vibrators shall be approved by the Engineer.

(2) The vibration frequency shall be greater than 4000 impulses per minute.

(3) The intensity of vibration shall visibly move the mass of concrete throughout a radius of 450 mm.

(4) The Contractor shall provide a sufficient number of vibrators to properly consolidate each batch immediately after it is placed in the forms.

(5) The Contractor shall have a tachometer available to check the speed of the vibrators.

d. (1) Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and embedded fixtures and into the corners and angles of the forms.

(2) The vibrators shall be inserted and withdrawn out of the concrete slowly.

e. The vibrations shall not cause segregation. Localized grout formation shall be avoided.

f. Application of vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective.

g. Vibrations shall not be applied directly or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration.

h. Vibrators shall not be used to move the concrete in the forms.

13. Placing Concrete Under Water:

a. The Engineer shall approve all concrete placed under water.

b. (1) Concrete placed under water shall be the same class and mix as used in the remainder of the structure except cement content shall be increased 10 percent.

(2) Concrete shall be tremied in place forming a compact mass. It shall not be disturbed after being deposited.

(3) Still water shall be maintained at the point of deposit, and the forms shall be watertight.

c. (1) The tremie shall consist of a watertight tube having a diameter of not less than 250 mm. It shall be constructed in sections having flexible, watertight couplings.

(2) The tremies shall not be constructed of aluminum or aluminum alloy that will react with the concrete.

(3) The tremies shall be supported to allow free movement of the discharge-end over the entire top surface of the work. They shall allow rapid lowering when necessary to retard or stop the concrete flow.

(4) The discharge end shall be closed at the start of the work so as to prevent water from entering the tube and shall be entirely sealed at all times. The tremie tube shall be kept full at all times.

(5) When a batch is dumped into the hopper, the concrete flow shall be induced by slightly raising the discharge-end, and yet always keeping it in the concrete that is being deposited.

(6) The flow shall be continuous until work is completed.

(7) Concrete shall be placed continuously from start to finish. The surface of the concrete shall be kept as nearly horizontal as practicable at all times.

d. Once the concrete has set, standing water shall be removed, the concrete inspected, and all laitance or other unsatisfactory material shall be removed from the surfaces.

14. Concreting in Cold Weather:

a. The following requirements shall govern the placement of concrete when the ambient temperature is less than 5°C:

(1) The temperature of the concrete shall not be less than 10°C immediately after being placed.

(2) The Contractor shall furnish heating equipment and/or enclose and protect the structure in such a way that the concrete and air surrounding it shall be maintained at a temperature between 10°C and 40°C for the first 72 hours after the concrete has been placed, and at a temperature between 5°C and 40°C for the next 48 hours. The temperature of the air surrounding the concrete shall be gradually reduced to the outside air temperature at a rate not faster than 3°C/h.

(3) Curing moisture must be maintained.

(4) The use of "salamanders" or other open flame heating units is prohibited. A shield shall be provided on heating equipment involving combustion so that no exposed metal will be in contact with the source of heat.

b. (1) The Contractor may use form insulation to maintain concrete at the temperatures indicated in Paragraph 14.a.(2) of this Subsection.

(2) The temperature of the concrete at the time of mixing may be adjusted to assure that the temperature of the concrete will not exceed 38°C due to the heat of hydration.

(3) The insulated forms shall remain in place for 5 days.

(4) The forms may be loosened slightly, if necessary, to control the temperature of the concrete below the maximum value specified. If loosening of the forms is necessary, prior approval of the Engineer must be obtained before the forms can be loosened.

(5) When forms are to be removed after the specified 5-day period, the fall of the concrete temperature shall not be at a rate faster than 3°C in any 1 hour.

(6) The Contractor shall provide 4 galvanized steel conduit tubes 25 mm in diameter and 300 mm long for each application of insulated forms. These tubes shall be provided with satisfactory rubber stoppers. The tubes shall be placed in the concrete as directed by the Engineer and shall be used to take the concrete's temperature. After curing is completed, the tubes shall be removed and the remaining holes shall be grouted.

c. The Contractor shall assume all risk connected with the placing of concrete during freezing weather, and permission given by the Engineer to place concrete during such time will in no way relieve the Contractor of the responsibility for satisfactory results. Any concrete showing damage from freezing shall be rejected.

15. Joints:

a. Joints shall be square and normal to the forms; and bulkheads shall be provided for all, except horizontal, joints.

b. Construction joints shall not allow movement of abutting surfaces. They shall be made only where located in the plans or indicated in the placing diagram unless otherwise provided in these *Specifications* and approved by the Engineer.

c. (1) Open, expansion, and fixed joints; water stops; and bearing seats shall be constructed according to the details shown in the plans.

(2) Open joint templates shall be placed and removed without chipping or breaking the corners of the concrete.

(3) When preformed, filled, expansion joints are specified, the material shall be placed in correct position as the concrete on one side of the joint is placed. When the form is removed, the concrete on the other side shall be placed.

(4) The plates, angles, or other structural components of steel joints shall be accurately shaped at the shop to conform to the sections of the concrete floor.

(5) Positive methods shall be employed in placing steel joints to keep them in correct position when placing the concrete.

d. (1) Before depositing new concrete on or against concrete which has hardened, the forms shall be retightened and the concrete surface shall be thoroughly cleaned of foreign matter and laitance.

(2) The placing of concrete shall be carried continuously from joint to joint. The face edges of all joints shall be carefully finished true to line and elevation.

16. Curing Concrete:

a. Exposed, unformed concrete surfaces which do not require a rubbed finish shall be wet-cured or membrane-cured.

b. (1) Surfaces from which forms have not been removed will not require covering and curing until the forms are removed.

(2) No additional covering or curing is required after the forms are removed if they were in place for at least 72 hours.

c. Unformed concrete surfaces which will receive a rubbed finish shall be wet-cured.

d. A wet-cure requires that immediately after finishing, the exposed concrete be covered with a double thickness of wet burlap, which shall be kept saturated for at least 72 hours.

e. (1) Membrane curing requires that immediately after finishing, the exposed concrete shall be sprayed with a continuous, uniform coating of white pigmented, membrane-forming curing compound. Details of application shall be as specified in Subsection 603.03, Paragraph 6.

(2) Curing compound shall not be applied to construction joints, reinforcing steel, or surfaces which are to receive a rubbed finish. Any compounds applied to such surfaces or items shall be removed by blast cleaning.

(3) The curing membrane shall be protected and maintained throughout the 72-hour curing period. Any damage to the membrane during this period shall be immediately repaired.

17. Concrete Surface Finish:

a. (1) The Contractor shall finish all concrete surfaces, except bridge decks, in accordance with the requirements of this Section.

(2) All formed concrete surfaces shall first be given an ordinary surface finish.

(3) Surfaces requiring a rubbed finish are shown in the plans.

(4) A "grout-cleaned" surface finish will be considered an acceptable alternate to a rubbed finish. Concrete cast against steel forms or smooth, hard form liners, such as masonite, metal, or fiberglass, may be given a "grout-cleaned" surface finish.

(5) Concrete surfaces which are not to receive a rubbed finish shall be float-finished.

b. Ordinary Surface Finish:

(1) Immediately following the removal of forms, all fins and irregular projections shall be removed from all surfaces.

(2) Cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges, and other defects shall be thoroughly cleaned, saturated with water, and then pointed and trued. The mortar shall be made from cement and fine aggregate mixed in the same proportions as the concrete class being finished.

(3) Mortar used in pointing shall be not more than 1 hour old.

(4) The mortar patches shall be cured as prescribed in this Subsection.

(5) All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete.

(6) The joint filler shall be left exposed for its full length with clean and true edges.

c. Rubbed Finish:

(1) Forms must be in place at least 12 hours, exclusive of time when the temperature is below 5°C, before they are removed to allow a rubbed surface finish.

(2) If forms are removed before curing is complete to apply a rubbed surface finish, the concrete shall be kept wet while exposed.

(3) When rubbing is completed, the surfaces shall be covered and the wet-cure resumed until a 72-hour wet-cure period is complete.

(4) The concrete surface to be finished shall be saturated with water.

(5) Rod holes and defects shall then be painted and allowed to set.

(6) The surface shall be rubbed with a medium coarse carborundum stone using a small quantity of mortar on its face. The mortar shall be composed of cement and fine sand mixed in the proportions used in the concrete being finished.

(7) Rubbing shall continue until all form marks, projections, and irregularities have been removed, all voids are filled, and a uniform surface has been obtained.

(8) The paste produced by this rubbing shall be left in place.

(9) The final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface has a smooth texture and uniform color.

(10) After the final finish is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder, and objectionable marks.

d. Grout Cleaned Finish:

(1) Surfaces to be grout cleaned shall be steel brushed to remove laitance and scale and to reveal partly obscured air bubble holes. Uneven form joints shall be ground smooth.

(2) The surface shall be dampened and covered with an application of grout composed of 1 part cement to 1.5 parts fine sand with sufficient water to produce a thick paint consistency.

(3) Immediately after application of the grout, the surface shall be scoured with a cork float or other suitable material. This floating shall completely fill all holes and other irregularities in the surface.

(4) When the grout is of such plasticity that it will not be pulled from the holes, a float of sponge rubber or burlap shall be used to remove excess grout.

(5) When the grout is thoroughly dry, the surface shall be vigorously rubbed with dry burlap to completely remove any dried grout. No visible film of dry grout shall remain.

(6) Grout cleaning shall be done when the air temperature is at least 5°C and rising. All cleaning on an area shall be completed the same day it is started.

(7) Cement for grout cleaning shall be Type I with white portland cement added as necessary to produce the desired color.

e. Floated Surface Finish:

(1) Exposed concrete surfaces shall be struck off with a wooden template. Sufficient excess concrete shall be maintained ahead of the strike-off so that coarse aggregate is forced below the surface.

(2) The surface shall be thoroughly worked with a wooden float to produce a reasonably smooth, fine-grained surface.

(3) Edges, corners, and joints shall be carefully finished by means of suitable edging tools.

18. Benchmarks:

a. This work shall consist of installing Department-furnished benchmarks on structures. The benchmarks shall be installed near the right corner of abutment No. 1 on the horizontal portion of the top of the concrete barrier rail (Jersey barrier).

b. The benchmark is a circular, 50 mm diameter, solid brass marker with a slightly domed head and a 50 mm long ribbed shank. The Contractor shall obtain the benchmarks at the District Office. The Department will stamp the benchmark with the required information. The Contractor shall cast the benchmark into the concrete so its perimeter is flush with the finished surface and the top is above the surface. Recessed installations are not acceptable.

19. When the plans provide for using any part of the existing concrete or masonry bridge or structure in the new bridge or structure, only those portions shall be removed which are so indicated in the plans. The connecting edges of the existing structure shall be cut, chipped, and trimmed to the required lines and grades without weakening or damaging that part of the structure to be retained. All existing reinforcing steel which is encountered shall be cleaned, straightened, and extended into the new work as shown in the plans.

20. The Contractor shall paint all exposed metal, except weathering grade steel, as prescribed in Section 709.

21. a. Concrete barrier curbs and bridge rails shall present a smooth, uniform appearance conforming to the horizontal and vertical lines shown in the plans or as directed by the Engineer, and shall be free of lumps, sags, or other irregularities.

b. The top and exposed surfaces of barrier curbs and rails shall not vary more than 6 mm from the edge of a 3 m straightedge, and the faces shall not vary more than 12 mm from the edge of a 3 m straightedge. Areas not conforming to the above requirements shall be removed and replaced by the Contractor at no additional cost to the Department.

704.04 -- Method of Measurement

1. a. The quantity of concrete for which payment will be made shall be computed by the Department in cubic meters from dimensions shown in the plans. No field measurement is required. Pay quantities are those shown in the plans.

b. The concrete seal course quantity will be measured in cubic meters of concrete placed within a volume bounded by vertical planes 450 mm outside and parallel to the limits of the footings.

2. The volume involved in fillets, scorings, and chamfers 600 mm² or less in cross sectional area shall be neglected.

3. The volume of precast or cast-in-place concrete piles encased in the concrete shall be deducted from the concrete plan quantity.

4. No deductions shall be made for the volume of concrete displaced by steel reinforcement, floor drains, or expansion joint material.

5. a. The Department will compute the quantity of concrete for box culverts based on the cross-sectional area of the culvert's walls times the centerline length of the culvert.

b. (1) An additional allowance is made for concrete box culverts constructed with either a horizontal or vertical break in barrel alignment.

(2) The additional allowance for each break in alignment shall be calculated by measuring the inside perimeter of the nominal box opening in meters, then dropping the units (meters) and multiplying the unit-less perimeter measurement times 0.125 m³.

6. "Preparation of Bridge at Station ____" is measured by the each.

704.05 -- Basis of Payment

1.	<u>Pay Item</u>	<u>Pay Unit</u>
	Class ____ Concrete for ____	Cubic Meters (m ³)
	Seal Course	Cubic Meters (m ³)
	Preparation of Bridge at Station ____	Each (ea)

2. All costs for concrete rails shall be included in the appropriate concrete and reinforcing steel pay items for the structure.

3. The seal course shall not be thicker than 230 mm, and any concrete placed in excess of 230 mm deep will be done at no additional cost to the Department. Seal course excavation is subsidiary to the seal course concrete.

4. All costs associated with obtaining benchmarks from the District Office and installing them shall not be measured for payment but shall be considered subsidiary to the items for which direct payment is provided.

5. Concrete curing shall be considered as subsidiary to the concrete construction.

6. Furnishing, placing, and grouting bars for rock anchors is subsidiary to the concrete bid item for the structure.

7. The construction of weep holes is subsidiary to the concrete bid item for the structure.

8. a. Payment deductions shall be taken when the measured 28-day compressive strength of cores or cylinders is less than the design compressive strength.

b. The pay deduction percentage is calculated as shown below:

$$\frac{2 \times (\text{Design Compressive Strength} - \text{Actual 28-day Compressive Strength})}{\text{Design Compressive Strength}} = \text{Percent Deduction}$$

c. (1) The actual 28-day compressive strength is determined by the average strength of all cylinders made on a specific day to determine the 28-day compressive strength of all of a group's class of concrete poured that day.

(2) If a cylinder's compressive strength is more than 5 percent below the design compressive strength, then the average of 3 core samples taken 28-30 days after the concrete was poured will be used to determine the compressive strength.

9. Payment is full compensation for all work prescribed in this Section.