

SECTION 55

CONCRETE MASONRY

55.1 DESCRIPTION

A. General

This work consists of false work and form construction and the furnishing, handling, placing, curing, and finishing of concrete for structures.

B. Related Work

Section 57	Reinforcement for Concrete Masonry
Section 100	Portland Cement
Section 101	Air-Entraining Admixtures
Section 102	Chemical Admixtures for Concrete
Section 104	Water for Use in Portland Cement Concrete
Section 105	Fine Aggregate for Use in Portland Cement Concrete
Section 106	Masonry Mortar Sand and Epoxy Resin Mortar Sand
Section 107	Coarse Aggregate for Use in Portland Cement Concrete
Section 108	Concrete Curing Materials
Section 113	Preformed Expansion Joint Filler for Concrete
Section 114	Concrete Joint Sealer
Section 123	Reinforcement

55.2 MATERIALS

- A. Cement shall conform to the requirements of Section 100. Type II cement shall be used for all concrete.
- B. Fine Aggregate shall conform to the requirements of Section 105.
- C. Coarse Aggregate shall conform to the requirements of Section 107.
- D. Water shall conform to the requirements of Section 104.
- E. Admixtures shall conform to the requirements of Section 101, ~~102~~, and 1023.
- F. Reinforcing Steel shall conform to the requirements of Sections 57 and 123.
- G. Curing Materials shall conform to the requirements of Section 108.
- H. Joint Filler shall conform to the requirements of Section 113.

- I. Joint Sealer shall conform to the requirements of Section 114.

55.3 CONSTRUCTION REQUIREMENTS

A. Quality of Concrete, Proportioning, and Mix Design

When the Contractor proposes to use materials for Portland Cement Concrete pavement from sources not previously accepted by the City, the Contractor shall obtain independent, certified laboratory tests that verify that the materials meet the requirements of the applicable sections listed in Section 55.2. Minimum number of tests is once each year per source unless otherwise ordered by the Engineer.

When the Contractor proposes to use a mix design not previously accepted by the Owner, the Contractor shall obtain independent, certified laboratory tests that verify that the mix design meets a minimum strength of 4000 psi at 28 days. Minimum number of tests is one test per mix design once each year, unless otherwise ordered by the Engineer. Test results shall include three each of 7-, 14-, and 28-day compressive strength; water-cement ratios; slump (to be consistent with proposed placement method), and air content. These results shall be obtained from separate mix design batches.

These mix design results will be used to monitor and adjust, if necessary, the PCC Pavement placed on the project.

The Contractor shall proportion the materials as set forth in the laboratory design mix. In case satisfactory plasticity, workability, or strength is not secured using the design mix designated, the Engineer may alter proportions as necessary. Adjustment will not be made in the compensation due the Contractor because of design mix alterations.

The slump of the concrete at the time of placement shall be maintained between two and five inches. The slump of the concrete used in bridge decks shall be maintained between one inch and three and one-half inches at the time of placement.

Concrete, except that used in bridge decks, shall contain six percent, plus or minus one and five-tenths percent entrained air. Concrete used in bridge decks shall contain six percent plus or minus one percent entrained air. Air shall be entrained by means of an approved air-entraining admixture.

B. Equipment

Equipment shall be at the jobsite sufficiently ahead of the start of construction operations to be examined thoroughly.

1. Batching Equipment

Batching plant structures shall be maintained and properly leveled within the accuracy required by the design of the weighing mechanism.

Hoppers shall fully discharge without jarring the scales.

Clearances between scale parts, hoppers, and bin structure shall be such as to avoid displacement of, or friction between, parts due to accumulations, vibration, or other cause. Pivot mountings shall be designed so the parts will not jar loose and so constructed as to assure unchanging spacing of knife edges under all circumstances. Scales shall be so designed that exposed fulcrums, clevises, and similar working parts may readily be kept clean.

Weighing hoppers and other parts upon which wind action may cause inaccuracy in weighing shall be protected by means of shelters or wind breaks.

The dials of scales shall be completely enclosed in weatherproof cases and provided with a glass opening to permit observation and reading.

Dial scales shall be provided with markers to indicate the position of the dial indicator for predetermined loads.

Beam scales shall be equipped with an over and under indicator, which will show the beam in balance at zero load and at any beam setting. The indicator shall have an over and under travel equal to not more than five percent (5%) of the capacity of the beam.

The scales for weighing aggregates, cement, water, and admixtures shall be of the beam or spring less dial type designed as an integral part of the batch equipment. The scales shall be accurate within one-half percent (1/2%) at any point throughout the range of use of the scale. Scale graduations shall be no greater than one-tenth percent (0.1%) of the capacity of the scale. The scales shall not be sensitive to the weight indicated by one graduation.

When water is measured by volume, the measuring equipment shall include an auxiliary tank from which the measuring tank shall be filled. The measuring tank shall be equipped with an outside tap and valve for checking the setting, unless other means are provided for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.

2. Mixing and Hauling Equipment

Mixers having a rated capacity of less than a one (1) bag batch shall not be used.

Mixers and agitators shall have attached, in a prominent place, the manufacturer's plate or plates showing the various uses for which the equipment

is designed and the capacity of the drum or container in terms of volume of mixed concrete.

The pickup and throw-over blades in the drum shall be restored or replaced when any part or section is worn down three-fourths (3/4) inches or more below the original height of the manufacturer's design. The Contractor shall have available a copy of the manufacturer's design showing dimensions and arrangement of blades in reference to original height and depth. Mixers that have an accumulation of hard concrete or mortar in them shall not be used.

Mixers, except truck mixers, shall be equipped with an approved timing device, which will automatically lock the discharge lever, when the drum has been charged, and release it at the end of the mixing period. The timing device shall be equipped with a bell or other suitable warning device adjusted to give a signal each time the lock is released.

Truck mixers shall be equipped with counters by which the number of revolutions of the drum or blades may readily be verified. The counters shall be automatically actuated at the time of starting mixing at mixing speed.

Mixers shall be capable of combining the ingredients of the concrete into a thoroughly mixed and uniform mass and discharging the concrete with a satisfactory degree of uniformity.

The hauling bodies of non-agitating equipment shall be smooth, mortar-tight metal containers equipped with gates that permit control of the discharge of the concrete.

3. Wood Forms

Forms shall be designed, built, and maintained to sustain the pressure and weight of the green concrete and construction loads, which will come upon them. The design of the forms shall take into account the effect of vibration of the concrete as it is placed.

Forms or form lumber, which is to be reused, shall be clean and in good condition. Lumber that is split, warped, bulged, or marred, or that has other defects which may produce inferior work shall not be used.

The forms for concrete surfaces shall be constructed to produce mortar-tight joints and smooth, even, concrete surfaces. Forms shall be filleted at all sharp corners and shall be given a bevel or draft in all projections, such as girders and copings, to insure easy removal.

The required strength and smoothness may be obtained by lined forms or metal forms.

Metal ties or anchorages within the forms shall be constructed to permit their placement without injury to the concrete. In case ordinary wire ties are permitted, all wires, upon removal of the forms, shall be cut back at least one-quarter inch from the face of the concrete. Fittings for metal ties shall be of such design that, upon removal, the cavities that are left, will be of the smallest practical size.

Forms shall be set and maintained true to the line designated until removal is permitted. When forms appear to be unsatisfactory, either before or during the placing of concrete, the Engineer shall order the work stopped until the defects have been corrected.

Forms shall be surface treated with oil or saturated with water immediately before placing the concrete. For members with exposed faces, the forms shall be surface treated with an approved oil to prevent the adherence of concrete. Material, which will adhere to or discolor the concrete, shall not be used.

4. Metal Forms

The requirements for wood forms, in regards to design, mortar tightness, filleted corners, beveled projections, bracing, alignment, reuse, and oiling shall also apply to metal forms. The metal used for forms shall be of such thickness that the forms will remain true to shape. Bolt and rivet heads shall be countersunk. Clamps, pins, or other connecting devices shall hold the forms rigidly together and allow removal without injury to the concrete. Metal forms, which do not present a smooth surface or line up properly, shall not be used. Special care shall be exercised to keep metal forms free from rust, grease, and other foreign matter, which will discolor the concrete.

C. False work

The Contractor shall submit four sets of detailed false work and centering plans for all bridges for review. The plans shall be submitted to provide the Engineer ample time for review prior to placing concrete. The Contractor shall also state on the plans the approximate date that he intends to place the concrete. Concrete placement will not be permitted unless false work plans have been reviewed and comments conveyed to the Contractor.

False work and centering shall be designed and constructed to provide the necessary rigidity and to support the dead and live loads to which it may be subjected during construction, without appreciable settlement or deformation.

The Contractor shall be responsible for the use of these plans and the strength of false work and centering.

On continuous concrete bridges, transverse construction joints may be used at the one quarter (1/4) points of any span adjacent to interior bents, provided the following requirements are adhered to:

1. A false work bent must be located at each transverse construction joint.
2. A placing sequence indicating the location of all joints and the sequence and direction of placements must be submitted to the Engineer for approval.
3. Concrete shall attain a minimum strength of three thousand (3000) psi between successive pours.
4. False work plans shall be submitted with the placement sequence if not previously submitted.

D. Handling, Measuring, and Batching Materials

The separate aggregate components shall not become intermixed prior to being weighed, and the weigh hopper or hoppers shall be charged to result in batched weights within the following tolerances:

When fine and coarse aggregates are weighed cumulatively, the aggregate batching equipment shall be operated within a delivery tolerance of one-half of one percent of the net weight of the total aggregate batch.

When fine and coarse aggregates are weighed separately, the aggregate batching equipment shall be operated within a delivery tolerance of two percent of the weight of the material being weighed.

Cement shall be measured by the sack or by weight. When cement is weighed, separate scales and hoppers shall be used with a device to indicate positively the complete discharge of the batch of cement into the batch box or container. The cement batching equipment shall be operated within a delivery tolerance of one percent of the net weight of the cement per batch.

Water may be measured by volume or by weight. The measuring equipment shall be operated within a delivery tolerance of one percent of the net weight or volume of water per batch.

Air-entraining or other admixtures may be measured by volume or by weight. The measuring equipment shall be operated within a delivery tolerance of three percent of the net weight or volume of admixture per batch.

E. Mixing Concrete

Except as otherwise restricted by delivery or placement time, concrete may be mixed at a central stationary plant site or in truck mixers.

Mixers shall not be charged in excess of the rated capacity.

When a concrete batch is transported in a truck mixer or agitator and the batch is smaller than 60 percent of the rated capacity of the truck mixer or agitator, the following percentage of additional cement shall be added to the batch:

40% to 60% rated cap	5%
20% to 40% rated cap	10%
10% to 20% rated cap	15%
0% to 10% rated cap	20%

The above provisions regarding extra cement shall also apply to the mixing of small batches in central plants as well as to the transporting.

Mixing and agitating speeds shall be designated by the manufacturer of the equipment.

1. Central Plant Mixing

Manual operation of mixers may be permitted only in the case of failure of the automatic timing device. Automatic operation must be restored before work may commence the day following the failure.

The batch shall be so charged into the drum that a portion of the mixing water enters in advance of the cement and aggregates. The flow of water shall be uniform, and all water shall be in the drum by the end of the first 15 seconds of the mixing period.

Concrete shall be mixed for a period of not less than one minute after all materials, excluding water, are in the mixer.

Concrete mixed less than the specified mixing time shall be discarded and disposed of by the Contractor.

2. Truck Mixing

Mixing time for truck mixed concrete shall be not less than 70, or more than 100 revolutions of the drum or blades at mixing speed after all ingredients, including water, are in the drum. Additional mixing beyond 100 revolutions, if any, shall be done at agitating speed.

Unless otherwise permitted by the Engineer, the mixing water required by the design mix, or as ordered, shall be added at the time of batching. The Engineer may order additional water and/or cement added to the batch after completion of the original mixing, in which case the batch shall be mixed an additional 30 revolutions at mixing speed. The Contractor shall provide means to accurately measure the amount of water added.

3. The water to cement ratio of concrete used for bridge decks shall not exceed 0.45 by weight.

F. Volumetric Batching and Continuous Mixing

Volumetric batching and continuous mixing of concrete will be permitted contingent on the equipment, calibration, and production meeting the following.

1. Equipment

The proportioning and mixing equipment shall be a self-contained, mobile, continuous mixer meeting the following requirements:

- a. The mixer shall be capable of carrying sufficient unmixed dry bulk cement, fine aggregate, coarse aggregate, admixtures, and water in separate compartments to produce not less than six cubic yards of concrete.

For full-depth bridge deck placements, the production capacity shall be a minimum of 60 cubic yards per hour. The Contractor shall satisfy the Engineer that production capabilities of the mixer are sufficient for the type and magnitude of the placement intended. More than one mixer may be required to provide a satisfactory placement rate.

- b. The mixer shall be capable of positive measurement of cement being introduced into the mix. A recording meter, visible at all times and equipped with a ticket printout, shall indicate this quantity.
- c. The mixer shall provide control of the flow of water introduced into the mixer. Water flow shall be coordinated with the cement and aggregate feeding mechanisms, and shall be readily adjustable to provide for minor variations in aggregate moisture. Water flow shall be indicated by a calibrated flow meter.

In addition to the flow meter, mixers used for bridge deck concrete, low slump concrete, and latex modified concrete shall be equipped with recording water meters capable of recording, to the nearest one-tenth (0.1) gallon, the number of gallons introduced into the mixer.

- d. The mixer shall be capable of being calibrated to automatically proportion and blend all components on a continuous or intermittent basis.
- e. The mixer shall provide positive control of admixtures introduced into the mix. Admixture flow shall be coordinated with the feeding mechanisms of the other ingredients and shall be readily adjustable. The admixture injection system shall meet the manufacturer's recommendations regarding type and design.
- f. When mixing latex modified concrete, the mixer shall be equipped with recording meters capable of recording, to the nearest one-tenth (0.1) gallon, the number of gallons of latex emulsion introduced into the mix.

2. Equipment Calibration

- a. An annual calibration and inspection certificate will be required for each mixer before the start of the first project for which the mixer will be used each year. This certificate can be from a State Department of Transportation review. The calibration will establish the meter count, i.e., the number of revolutions and discharge time in seconds required to dispense ninety-four (94) pounds of cement. Gate openings and pointer adjustments for aggregates and general operating condition of the equipment will also be inspected, as per the manufacturer's recommendations.

The Contractor shall have available at the calibration and inspection a representative to witness the calibration and a qualified mixer operator. The Contractor shall furnish all necessary scales, containers, stop watches, mixer operating manuals, and other materials and equipment necessary for the calibration and inspection.

- b. A materials discharge verification check may be ordered whenever, in the opinion of the Engineer, conditions warrant. Individual components may be ordered verified. On latex modified mixtures, cement and latex emulsion discharge shall be verified prior to the first placement on each project.
- c. Proportioning of individual components shall be within the following tolerances:

Cement (weight percent) 0% to + 4%

Fine Aggregate (weight percent) $\pm 2\%$

Coarse Aggregate (weight percent)..... $\pm 2\%$

Water (weight or volume percent)..... $\pm 1\%$

Latex Emulsion (weight percent) $\pm 1\%$

Yield (volume percent)..... $\pm 2\%$

The discharge time interval for components other than aggregates shall be the time established for the discharge of 94 pounds of cement. A lesser discharge time, approved by the Engineer, may be used for aggregates. Individual components used during discharge checks shall be from the same sources as those to be used on the project. When performing materials discharge checks, relative to minimum quantities of materials in the bins shall be adhered to.

If the cement discharge is not within the tolerance provided above, a new meter count and discharge time shall be established using calibration form DOT-293.

3. Proportioning and Mixing

The operations of proportioning and mixing concrete shall comply with the following requirements:

- a. The proportioning and mixing equipment operator shall be thoroughly familiar with the equipment and its operation.
- b. Mixers shall be clean and ingredients accurately proportioned.
- c. Concrete shall be mixed at the site in accordance with the specific requirements for the equipment used.
- d. Concrete as discharged from the mixer shall be uniform in composition and consistency. Mixing capability shall be such that finishing operations can proceed at a steady pace and the final finishing is completed before the formation of a plastic surface film.

4. Termination of Use

Permission for continued use of a mixer may be rescinded upon failure to maintain acceptable production or inability to meet the specifications for the type of concrete being produced.

G. Limitations of Mixing

Mixed concrete quantities shall be such quantities as required for immediate use and shall be placed before initial set has occurred. Concrete in which initial set has begun prior to beginning placement shall be wasted. Re-tempering of concrete will not be allowed.

Concrete shall not be mixed, placed, or finished when the natural light is insufficient to provide an acceptable product, unless an adequate and approved artificial lighting system is provided. Mixing water shall not be heated above 160°F. Aggregates shall not be heated above 100°F and shall be free of all frozen lumps, ice and snow.

H. Delivery Requirements

When concrete is continuously agitated in the hauling unit, it shall be discharged within 90 minutes after the cement has been placed in contact with the aggregates.

When the concrete temperature is 80°F or above, the time limitation shall be 45 minutes.

When concrete is not continuously agitated in the hauling unit, it shall be discharged within a period of 45 minutes after the cement has been placed in contact with the

aggregates, except the time limitation shall be 30 minutes when the concrete temperature is 80°F or above.

The rate of delivery of concrete to the job site shall be uniform. The interval between batches shall not exceed 30 minutes unless otherwise permitted by the Engineer.

I. Placing Concrete

The Contractor shall give the Engineer sufficient advance notice before starting to place concrete to permit inspection of forms, reinforcing steel and preparation for placing. Concrete shall not be placed without approval of the Engineer.

Placement of concrete on a frozen surface or frost of any depth will not be permitted. The surface of forms, steel, and adjacent concrete, which will encounter the concrete being placed, shall be raised to a temperature above freezing prior to placement.

The temperature of concrete immediately after placing shall be not less than 50°F or more than 90°F. The top limit for bridge deck concrete shall be 80°F.

Placement of concrete for bridge decks will not be permitted during the period from November 1 to April 1 without written authorization from the Engineer.

Before placing concrete, all sawdust, chips, other debris, and extraneous matter shall be removed from the interior of forms. Struts, stays, and braces serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete, shall be removed when the fresh concrete has reached an elevation rendering their service unnecessary. These temporary members shall be removed from the forms and not buried in the concrete.

When concrete is deposited through a chute, the slope of the chute shall allow the concrete to flow slowly without segregation. The delivery point of the chute shall be as close as possible to the point of deposit. Chutes and spouts shall be kept clean and shall be thoroughly flushed with water before and after each run. The water used for flushing shall be discharged outside the forms.

Free fall of concrete shall not exceed five feet except where it is impractical to restrict the fall by drop chutes such as in thin walls or columns where the reinforcement is such as to prohibit the use of chutes. In such cases, methods of placement shall be such as to prevent objectionable separation of coarse aggregate.

The sequence of placing concrete, including the installation of construction joints, shall be as specified on the plans. Concrete shall be placed in continuous horizontal layers. Each layer shall be placed before the preceding layer has attained its initial set.

The concrete shall be consolidated by vibrating internally or externally, or both, as directed by the Engineer. The vibrating shall be done with care to avoid displacement of reinforcing or forms. The vibration shall be of sufficient duration and

intensity to thoroughly consolidate the concrete but shall not be continued to cause segregation, localized areas of grout, or damage to concrete, forms, and reinforcement.

Vibration shall not be applied directly to reinforcement, which extends into sections or layers of concrete, which have hardened to the degree that the concrete ceases to be plastic under vibration. Vibrators shall not be used to make concrete flow over distances and shall not be used to transport concrete in the forms.

Accumulations of mortar splashed upon the reinforcing steel and the surfaces of forms shall be removed to the satisfaction of the Engineer. Care shall be exercised not to injure or break the concrete-steel bond at and near the surface of the concrete while cleaning the reinforcing steel. Dried mortar chips and dust shall not be puddled into the unset concrete.

J. Depositing Concrete in Water

Concrete shall not be deposited into or under flowing water. Concrete may be placed in or under still water only under the following conditions and under the immediate supervision of the Engineer. Concrete placed in or under still water shall be of the class required with an additional ten percent cement.

1. If water courses and sumps are provided outside of the area over which concrete is to be placed, and it is demonstrated that the water elevation can be controlled at or near the bottom with no appreciable flow across the area, the Contractor will be permitted to place the concrete. The placement of concrete shall start at a point most remote from the sumps and shall progress toward the sumps, shoving and displacing water as the placement progresses.
2. When the water elevation cannot be maintained as specified in paragraph 1, the Contractor will be required to place a concrete foundation seal of the dimensions necessary. This seal shall be considered as a sub-footing and shall be placed below the bottom of footing as shown on the plans or as determined by the Engineer.

Dewatering of the foundation seal may proceed when the concrete is sufficiently strong to withstand the hydrostatic pressure. After dewatering, all laitance or other unsatisfactory material on the top of the seal shall be removed by scraping, chipping or other means.

Pumping from the interior of any foundation enclosure shall be done to preclude the possibility of the movement of water through any fresh concrete. Pumping will not be permitted during the placing of concrete or for a period of at least twenty-four (24) hours thereafter, unless it can be done from a suitable sump separated from the concrete work by a reasonably water-tight wall or other effective means.

K. Protection of Concrete

The following provisions apply to all concrete in addition to the requirements for curing as set forth in Section 55-3 Concrete Masonry.

Any concrete placed between November 1 and April 15 shall be covered by insulated blankets or equivalent heat retention methods, unless such requirements are waived by the Engineer.

Concrete for sidewalks, curb and gutter, drop inlets, manholes, ditch checks, pipe headwalls, approach slabs, pavement, etc. shall be maintained above 32°F until it has attained a compressive strength of 1500 psi. The compressive strength will be checked with a Swiss Impact Hammer in accordance with SD 409.

Enclosures for protection of concrete shall be capable of maintaining the temperature specified in the following and shall be of a height that permits free circulation of artificial heat. The use of salamanders or other types of open-flame heating unit is prohibited.

Form insulation shall be bats of fiberglass, rock wool, balsam wool, or similar commercial insulation material. Insulation shall remain in place for the full protection period. The forms may be loosened slightly to control the temperature of the concrete.

The Contractor shall drill holes in the forms and provide thermometer wells one-half inch to one inch in depth where required by the Engineer to determine the temperature of the concrete.

Concrete for bridges, box culverts, retaining walls, anchor blocks, median barriers, light and signal footings, and other structures when indicated on the plans shall be maintained at a temperature of 50°F or above for the first 72 hours after the concrete has been placed. The concrete shall be maintained at a temperature of 40°F or above for the next 48-hour period. In the event lower temperatures are recorded during this protection period, one extra day of protection time at temperatures above 40°F shall be added to the original five days of protection for each day that the minimum concrete temperature falls below the specified temperature.

If an additional bag of cement per cubic yard is used, or if high early strength cement is permitted, the concrete shall be maintained at a temperature of 60°F or above for 72 hours. In the event temperatures less than 60°F are recorded during this protection period, the protection time required shall be increased according to the preceding paragraph, with its provision for low temperatures also being applicable.

Until one of the protection periods have been satisfied, cold weather protection shall continue, false work shall remain in place, live loads shall not be applied, and the concrete temperature shall be maintained above 35°F.

At the end of the protection period, the concrete temperature shall not be permitted to fall more than 40°F for each 24-hour period.

The temperature of concrete that is being protected by means of housing and heating and/or insulated forms shall not exceed 100°F during the protection period.

It will be permissible to flood concrete to a minimum depth of one foot. The water shall be maintained for ten days after the concrete is placed at a temperature, which will prevent freezing of the water in contact with the concrete.

L. Removal of Formwork and Construction of Superimposed Elements

In the determination of the time for the removal of false work and forms, consideration shall be given to the location and character of the structure, the weather, and any other conditions influencing the setting of the concrete.

Methods of false work and form removal likely to cause overstressing of the concrete shall not be used. Supports shall be removed in a manner that permits the concrete to uniformly and gradually take the stresses due to its own weight.

When field operations are not controlled by tests, false work and forms shall not be removed nor superimposed concrete placed without the approval of the Engineer. The following periods are exclusive of days when the temperature is below 40°F.

If field operations are controlled by tests, either cylinders or Swiss hammer, false work and forms may be removed from the affected concrete and placement of superimposed concrete may proceed when such concrete reaches the strength in the following table:

Structural Elements	Removal of Formwork			Placing of Concrete in Superimposed Elements		
	Time	or	Concrete Strength PSI	Time	or	Concrete Strength PSI
Footings	12 -24 hrs.		800	48 -72 hrs.		1600
Columns	12 -24 hrs.		800	7 -12 days		2000
Pier & Bent Caps	10 -15 days		2400	15 -20 days		3000
Abutment & Sills	12 -24 hrs.		800	15 -20 days		3000
Deck Slabs for Concrete Bridges	10 -15 days		2400	36 -48 hrs.		1200
Other Deck Slabs & Top Slab of RCBC	7 -12 days		2000	36 -48 hrs.		1200
Vertical Surfaces not Carrying Load	12 -24 hrs.		800			
Vehicle Surfaces Carrying Load	3 -5 days		2000	7 -10 days		3000

M. Backfilling and Application of Live load

All concrete, except approach slabs, footings, columns, curb and gutter, and sidewalk shall have attained design strength before backfilling or before applying highway live loads. Approach slabs may be open to traffic when a compressive strength of 4000 psi is attained. Footings, columns, curb and gutter, and sidewalks shall not be backfilled until permission has been given by the Engineer.

N. Joints

Joints shall be constructed at the locations and of the dimensions shown on the plans or as directed by the Engineer. In joining fresh concrete to that which has already set at a construction joint, the concrete in place shall have all loose material removed.

O. Curing Concrete

Concrete shall be promptly protected by covering with canvas, straw, burlap, sand, or other satisfactory material and kept moist by flushing or sprinkling with water. Forms remaining in place shall be considered as adequate cover for curing for the number of days such forms remain in place, providing all exposed concrete surfaces are so covered. Curing shall continue for a period of not less than seven days after placing the concrete. Other precautions to insure development of strength shall be taken as the Engineer may direct.

In lieu of the above method of curing, white pigmented membrane curing compound may be used. The compound shall be uniformly applied after the final finishing operations are completed and immediately after the free water has left the surface.

The curing compound may be applied in either one or two applications in accordance with the direction of the manufacturer. If applied in two coatings, the second shall not be applied later than 30 minutes after the first.

Equipment, workers, or materials will not be allowed on the concrete surface for a minimum of seven days after the application of the curing compound, unless the surface is adequately protected with a layer of fine sand or other approved material. Such covering shall not be applied for at least eight hours after application of the curing compound. If, during the seven day curing period, the membrane film is broken or damaged, the areas affected shall be given a duplicate treatment of the curing material, applied at the same rate as the first treatment.

Surfaces, which are to receive a commercial texture finish, shall be cured by a method other than membrane cure. Surfaces, which are to receive a rubbed finish or a brush finish, shall be cured by a method other than membrane cure until the rubbing or brushing has been completed after which the membrane curing may be used as directed above. Membrane curing compound will not be allowed on any surface to which concrete is to be bonded.

Bridge decks, approach slabs, bridge curb, and curb and gutter adjacent to bridges shall be cured as follows:

Bridge curb and curb and gutter shall be cured by a uniform application of Linseed Oil Base Emulsion Curing Compound at the specified rate as soon as final finish operations are completed. When a commercial finish is to be applied, curing shall be accomplished with cotton or burlap mats and polyethylene sheeting.

As soon as bridge deck and approach slab concrete has received the final surface finish, Linseed Oil Base Emulsion Curing Compound shall be uniformly applied at the specified rate. This application is not a substitute for curing with burlap mats and polyethylene sheeting but is required for moisture retention until the burlap mats and polyethylene curing materials can be placed. The burlap mats and polyethylene sheeting curing materials shall be in place not later than 12:00 noon of the day following concrete placement. Concrete surfaces, which are to have superimposed concrete placed upon or against them shall be protected from application of Linseed Oil Base Emulsion Curing Compound and shall be cured with cotton or burlap mats and white polyethylene sheeting. Reinforcing steel shall also be protected from application of Linseed Oil Base Emulsion Curing Compound.

Application of Linseed Oil Base Emulsion Curing Compound shall conform to the following requirements:

1. Prior to application, the material shall be mixed to a uniform consistency without the use of air, violent agitation, or thinning.
2. The material shall be maintained above 50°F during application.
3. The material shall be spray applied with an applicator of sufficient capacity and spray nozzles of proper size and design to provide a uniform application at the specified rate immediately after the concrete has received the final finish.
4. Unless otherwise provided on the plans or ordered by the Engineer, minimum application rate shall be as follows:

Carpet drag or broom finish - one gallon/150 square feet

Steel tine finish - one gallon/125 square feet

Surfaces designated to be cured with cotton or burlap mats and polyethylene sheeting shall be cured in the following manner:

The surface of the concrete to be cured shall be entirely covered with cotton or burlap mats. The mats shall be placed so the entire surface is completely covered with sufficient material beyond the periphery of the area to assure

adequate curing of the edges. The mats shall be thoroughly saturated with water and shall be placed with the wettest side down. As an alternate method of placing the burlap, the deck may be flooded with water, the burlap placed immediately on the flooded deck and the burlap thoroughly saturated in place prior to covering with polyethylene.

Immediately after placement, the mats shall be entirely covered with white polyethylene sheeting. The units used shall be lapped at least 18 inches. The sheeting shall be so placed and weighted down to assure intimate contact with the surface covered.

Curing shall be maintained for a period of seven days after concrete has been placed. The mats shall be kept moist by periodic applications of water.

P. Surface Finish

The surfaces of all concrete masonry shall be worked during placing. The working shall force all coarse aggregate from the surface and thoroughly work the mortar against the forms to produce a smooth finish relatively free of water, air pockets, or honeycombing.

As soon as the concrete has set sufficiently, the forms on all exposed surfaces shall be carefully removed, and all depressions resulting from the removal of metal ties or other causes shall be carefully pointed with a mortar of sand and cement in the same proportions as the concrete being treated. All fins and rough corners on the surfaces shall be removed to present a neat and uniform appearance.

Additional finishing will be required as follows:

1. Rubbed, Brushed, and Commercial Texture Finishes

One of these three finishes will be required for all railing, curb, parapets, wings and other surfaces not subject to wear, which are visible to the traveling public. A selected finish must be used throughout the entire structure, except the finish for the top and inside of the curb may be different than that used for the other parts of the structure. These finishes will not be required on wing walls and parapets of box culverts and wing walls and backsides of curbs on bridges, which do not have traffic passing beneath them, provided the forms result in a smooth, unblemished surface.

a. Rubbed Finish

As soon as the pointing has set sufficiently, the surfaces to receive a rubbed finish shall be thoroughly wetted with a brush and rubbed with a medium coarse carborundum stone or an abrasive of equal quality using a small amount of mortar on its face. The rubbing shall be continued until all form marks and projections are removed, producing a relatively smooth clean surface free from pits or irregularities.

The final finish shall be obtained by rubbing with a fine carborundum stone or an abrasive of equal quality. This rubbing shall continue until the entire surface has a smooth texture and a uniform color.

b. Brushed Finish

This finish will be permitted only if it is accomplished within 12 hours of concrete placement. The forms shall be removed as soon as the concrete is able to stand firm without slumping. The surface shall be worked with a rubber float, which may be dipped in a very wet three to one (3:1) sand and cement grout mixture. Immediately after the surface is worked into a lather, a soft bristle brush shall be used to smooth the surface, leaving a fine grained, smooth, but sanded texture. A "plastering" job resulting from the use of an excess of grout on the surface will not be permitted.

c. Commercial Texture Finish

This finish shall consist of an application, using a rubber float or approved equal, of latex or acrylic-based bonding agent mixed with a standard or commercial packaged mortar.

The Owner will maintain a list of approved materials and mixes to be used. Unless the bonding agent material and mixture proposed for use is one, which has been previously approved by the Owner, the Contractor shall have the material and mixture tested in a recognized commercial testing laboratory in accordance with procedures prescribed by the Owner. Work in conjunction with the commercial texture finish shall not be started until the material and mixture have been approved.

The mixture shall be applied in sufficient thickness to completely cover the original surface with a one-coat application, but shall not be so thick as to cause runs, sags, or a plastered effect. The final surface after drying shall be uniform in color and texture, with no evidence of laps or breaks in continuity.

Corrective work will be required over areas, which have not been satisfactorily finished, at the Contractor's expense, including as much adjacent area as necessary to provide uniformity of appearance.

Preferably, application of the commercial texture finish shall not be started until other work, which might mar the finish has been completed. Should the Contractor elect to commence with the finishing operation prior to completion of any work that might mar the surface, provisions shall be made to protect the surface. The finishing operation shall be carried on continuously from beginning to completion on any one surface.

2. Float Finish

Unformed surfaces, except bridge decks, shall be given a float finish. After the concrete has been struck off, the surface shall be thoroughly worked and floated with a suitable floating tool of wood, canvas, magnesium, or cork. Before the finish has set, the surface cement film shall be removed with a fine brush in order to have a fine-grained, smooth but sanded texture.

3. Bridge Deck Finish

The concrete shall be placed slightly higher than the finished surface of the deck. Immediately after the concrete has been placed and consolidated as specified, the surface shall be struck off and finished with an approved finishing machine that meets the following minimum requirements:

The machine shall be a self-propelled rotating cylinder type, with one or more rotating steel cylinders and augers. The machine shall span the concrete placement width. The cylinders and augers shall place and consolidate the concrete to the established profile by traversing the placement width, transverse to the roadway centerline. The machine shall be capable of forward and reverse motion under positive control, with provision for raising all cylinders and augers to clear the surface when traveling in reverse. Modifications to the factory product will require approval by the Engineer. The portion of the deck adjacent to curbs shall be neatly finished to a true surface with a wooden hand float.

Before the concrete has attained its initial set, it shall be given a final finish by transverse brooming or carpet drag to provide a surface micro texture.

The surface of the concrete bridge deck shall be given a metal tine finish. Tined grooves shall be a nominal one-eighth inch deep with effective spacing of three-fourths inch to one inch. Care shall be taken to avoid overlaps of the passes in the tining operation. The 12 inches of the deck next to curb shall be left untined.

After the concrete has hardened, the surface and joints shall be tested with a ten foot straightedge. The permissible longitudinal and transverse surface deviation shall be one-eighth inch in ten feet. Any portion of the deck showing variation from the template of more than one-eighth inch shall be either ground to an elevation that will be within the permissible deviation or be price adjusted, at the discretion of the Engineer. A tool equipped with specially prepared circular diamond blades mounted on a horizontal shaft shall be used when grinding is necessary.

Areas that have been ground shall not be left smooth or polished but shall have a uniform texture equal in roughness to the surrounding unground concrete.

4. Exposed Aggregate Pavement

Exposed aggregate pavement/surfacing shall have an exposed, natural, rounded, river rock finish. This finish may be accomplished by placing a concrete curing retarder material on the surface of the freshly placed concrete. When underlying concrete is sufficiently hardened, the set retarded surface mortar may be removed by flushing with water and a gentle scrubbing with a broom, leaving the underlying aggregate exposed. The surface shall be allowed to dry and a covered with a coat of clear, non-yellowing, UV resistant urethane sealer.

Q. Pre-pour Inspection Requirements for Concrete Bridge Decks

Pre-pour inspections will be conducted for all new concrete bridge decks. The Contractor shall advise the Engineer 24 hours in advance of the time when deck preparation will be complete and ready for inspection. At the time of inspection, the Contractor shall have completed the following items of work:

1. Formwork and decking shall be complete and joints shall have been made mortar tight.
2. Reinforcing steel shall have been accurately placed, secured and tied as per specifications.
3. Screed Rails shall have been set and adjusted for final grade.
4. Finishing machine shall have been adjusted for crown slope and placed upon the screed rails.
5. Necessary walkways and safety railing shall have been installed.
6. A responsible employee of the Contractor shall have been designated to accompany the Engineer during the pre-pour inspection.

Following the pre-pour inspection, any work, which should be completed before deck pouring operations begin, shall be completed during the Contractor's normal work shift. Preparation work shall not extend into the late evening hours. Violation of this provision will be cause to postpone the scheduled deck placement as directed by the Engineer.

R. Concrete Quality Tests

The Contractor is to be responsible for slump, air content, seven and twenty-eight day compressive strength test sets. All sampling and testing shall be done by certified testing laboratory personnel.

Testing shall be done at the rate of one test set per maximum 30 cubic yards of concrete placed. All test results shall be submitted to the Engineer prior to final payment. The Engineer or his representative shall be present for all field sampling.

55.4 METHOD OF MEASUREMENT

Concrete masonry will be measured in accordance with the neat line dimensions shown on the plans, unless changes are ordered in writing during construction.

Volumes of concrete masonry will be computed to the nearest one-tenth cubic yard. Deductions will not be made for the volume of concrete occupied by utility conduit, six inch or smaller drainage pipe, reinforcing steel, encased structural steel, pile heads, anchors, sleeves, and encased grillage, or for volume of concrete displaced by weep holes, joints, drains and scuppers, or for fillets, chamfers or scorings, one inch square or less in cross-section.

Concrete used for foundation seals will not be measured for payment.

Concrete approach and sleeper slabs will be measured to the nearest one-tenth square yard.

55.5 BASIS OF PAYMENT

The accepted quantities of concrete masonry will be paid for at the contract price per cubic yard to the nearest one-tenth cubic yard.

Concrete approach and sleeper slabs will be paid for at the contract unit price per square yard to the nearest one-tenth square yard.

Payment will be full compensation for materials, labor, equipment and tools necessary, including concrete, reinforcing steel, joint sealer, plastic sheeting, preformed expansion joint material, sawing, testing, and incidentals.

END OF SECTION