

TECHNICAL SPECIFICATION

ITEM 03300 CAST-IN-PLACE CONCRETE

1.0 GENERAL

1.1 SCOPE

- a. This section gives requirements for normal weight structural concrete.
- b. Coordinate the requirements of this section with all other sections of Division 3, Concrete. All requirements of this section apply to those except as may be otherwise specified in such sections.

1.2 REFERENCE STANDARD

The current issue of ACI-301, "Specifications for Structural Concrete for Buildings" is a part of this specification and is applicable to this project.

1.3 SUBMITTALS

- a. Mill Certificates. Required for all bulk cement and reinforcing steel.
- b. Admixtures. Submit brochures on admixtures proposed for use if different from those specified.
 - (1) A submittal is required from the manufacturer of the approved airetraining admixture. Give requirements to control percent of air content under all conditions including temperature variations. Provide three (3) copies.
 - (2) A submittal is required from the manufacturer of the approved waterreducing retarder. Give requirements for quantities and types to be used under various temperatures and job conditions to produce a uniform, workable concrete mix.
- c. Design Mixes. Submit test data on proposed design mixes for each type of concrete in the project.
- d. Curing Method. Submit the proposed curing method for all concrete. If the use of a white pigmented membrane-forming compound is recommended, submit evidence that the compound is satisfactory for the intended application. A written guarantee will be required.

1.4 STORAGE OF MATERIALS

- a. Cement. Store cement in weathertight buildings, bins or silos to provide protection from dampness and contamination and to minimize warehouse set.
- b. Aggregate. Arrange and use aggregate stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding three-feet (3') in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregates.
- c. Sand. Before using, allow sand to drain until a uniform moisture content is reached.

- d. Admixtures. Store admixtures to avoid contamination, evaporation or damage. For those used in the form of suspensions or nonstable solutions, provide suitable agitating equipment to assure uniform distribution of ingredients. Protect liquid admixtures from freezing and other temperature changes which would adversely affect their characteristics.

1.5 TESTING LABORATORY SERVICES

The tests required in this section will be performed by a commercial testing laboratory as specified in Division 1, General Requirements.

2.0 PRODUCTS

2.1 MATERIALS

- a. Portland Cement. Use cement conforming to ASTM C-150, Type "I." Type III may be used when specifically authorized. Use the same brand of cement upon which the selection of concrete was based. Only one (1) brand of each type will be permitted in any one structure, unless otherwise specified.
- b. Admixtures. Use the following admixtures as required or permitted. The use of calcium chloride will not be permitted. The products must conform to the referenced standards.
 - (1) Air-entraining Admixtures. Conform to ASTM C-260, such as Sika's "AER," Sonneborn's "Aerolith" or approved equal.
 - (2) Chemical Admixtures. Conform to ASTM C-494, "Tentative Specifications for Chemical Admixtures for Concrete."
 - (3) Water-reducing Retarder. Use of an admixture containing chloride is not permitted. The product must be nonstaining. Use Master Builder's "MBHC," Sika's "Plastiment" or approved equal.
- c. Mixing Water. Fresh, clean and drinkable.
- d. Aggregates. Use coarse aggregate from only one (1) source and fine aggregate from only one (1) source for exposed concrete in a single structure.
 - (1) Coarse aggregate for normal weight concrete shall conform to ASTM C-33. Grading limits for precast, prestressed members and for all members six- inches (6") or less in least dimension, one-inch (1") to No. 4. Grading for all other normal weight concrete, 1½-inches (1½") to No. 4.
 - (2) Use natural sand complying with ASTM C-33 for fine aggregate in normal weight concrete.
- e. Membrane-forming Curing Compound. ASTM C-309, white pigmented commercial curing compound which will not permanently discolor concrete.
- f. Sheet Material for Curing Concrete. ASTM C-171, waterproof paper, polyethylene film or white burlap-polyethylene sheeting.
- g. Non-shrink Grout. Master Builders' "Embeco 153," or approved equal, consisting of specially prepared catalyzed metallic aggregate, Portland cement that is not air-entrained, and specially size-graded sand.
- h. Reinforcing Steel. Use ASTM A-615, Grade 40 reinforcing steel. Use deformed bars except where smooth bars are specified.

- i. Expansion Joints. Use ASTM D-994 expansion joint filler, ¾-inches (¾") thick, unless otherwise show, from full depth to one-inch (1") above the slab. Use ASTM-1190 joint sealer to fill the joint. Provide joint filler and sealer at locations shown.

2.2 PROPORTIONING

- a. Objective. Select proportion of ingredients to produce concrete having proper placability, durability, strength, appearance, and other required properties. Proportion ingredients to produce a homogeneous mixture which will work readily into corners and angles of forms and around reinforcement by methods of placing and consolidation employed on the work, but without permitting materials to segregate or allowing excessive free water to collect on the surface.
- b. Strength. Provide ultimate strength concrete in all portions of the work. Strength must conform to values for the class of concrete specified for each portion of the structure. Requirements are based on 28-day compressive strength. If high early-strength concrete is specified, requirements are based on seven (7) day compressive strength.
- c. Entrained Air. Air-entrain all concrete, unless otherwise specified. Provide for not less than three-percent (3%) nor more than five-percent (5%) by volume of total entrapped and entrained air for normal weight concrete.
- d. Slump. The maximum permissible slump for concrete is four-inches (4"); the minimum is two-inches (2"). Determine slump by methods given in ASTM C-143.
- e. Admixtures. Proportion admixtures according to the manufacturer's recommendations. Use of an approved accelerator is permitted when the air temperature is less than 40°F. Use of an approved retarder is required when the temperature of placed concrete exceeds 85°F.
- f. Classification and Use.

(1) Classification:

<u>Class</u>	<u>Minimum 28-Day Compressive Strength (psi)</u>	<u>Minimum Cement Contents Sacks per Cubic Yard*</u>
Normal Weight A	3000	5
Sidewalks B	2500	4½
Structural C	4000	6

* If the required strength is not secured with the minimum cement content as specified, add cement or provide other aggregates as necessary.

(2) Use the specified classes of concrete in the following locations:

- (a) Class A – Slope Paving, Overflow Weir Structure, Culverts, and Wing Walls.

- g. Water-Cement Ratio for Normal Weight Concrete. If the relationship between strength and the water-cement ratio has been determined previously for materials specified for normal weight

concrete, the ratio may be used. Otherwise, determine the proper water-cement ratio by using the following procedures.

- (1) Make concrete trial mixtures having suitable proportions and consistency. Use at least three (3) different water-cement ratios which will produce a range of strengths encompassing those required. Design trial mixes to produce the maximum allowable slump.
 - (2) Determine proportions of ingredients and conduct tests in accordance with basic relationships and procedures outlined in ACI 613, "Recommended Practice for Selecting Proportions for Concrete."
 - (3) Make and cure specimens according to ASTM C-192, "Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory." For each water-cement ratio, prepare at least three (3) specimens for each age test. Test for strength at seven (7) days and 28 days, or other age as required. Conduct tests according to ASTM C-39, "Method of Test for Compressive Strength of Molded Concrete Cylinders."
 - (4) From results of these tests plot a curve showing the relationship between water-cement ratio and compressive strength.
- h. Alternate Determination of Proportions. In lieu of proportioning as specified for normal and lightweight concrete, a mix design employing the same ingredients proposed for use, and used successfully on previous projects under similar conditions may be used. To obtain the necessary approval, submit the following:
- (1) Concrete mix design.
 - (2) Reports for at least 20 consecutive sets of 7-day and 28-day concrete strength tests made during the last six (6) months.
 - (3) Reports of compliance tests of fine and coarse aggregates made during last six (6) months.

2.3 MIXING NORMAL WEIGHT CONCRETE

- a. Ready-Mixed Concrete. Mix and transport ready-mixed concrete according to ASTM C-94, "Specifications for Ready-Mixed Concrete." In addition, the batch plant shall provide for the following items:
- (1) Arrangement. Provide separate bins or compartments for different sized aggregates and for bulk cement. Compartments of ample size constructed so that materials will be kept separate under all working conditions are required.
 - (2) Weighing of Materials. Aggregates may be weighed in separate weigh batchers with individual scales. Weigh bulk cement on a separate scale in a separate weigh batcher. Observe the following limits of accuracy when weighing or measuring materials.

<u>Materials</u>	<u>Percent Accuracy</u>
Cement	1
Water	1
Aggregates	2
Admixture	3

- (3) Water Meter or Batcher. Provide a suitable measuring device capable of measuring mixing water within the specified accuracy for each batch. Note the number of gallons of water as batched on printed batching tickets.

- (4) Moisture Control. Provide a moisture meter to measure the amount of free water in fine aggregates within 0.3 of a percent. Compensate for varying moisture contents of fine aggregates and change batch weights of materials if necessary before batching.
- (5) Scales. Provide adequate facilities for accurate measurement and control of each material entering each batch of concrete. Accuracy of weighing equipment must conform to applicable requirements of ASTM and NRMCA for such equipment.
- (6) Recorders or Printers. Provide recorders/printers to produce tickets. Each ticket will provide a printed record of weights for cement as batched and for separate aggregates as batched individually. Use the type of indicator that returns for zero punch or to zero after a batch is discharged. Clearly indicate by stamped letters or numbers the difference between aggregates and cement as batched. Show the time of day stamped or printed at intervals of not more than six (6) minutes. Deliver recorded ticket copies with concrete. The testing agency will keep one (1) copy.
- (7) Protection. Protect weighing, indicating, recording or printing, and control equipment against exposure to dust and weather.

b. Transit Mix Truck Requirements.

- (1) Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant.
- (2) Keep the water tank valve on each transit truck locked at all times that the truck is in use. Any addition of water must be directed by the Engineer. Added water must be incorporated by additional mixing of at least 35 revolutions or two (2) minutes.
- (3) Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.

c. Batch Mixing at Site.

- (1) Mix concrete in a batch mixer conforming to requirements of the Mixer Manufacturers' Bureau of the Associated General Contractors of America. Use a mixer equipped with a suitable charging hopper, water storage tank and water measuring devices. It must be capable of thoroughly mixing aggregates, cement and water into a uniform mass within the specified mixing time, and of discharging the mix without segregation. Operate the mixer according to the rated capacity and recommended revolutions per minute printed on the manufacturer's rating plate.
- (2) Charge the batch into the mixer so that some water will enter in advance of cement and aggregates. Keep water running until $\frac{1}{4}$ of specified mixing time has elapsed. Provide controls to prevent discharging until the required mixing time has elapsed. When concrete of normal weight is specified, provide controls to prevent the addition of water during mixing. Discharge the entire batch before the mixer is recharged.
- (3) Mix each batch of two (2) cubic yards or less for not less than one (1) minute and 30 seconds. Increase mixing time 15 seconds for each additional cubic yard or fraction of a yard.
- (4) Keep the mixer clean. Replace pick-up and throw-over blades in the drum when they have lost 10 percent (10%) of original depth.

d. Admixtures.

- (1) Charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device. Measure admixture to an accuracy within ± 3 percent (3%). Do not use admixtures in powdered form.
- (2) Two (2) or more admixtures may be used in the same concrete, provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other. Inject the admixtures separately during the batching sequence.
- (3) Add retarding admixtures as soon as practicable after the addition of cement.

e. Temperature Control.

- (1) When the mean temperature falls below 40°F, keep the admixed temperature above 55°F to maintain concrete above the minimum placing temperature.
- (2) If water or aggregates have been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to the mixtures of water and aggregate when the temperature of the mixture is greater than 95°F.
- (3) In hot weather, cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature. If necessary, substitute well-crushed ice for all or part of the mixing water.

3.0 EXECUTION

3.1 PREPARATION

- a. Coordination. Mix concrete only in quantities for immediate use. Discard concrete which has set. Retempering of set concrete is not permitted. Completely discharge concrete at the site within one (1) hour and 30 minutes after adding cement to aggregate. In hot weather reduce this time to one (1) hour or less to prevent stiffening of concrete before it is placed.
- b. Protection from Adverse Weather. Unless adequate protection is provided or approval is obtained, do not place concrete during rain, sleet, snow or freezing weather. Do not permit rainwater to increase mixing water or to damage the surface finish. If rainfall occurs after placing operations begin, provide adequate covering to protect the work.
- c. Placing Temperature.
 - (1) Cold Weather. Unless special provisions are made for heating the concrete mix and concrete in forms, do not place any concrete when the air temperature is below 40°F or is predicted to be below 40°F within the next 48 hours after placement. Provide and use protective material and heating equipment as required to maintain the temperature of the concrete surface at not less than 35°F for a period of at least 36 hours after placement.
 - (2) Hot Weather. When the air temperature is above 85°F, use of an approved retarding agent is required in all concrete. Concrete temperature prior to placement shall not exceed 95°F.
- d. Adjusting Slump. If concrete arrives at the project with slump below that specified, water may be added. Indiscriminate addition of water to increase slump is prohibited. Do not exceed either the maximum permissible water-cement ratio or maximum slump. Any addition of water above the maximum water-cement ratio must be accompanied by a corresponding quantity of cement. Mix adjustments to obtain specified slump must be approved and directed by the Engineer.

3.2 CONVEYING

- a. Objectives. Handle concrete from mixer to placement as quickly as practicable while providing concrete to required quality in the placement area. Use methods which prevent loss of ingredients and segregation.
- b. Equipment. Obtain approval of the conveying equipment. Select equipment of size and design to insure continuous flow of concrete at the delivery end. Conform to the following equipment and operations requirements.
 - (1) Provide truck mixers, agitators, nonagitating units and manner of operation conforming to requirements of ASTM C-94, "Specifications for Ready-Mixed Concrete."
 - (2) Use belt conveyors configured horizontally or at a slope which causes no segregation or loss. Use an approved arrangement at the discharge end to prevent separation. Discharge long runs without separation into a hopper.
 - (3) Provide metal or metal-lined chutes. Arrange for slopes not exceeding one (1) vertical to two (2) horizontal and not less than one (1) vertical to three (3) horizontal. Chutes more than 20 feet long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.
 - (4) Pumping of concrete will be permitted only after written approval. Use a batch design and aggregate sizes suitable for pumping.
- c. Maximum Time to Placement

The maximum time interval between the addition of cement to the batch, and the placing of concrete in the forms shall not exceed the following:

<u>Air or Concrete Temperature (Whichever is Higher)</u>	<u>Maximum Time (Addition of Water or Cement to Placing in Forms)</u>
Non-Agitated Concrete	
Over 80°F	15 Minutes
35°F to 79°F	30 Minutes
Agitated Concrete	
90°F or Above	45 Minutes
75°F to 89°F	60 minutes
35°F to 74°F	90 Minutes

The use of an approved retarding agent in the concrete will permit the extension of each of the above temperature-time maximums by 30 minutes for bridge decks, top slabs of direct traffic culverts and cased drilled shafts, and one hour for all other concrete except that the maximum time shall not exceed 30 minutes for non-agitated concrete.

3.3 PLACING

- a. Preparation. In addition to the previous requirements, confirm that formwork has been completed. Remove ice, excess water, dirt and other foreign materials from forms. Confirm that

reinforcement is securely in place and expansion joint material, anchors and other embedded items are properly positioned. Have a competent workman at the pour location who can assure that reinforcement and embedded items remain in design locations while concrete is being placed. Sprinkle semiporous subgrades to eliminate suction. Seal extremely porous subgrades in an approved manner.

b. Procedure.

- (1) Deposit concrete continuously, or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.
- (2) Proceed with placement at a rate such that concrete which is being integrated with fresh concrete is still plastic. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.
- (3) Remove temporary spreaders from forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only if made of galvanized metal or concrete, and if prior approval has been obtained.
- (4) Do not start placing of concrete in supported elements until concrete previously placed in columns and walls is no longer plastic.
- (5) Deposit concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to a procedure which will cause segregation.
- (6) Where surface mortar is to be the basis of a finish, especially those designated to be painted, work coarse aggregate back from forms with a suitable tool to bring the full surface of mortar against the form. Prevent formation of excessive surface voids.
- (7) Consolidate concrete by vibration, spading, rodding or forking so that concrete is thoroughly worked around reinforcement, around embedded items and into corners of forms. Eliminate air or stone pockets which may cause honeycombing, pitting or planes of weakness. A minimum frequency of 7000 revolutions per minute is required for mechanical vibrators. Do not use vibrators to transport concrete within forms. Insert vibrators and withdraw at points from 18 to 30 inches apart. At each insertion vibrate sufficiently to consolidate concrete, generally from 5 to 15 seconds. Do not over-vibrate causing segregation. Keep a spare vibrator on the site during concrete placing operations.

- c. Concreting Under Water. When required or permitted, deposit concrete under water by an approved method. Obtain advanced approval of the method from the Engineer. Deposit concrete in such a way that fresh concrete enters the mass of previously placed concrete from within, causing water to be displaced with a minimum disturbance at the surface of the concrete.

3.4 REPAIRING SURFACE DEFECTS

- a. Defective Areas. Repair defective areas immediately after the removal of forms.

- (1) Remove honeycombed and other defective concrete down to sound concrete. To prevent absorption of water from patching mortar, dampen the defective area and a strip six-inches (6") wide surrounding the area to be patched. Prepare bonding grout by mixing approximately one (1) part cement to one (1) part fine sand passing a No. 30 mesh sieve. Mix to a consistency of thick cream, and brush thoroughly into the surface.

- (2) Make patching mortar of the same materials and of approximately the same proportions as concrete, except omit coarse aggregate. Prepare mortar with not more than one (1) part cement to 2½ parts sand by damp loose volume. Substitute white Portland cement for part of the gray Portland cement on exposed concrete in order to produce a color matching the color of surrounding concrete. Determine color by making a trial patch.
 - (3) Use no more mixing water than necessary for handling and placing. Mix patching mortar in advance and allow to stand. Mix frequently with a trowel until it has reached the stiffest consistency that will permit placing. Do not add water.
 - (4) After surface water has evaporated from the area to be patched, thoroughly brush a coat of bond grout into surface. When bond grout begins to lose its water sheen, apply the premixed patching mortar. Thoroughly consolidate the mortar into place and strike off to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, leave undisturbed for at least one (1) hour before final finishing. Keep the patched area damp for seven (7) days. Do not use metal tools in finishing patches in a formed wall which will be exposed.
- b. Tie Holes. Patch tie holes immediately after removal of forms. After cleaning and thoroughly dampening the tie hole, fill solid with patching mortar.
 - c. Proprietary Materials. If permitted or required, proprietary compounds for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures. Use such compounds according to the manufacturer's recommendations.

3.5 FINISHING OF FORMED SURFACES

- a. Surfaces Requiring No Finish. A finish is not required on surfaces concealed from view by earth, water, ceiling, etc. in the completed structure.
- b. Smooth Form Finish.
 - (1) Use plywood or fiberboard linings or forms in as large sheets as practicable and with smooth, even edges and close joints.
 - (2) Patch tie holes and defects. Rub fins and joint marks with wooden blocks to leave a smooth, unmarred finished surface.
 - (3) Use a smooth form finish on faces of exposed concrete.

3.6 FINISHING SLABS AND SIMILAR FLAT SURFACES

- a. Shaping to Contour. Use strike-off templates or approved compacting-type screeds riding on screed strips and edge forms to bring concrete surface to the proper contour. See the section on Concrete Formwork for edge forms and screeds.
- b. Consolidation. Thoroughly consolidate concrete in slabs and use internal vibration in beams and girders of framed slabs and along bulkheads of slabs on grade. Obtain consolidation of slabs and floors with vibrating bridge screeds, roller pipe screeds, or other approved means. Concrete to be consolidated must be as dry as practicable. Do not permit manipulation of surfaces prior to finishing operations.
- c. Tolerances for Finished Surfaces. Tolerances are checked by placing a straightedge of specified length anywhere on the slab. The gap between slab and straightedge must not exceed the tolerance listed for the specified class.

<u>Class</u>	<u>Straightedge Length In Feet</u>	<u>Tolerance In Inches</u>
A	10	$\frac{1}{8}$
B	10	$\frac{1}{4}$
C	10	$\frac{1}{8}$

d. Floated Finish.

- (1) After concrete has been placed, struck off, consolidated and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared, or when the mix has stiffened sufficiently to permit proper operation of a power-driven float. Consolidate the surface with power-driven floats. Use hand floating with wood or cork-faced floats in locations inaccessible to a power-driven machine and on small, isolated slabs.
- (2) Recheck tolerance of the surface after initial floating with a 10-foot (10') straightedge applied at not less than two (2) different angles. Cut down high spots and fill low spots to Class "B" tolerance. Immediately refloat slab to uniform, smooth, granular texture.

e. Troweled Finish.

- (1) To obtain a troweled finish, a floated finish as previously specified must be applied. After power floating, use a power trowel to produce a smooth surface which is relatively free of defects but which may still contain some trowel marks. Do additional trowelings by hand after the surface has hardened sufficiently. Do final troweling when a ringing sound is produced as the trowel is moved over the surface. Thoroughly consolidate the surface by hand troweling operations.
- (2) Produce a finished surface free of trowel marks, uniform in texture and appearance and conforming to Class "A" tolerance. On surfaces intended to support floor coverings, remove defects which might show through covering by grinding.

3.7 CURING PROCEDURES

- a. Objective. Protect freshly deposited concrete from premature drying and excessively hot or cold temperatures. Maintain a minimal moisture loss and a relatively constant temperature during the time necessary for hydration of cement and proper hardening of concrete.
- b. Initial Curing. Immediately after the finishing operation, begin initial curing. Keep concrete continuously moist at least overnight. Use one of the following materials and methods for initial curing:
 - (1) Ponding or continuous sprinkling.
 - (2) Absorptive mat or fabric kept continuously wet.
 - (3) Sand or other covering kept continuously wet.
 - (4) Continuous steam bath (not exceeding 150°F at the surface of concrete).
 - (5) Vapor mist bath.
 - (6) Membrane-forming curing compound applied according to the manufacturer's recommendations.

- c. Final Curing. Immediately following the initial curing and before concrete has dried, provide additional curing by one (1) of following materials or methods:
- (1) Continuing the method used in initial curing.
 - (2) Waterproof paper, polyethylene film or white burlap-polyethylene sheeting.
 - (3) Other moisture-retaining coverings as approved.
- d. Duration of Curing. Continue final curing until the cumulative number of days or fractions of days during which the ambient temperature is above 50°F has totaled seven (7). If high-early-strength concrete has been used, combine final curing for a total of three (3) days. Prevent rapid drying at the end of the curing period.
- e. Curing Day. A curing day is defined as a calendar day when the temperature, taken in the shade away from artificial heat, is above 50 F for at least 19 hours, (or colder days if satisfactory provisions are made to maintain the temperature at all surfaces of the concrete above 40° F for the entire 24 hours). The required curing period shall begin when all concrete has attained its initial set.
- f. Formed Surfaces. Steel forms heated by the sun and wood forms in contact with concrete during final curing period shall be kept wet. If forms are to be removed during the curing period, employ one (1) of the above curing materials or methods immediately. Continue such curing for the remainder of the curing period.
- g. Temperature.
- (1) Cold Weather. Place concrete only when the temperature is above 40°F and rising. Place no concrete if the temperature is below 50 F and falling. Maintain the ambient temperature of the air surrounding the concrete above 50 F for the required curing period. When necessary, make arrangements for heating, covering, insulating or housing concrete work in advance of placement to maintain the required temperature and moisture conditions. Prevent injury due to concentration of heat.
 - (2) Hot Weather. When necessary, make arrangements for installation of windbreaks, shading, fog spraying, sprinkling, ponding or wet covering of light color in advance of placement. Take such protective measures as quickly as concrete hardening and finishing operations will allow.
 - (3) Temperature Changes. Control changes in temperature of concrete at a rate as uniform as possible. Do not permit a temperature change to exceed 5°F in any one hour or 50°F in any 24-hour period.
- h. Protection From Mechanical Injury. During the curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock and excessive vibration. Protect finished concrete surfaces from damage caused by construction equipment, materials, or methods and by rain or running water. Do not load self-supporting structures in any way that overstresses concrete.