

400 CONCRETE STRUCTURES.
(REV 6-26-08) (FA 7-24-08) (1-09)

ARTICLE 400-1 (Page 359) is deleted and the following substituted:

400-1 Description.

Construct concrete structures and other concrete members, with the exception of pavement and incidental concrete construction (which are specified in other Sections).

Refer to Section 450 for prestressed construction requirements additional to the requirements of this Section.

For precast concrete structures meet the requirements of Section 450 for storage, shipping and erection.

Obtain incidental precast products from a plant that is currently on the list of Producers with Accepted Quality Control Programs. Producers seeking inclusion on the list shall meet the requirements of 105-3.

SUBARTICLE 400-5.7 (Pages 362-365) is deleted and the following substituted:

400-5.7 Stay-In-Place Metal Forms:

400-5.7.1 General: Utilization of stay-in-place metal forms is permitted in lieu of removable forms to form concrete bridge decks between beams and between the webs of individual box girders when designated in the plans. Stay-in-place metal forms may be of the cellular or non-cellular type, however, do not use cellular type forms when polymer sheeting is required. The flutes of non-cellular stay-in-place metal forms may be filled with polystyrene foam or concrete. When polystyrene foam is used to fill the forms, fill form flutes completely; do not allow any portion of the polystyrene foam to extend beyond the limits of the flutes. Ensure that the polystyrene foam remains in its required position within flutes during the entire concrete placement process. Do not use reinforcing steel supports or other accessories in such a manner as to cause damage to the polystyrene foam. Replace all damaged polystyrene foam to the satisfaction of the Engineer.

When the bridge superstructure environment is classified as moderately or extremely aggressive due to proximity to saltwater, apply polymer sheeting to the entire exterior surface of stay-in-place metal forms, except that the exterior surface of stay-in-place metal forms used to form the area between the webs of individual box girders does not require polymer sheeting. When polystyrene foam is used to fill the flutes of stay-in-place metal forms, apply polymer sheeting on the entire inside surface for all environmental classifications. When the flutes are concrete-filled, polymer sheeting is not required on the inside surface of the stay-in-place metal forms. Use polymer sheeting materials and application methods as described herein.

Prior to using stay-in-place metal forms, submit detailed plans for approval of the forming system, including method of support and attachment and method of protecting the supporting structural steel components from welding effects. Submit design calculations for the forming system, which have been signed and sealed by the Specialty Engineer. Detail stay-in-place metal forms such that they in no way infringe upon the concrete

outline of the slab shown on the plans. Use stay-in-place metal forms that provide and maintain the dimensions and configuration of the original slab in regards to thickness and slope.

Do not weld stay-in-place metal form supports and connections to the structural steel components. Do not connect polymer coated angles or other hardware that support polymer coated metal forms to the beam attachment straps or clips by welding.

Protect structural steel components from damage by using a shield to guard against weld splatter, weld overrun, arc strikes, or other damaging effects of the welding process. Upon completion of welding, rest the metal form support flush on the supporting steel component. Should any weld spatter, weld overrun, arc strike, or other effects of the welding process be evident or occur to the structural steel component, immediately stop in-place welding of the metal form supports for the remainder of the work. In this event, weld all metal form supports off of the structure and erect the forms after prefabrication, or use an alternate approved method of attaching the form supports. Remove improper weldment, repair the supporting steel component for any improper welding. Perform all required verification and testing at no expense to the Department and to the satisfaction of the Engineer.

Do not use stay-in-place metal forms until the forming system has been approved by the Engineer. The Contractor is responsible for the performance of the stay-in-place forms.

Structures designed, detailed, and dimensioned for the use of removable forms: Where stay-in-place metal forms are permitted, the Contractor is responsible and shall obtain the approval of the Engineer for any changes in design, etc. to accommodate the use of stay-in-place forms. The Engineer will compute pay quantities of the various components of the structure which are paid on a cubic yard basis from the design dimensions shown on the plans with no allowance for changes in deflection or dimensions necessary to accommodate the stay-in-place forms or concrete to fill the form flutes. The Engineer will limit pay quantities of other Contract items that the Contractor increases to accommodate the use of stay-in-place forms to the quantity required for the original plan design.

Submit all changes in design details of bridge structural members that support stay-in-place forms, showing all revisions necessary to enable the supporting components to withstand any additional weight of the forms and the weight of any extra concrete that may be required to fill the forms. Include with the design calculations a comparative analysis of the stresses in the supporting components as detailed on the Contract plans and as modified to support the forms. Use the identical method of analysis in each case, and do not allow the stresses in the modified components to exceed those of the component as detailed in the Contract plans. Include with the design the adjusted cambers for any changes in deflection over those shown on the original plans. Modify the beams to provide additional strength to compensate for the added dead loads imposed by the use of stay-in-place forms. Obtain the additional strength by adding strands to the pre-stressed beams or by adding steel material to increase the section modulus of steel girders. Substantiate the added strength by the comparative calculations. Do not use stay-in-place forms until the forming system and all necessary design revisions of supporting members have been approved by the Engineer.

Structures designed, detailed, and dimensioned for the use of stay-in-place metal forms:

Prior to using stay-in-place metal forms, submit detailed plans for approval of the forming system (including method of support and attachment) together with design calculations. Include an analysis of the actual unit weight of the proposed forming system

over the projected plan area of the metal forms. If the weight thus calculated exceeds the weight allowance for stay-in-place metal forms and concrete required to fill the forms shown on the plans, then modify the supporting components to support the excess weight as specified by the Contractor's Specialty Engineer.

For all structures utilizing structural steel supporting components, paint the vertical sides of the top flange prior to installation of the stay-in-place metal forms in accordance with Section 560.

For non-polymer sheeting form surfaces, use zinc paint coating in accordance with Section 562 to all accessories cut from galvanized sheets, which are not embedded in concrete.

400-5.7.2 Design: Meet the following criteria for the design of stay-in-place bridge deck forms:

1. Design the forms on the basis of dead load of form, reinforcement, and plastic concrete plus 50 lb/ft² for construction loads. Use a unit working stress in the steel sheet of not more than 0.725 of the specified minimum yield strength of the material furnished, but not to exceed 36,000 psi.

2. Do not allow deflection under the weight of the forms, reinforcement, and plastic concrete to exceed 1/180 of the form span or 1/2 inch, whichever is less, for form spans of 10 feet or less, or 1/240 of the form span or 3/4 inch, whichever is less, for form spans greater than 10 feet. In all cases, do not use a loading that is less than 120 psf total.

3. Use a design span of the form equal to the clear span of the form plus 2 inches. Measure the span parallel to the form flutes.

4. Compute physical design properties in accordance with requirements of the AISI Specifications for the Design of Cold Formed Steel Structural Members, latest published edition.

5. For all reinforcement, maintain the design concrete cover required by the plans.

6. Maintain the plan dimensions of both layers of primary deck reinforcement from the top surface of the concrete deck.

7. Do not consider the permanent bridge deck form as lateral bracing for compression flanges of supporting structural members.

8. Do not use permanent steel bridge deck forms in panels where longitudinal deck construction joints are located between stringers.

9. Secure forms to the supporting members by means other than welding directly to the member.

400-5.7.3 Materials:

400-5.7.3.1 Metal Forms: Fabricate stay-in-place metal forms and supports from steel meeting the requirements of ASTM A653 having a coating designation G165. Do not use form materials that are less than 0.03 inch uncoated thickness.

400-5.7.3.2 Polymer Sheeting: Use polymer sheeting comprised of at least 85% ethylene acrylic acid copolymer capable of being applied to both G165 and G210 steel sheet as described in ASTM A742. Ensure that the polymer sheeting has a nominal thickness of 12 mils as manufactured and a minimum thickness of 10 mils after lamination to the steel sheet. Ensure that the polymer sheeting remains free of holes, tears and discontinuities and sufficiently flexible to withstand the forming process without any detrimental effects to durability or performance. Ensure that the polymer sheeting is UV stabilized and contains antioxidants.

Ensure that the as-manufactured polymer sheeting (prior to application) has an Oxidative Induction Time (OIT) of 60 to 75 minutes at 170 °C in air when tested according to ASTM D3895. Perform additional OIT tests on samples taken from the finished product (polymer sheeting applied to forms) resulting in a minimum OIT according to ASTM D3895 of 32 minutes at 170 °C in air. Ensure that the polymer sheeting adheres to galvanized metal sufficient to prevent undercutting at penetrations made through the polymer sheeting or metal forms to the satisfaction of the Engineer. Ensure that edges subjected to shear cutting are coated by the form manufacturer with two coats of a compatible liquid coating repair material before delivery to the site. Ensure that steel used to produce polymer laminated metal forms is appropriately cleaned and prepared per NCCA (National Coil Coating Association) standard continuous coil coating practices. Ensure that pretreatment for use in conjunction with the manufacturer's polymer sheeting material is approved as compatible by the polymer sheeting manufacturer. Apply pretreatment in accordance with the polymer sheeting manufacturer's procedures. Apply polymer sheeting in accordance with the manufacturer's recommendations and procedures. Ensure that all steel has the polymer sheeting applied prior to fabrication of the stay-in-place forms and accessories.

Ensure that the screws to be used in the fastening of the stay-in-place laminated metal forms have a corrosion resistant cladding that will not have an adverse effect to the system due to the contact of dissimilar metals.

400-5.7.3.3 Certification: Provide a written certification from the manufacturer stating the product meets the requirements of this specification along with the delivery of the coated forms to the job site. Ensure that the certification conforms to the requirements of Section 6. Ensure that the manufacturer has a quality control program conforming to ISO 9001:2000 standards.

400-5.7.3.4 Polystyrene Foam: Use polystyrene foam comprised of expanded polystyrene manufactured from virgin resin of sufficient density to support the weight of concrete without deformation. Extrude the polystyrene foam to match the geometry of the flutes and provide a snug fit. Use polystyrene foam that has a density of not less than 0.8 lbs/cubic foot. Use polystyrene foam that has water absorption of less than 2.6% when tested according to ASTM C272. Provide a written certification from the manufacturer stating the product meets the requirements of this Specification along with the delivery of the product.

400-5.7.4 Construction: Install all forms in accordance with approved fabrication and erection plans.

Do not rest form sheets directly on the top of the stringer of floor beam flanges. Fasten sheets securely to form supports, and maintain a minimum bearing length of 1 inch at each end for metal forms. Place form supports in direct contact with the flange of the stringer or floor beam. Make all attachments for coated metal forms by bolts, clips, screws, or other approved means.

400-5.7.4.1 Form Galvanizing Repairs: For any permanent exposed steel where the galvanized coating has been damaged, thoroughly clean, wire brush, and paint it with two coats of galvanizing compound in accordance with Section 975 to the satisfaction of the Engineer. Do not touch up minor heat discoloration in areas of welds.

400-5.7.4.2 Polymer Sheeting Repairs: Inspect and identify areas for damage to the polymer sheeting and repair with liquid polymer coating similar and compatible with respect to durability, adhesion and appearance in accordance with ASTM A762, as furnished by the stay-in-place form manufacturer. Ensure that the inspection includes checking

the polymer sheeting for cuts, tears, cracking, surface pits, peeling, dirt, grease, oil, stains, rust or bare areas. Reject any panels that show coating blistering, peeling or cracking. Repair all polymer sheeting damage according to the following:

a. **Surface Preparation:** Ensure that all surfaces to be repaired are clean and free of any deleterious substances. Remove all traces of dirt, soil, oil deposits, greases, and other surface contaminants in accordance with the polymer sheeting and coating manufacturer's written specifications prior to touch-up and recoating.

b. **Application Procedures:** Ensure that the liquid polymer repair coating is applied to a clean dry surface and in accordance with the manufacturer's written specifications. Apply the repair coating using a suitable paintbrush or other means acceptable to the Engineer. Apply a first coat of product to the surface at 2-4 mils in thickness. Let the first coat air dry. Apply a second coat to form a complete layer and increase the thickness, immediately after verifying the first coat is dry to the touch (15 - 25 minutes depending on the local air drying temperature and atmospheric conditions). Apply the second coat at the same coating thickness as the first at 2-4 mils. Ensure that the total dry film thickness of the two coats is not less than 6 mils. Apply additional coats in this same manner until desired coating thickness is achieved.

400-5.7.5 Placing of Concrete: Vibrate concrete to avoid honeycomb and voids, especially at construction joints, expansion joints, valleys and ends of form sheets. Use approved pouring sequences. Do not use calcium chloride or any other admixture containing chloride salts in the concrete.

400-5.7.6 Inspection: The Engineer will observe the Contractor's method of construction during all phases of the construction of the bridge deck slab, including the installation of the metal form system; location and fastening of the reinforcement; composition of concrete items; mixing procedures, concrete placement, and vibration; and finishing of the bridge deck. Should the Engineer determine that the procedures used during the placement of the concrete warrant inspection of the underside of the deck, remove at least one section of the metal forms in each span for this purpose. Do this as soon after placing the concrete as practicable in order to provide visual evidence that the concrete mix and the procedures are obtaining the desired results. Remove an additional section in any span if the Engineer determines that there has been any change in the concrete mix or in the procedures warranting additional inspection.

If, in the Engineer's judgment, inspection is needed to check for defects in the bottom of the deck or to verify soundness, sound the metal forms with a hammer as directed by the Engineer after the deck concrete has been in place a minimum of two days. If sounding discloses areas of doubtful soundness to the Engineer, remove the metal forms from such areas for visual inspection after the concrete has attained adequate strength. Remove metal bridge deck forms at no expense to the Department.

At locations where sections of the metal forms have been removed, the Engineer will not require the Contractor to replace the metal forms. Repair the adjacent metal forms and supports to present a neat appearance and to ensure their satisfactory retention and where they are polymer sheeted, coat all exposed surfaces of stay-in-place metal form system elements that are not coated or are damaged with a field applied liquid polymer coating as specified in 400-5.7.4.2. As soon as the form is removed, the Engineer will examine the concrete surfaces for cavities, honeycombing, and other defects. If irregularities are found, and the Engineer determines that these irregularities do not justify rejection of the work, repair the concrete as directed, and provide a General Surface Finish in accordance with 40015. If the

Engineer determines that the concrete where the form is removed is unsatisfactory, remove additional metal forms as necessary to inspect and repair the slab, and modify the method of construction as required to obtain satisfactory concrete in the slab. Remove and replace all unsatisfactory concrete as directed, at no expense to the Department.

If the method of construction and the results of the inspections as outlined above indicate that sound concrete has been obtained throughout the slabs, the amount of sounding and form removal may be reduced when approved by the Engineer.

Corrosion of assembly screws will not be considered a structural or aesthetic problem and is considered acceptable.

Provide the facilities for the safe and convenient conduct of the inspection procedures.

SUBARTICLE 400-7.1 (Pages 368 and 369) is deleted and the following substituted:

400-7.1 Weather Restrictions:

400-7.1.1 Concreting in Cold Weather: Do not place concrete when the temperature of the concrete at placement is below 45°F.

Meet the air temperature requirements for mixing and placing concrete in cold weather as specified in Section 346. During the curing period, if NOAA predicts the ambient temperature to fall below 35°F for 12 hours or more or to fall below 30°F for more than 4 hours, enclose the structure in such a way that the concrete and air within the enclosure can be kept above 60°F for a period of 3 days after placing the concrete or until the concrete reaches a minimum compressive strength of 1,500 psi.

Assume all risks connected with the placing and curing of concrete. Although the Engineer may give permission to place concrete, the Contractor is responsible for satisfactory results. If the placed concrete is determined to be unsatisfactory, remove, dispose of, and replace the concrete at no expense to the Department.

400-7.1.2 Concreting in Hot Weather: Meet the temperature requirements and special measures for mixing and placing concrete in hot weather as specified in Section 346.

When the temperature of the concrete as placed exceeds 75°F, incorporate in the concrete mix a water-reducing retarder or water reducer if allowed by Section 346.

Spray reinforcing steel and metal forms with cool fresh water just prior to placing the concrete in a method approved by the Engineer.

Assume all risks connected with the placing and curing of concrete. Although the Engineer may give permission to place concrete, the Contractor is responsible for satisfactory results. If the placed concrete is determined to be unsatisfactory, remove, dispose of, and replace the concrete at no expense to the Department.

400-7.1.3 Wind Velocity Restrictions: Do not place concrete for bridge decks if the forecast of average wind velocity at any time during the planned hours of concrete placement exceeds 15 mph. Obtain weather forecasts from the National Weather Service "Hourly Weather Graph" for the city closest to the project site.

SUBARTICLE 400-7.5 (Pages 369 and 370) is deleted and the following substituted:

400-7.5 General Requirements for Placing Concrete: Do not place any concrete prior to approval of the Contractors quality control plan in accordance with 105-3. Deposit concrete as

nearly as possible in its final position. Do not deposit large quantities at one point and then run or work it along the forms. Take special care to fill each part of the forms, to work coarse aggregate back from the face, and to force concrete under and around reinforcing bars without displacing them.

Use a method and manner of placing concrete that avoids the possibility of segregation or separation of aggregates. If the Engineer determines that the quality of concrete as it reaches its final position is unsatisfactory, remove it and discontinue or adjust the method of placing until the Engineer determines that the quality of the concrete as placed is satisfactory.

Use metal or metal-lined open troughs or chutes with no aluminum parts in contact with the concrete. As an exception, chutes made of aluminum with a protective coating for ready mixed concrete trucks, no longer than 20 feet, may be used. This exception does not apply to any other means of concrete conveyance. Where steep slopes are required, use chutes that are equipped with baffles or are in short lengths that reverse the direction of movement. Where placing operations would involve dropping the concrete freely more than 5 feet, deposit it through pipes, troughs, or chutes of sheet metal or other approved material. Use troughs, chutes, or pipes with a combined length of more than 30 feet only with the Department's authorization. Keep all troughs, chutes, and pipes clean and free from coatings of hardened concrete by thoroughly flushing them with water after each run or more often if necessary.

Place concrete against supporting material that is moist at the time of concrete placement. If additional water is required, uniformly apply it ahead of the concrete placement as directed by the Engineer. Do not place concrete on supporting material that is frozen. The Contractor may use a moisture barrier in lieu of controlling the foundation grade moisture when approved by the Engineer.

SUBARTICLE 400-7.7 (Pages 370 and 371) is deleted and the following substituted:

400-7.7 Placing Concrete by Pumping: In general, use concrete pumping equipment that is suitable in kind and adequate in capacity for the work proposed. Use a pump discharge line that has a minimum diameter of 4 inches. Use a pump and discharge lines that are constructed so that no aluminum surfaces are in contact with the concrete being pumped. Operate the pump to produce a continuous stream of concrete, without air pockets. When using cement slurry or similar material to lubricate the discharge line when pumping begins, collect such material at the point of discharge. Dispose of the collected slurry in areas provided by the Contractor. Control the pump discharge locations so that the placement locations of the various LOTs of concrete represented by strength test cylinders can be identified in the event the test cylinders indicate deficient strength. When concrete is placed by pumping, take all test samples of concrete at the end of the discharge line, except in accordance with the provisions of Section 346.

SUBARTICLE 400-9.5 (Page 375) is deleted and the following substituted:

400-9.5 Joints in Sea Water or Brackish Water: For concrete placed in sea water or brackish water, do not place any construction joints between points 2 feet below the mean low water elevation and 6 feet above the mean high water elevation.

ARTICLE 400-14 (Pages 378 and 379) is deleted and the following substituted:

400-14 Removal of Forms.

Use the table below as the criterion for minimum time or compressive strength required before removal of forms or supports.

When using the time period criterion, include in the time period all days except days in which the temperature falls below 40°F.

Use the specified 28-day minimum compressive strength value as stated in 346-3.1 for each Class of Concrete utilized.

Location of Concrete Placement	Minimum Time for Form Removal for any Strength Concrete	Minimum (%) of 28-day Compressive Strength for Form Removal
(1) Deck slabs, top slabs of culverts and bottom of caps, forms under sidewalks, and safety curb overhangs extending more than 2 feet		
(a) Class II (Bridge Deck)	7 days*	75*
(b) Class II (Other than Bridge Deck)	7 days	75
(c) Class III	7 days	70
(d) Class IV	7 days	60
(e) Class V	7 days	50
(2) Walls, piers, columns, sides of beams and other vertical surfaces	24 hours**	50**
(3) Front face form of curbs	6 hours	70
* Reference 400-16.4 **Do not place additional load on the section until 70% of the specified 28-day concrete strength is attained. Also, refer to 400-7.4.		

When using the percent of required strength, cast test cylinders for each mix for compressive strength determination or develop a curing concrete strength versus time curve (S/T Curve) which can be used in lieu of multiple test cylinders to determine when percent of required strength has been met.

Prior to curve use; obtain the Engineer's approval of the S/T Curve and its supporting data. An approved testing laboratory may be used to provide this information with approval of the Engineer. Plot S/T Curves using at least three different elapsed times that begin once test cylinders are cast; however, one of the elapsed times must be prior to the Contractor's intended form removal. Each elapsed time plotted must have a corresponding compressive strength computed by averaging the compressive strength of two test cylinders.

Cure such test cylinders as nearly as practical in the same manner as the concrete in the corresponding structural component, and test them in accordance with ASTM C 39 and ASTM C 31. Perform cylinder casting, curing, and testing at no expense to the Department and under the observation of the Engineer. When the S/T Curve indicates a compressive strength equal to or greater than the percentage of specified strength shown in the table above for form removal, the Contractor may remove the forms. When the ambient air temperature falls 15°F or more below the ambient air temperature that existed during development of a S/T Curve, use a

S/T Curve that corresponds to the lower temperature and that is developed in accordance with this section.

Do not remove forms at any time without the consent of the Engineer. Even when the Engineer provides consent to remove the forms, the Contractor is responsible for the work.

SUBARTICLE 400-16.1 (Page 384) is deleted and the following substituted:

400-16.1 General: Cure cast-in-place and precast (non-prestressed) concrete as required herein for a minimum duration of 72 hours. If forms are loosened or removed before the 72 hour curing period is complete, expand the curing to cover these surfaces by either coating with curing compound or extending the continuous moist cure area.

Until curing has begun, retain concrete surface moisture at all times by maintaining a surface moisture evaporation rate less than 0.1 lb/ft²/hr. Periodically, at the site of concrete placement prior to and during the operation, measure the ambient air temperature, relative humidity and wind velocity with industrial grade weather monitoring instruments to determine the on-site evaporation rate. If the evaporation is, or is likely to become 0.1 lb/ft²/hr or greater, employ measures to prevent moisture loss such as application of evaporation retarder, application of supplemental moisture by fogging or reduction of the concrete temperature during batching. Compute the evaporation rate by using the nomograph in the ACI manual of Concrete Practice Part 2, Section 308R Guide to Curing Concrete, or by using an evaporation rate calculator approved by the Engineer.

SUBARTICLE 400-17.3 (Page 388) is deleted and the following substituted:

400-17.3 Time of Placing Superstructure: In the case of piers or bents with concrete caps, do not place the weight of the superstructure or of beams on the caps until they have reached the age of 10 days.

SUBARTICLE 400-17.4 (Page 388) is deleted and the following substituted:

400-17.4 Alternate Procedure: As an alternate procedure, in lieu of the time delay periods set forth in 400-17.1 and 400-17.3, test beams or cylinders may be cast from representative concrete and cured identically with the concrete in the corresponding structural component. Make the test beams in accordance with ASTM C 31 and test them in accordance with ASTM C 78. When the test results indicate a minimum flexural strength of 550 psi or indicate a minimum required compressive strength, concrete bridge decks and culverts may be opened to traffic or the superstructure and beams may be placed on caps.

ARTICLE 400-21 (Pages 390 and 391) is deleted and the following substituted:

400-21 Disposition of Cracked Cast-in-Place Concrete.

400-21.1 General: The investigation and disposition of cracked cast-in place concrete are described herein.

400-21.2 Investigation, Documentation and Monitoring: The Engineer will perform a thorough inspection of the concrete surfaces for cracks. If cracks are found, the Engineer will

measure crack lengths and widths. The Engineer will inspect concrete surfaces as soon as surfaces are fully visible after casting, between 7 and 31 days after the component has been burdened with full dead load, and a minimum of 7 days after the bridge has been opened to full unrestricted traffic. The Engineer will measure the width, length, termination points and precise location of all cracks and display, to scale, the results on a drawing referred to as a crack map. After initial inspection, the Engineer will monitor and document the growth of individual cracks at an inspection interval determined by the Engineer. Provide the access, equipment and personnel needed for the Engineer to perform this work.

400-21.3 Classification of Cracks: The Engineer will classify cracks as either nonstructural or structural. In general, nonstructural cracks are shallow depth cracks (between the surface of the concrete and the first layer of reinforcement), which form during curing. Structural cracks are cracks that extend beyond the depth of the reinforcing steel, which can form as a result of excessive load or inadequate support conditions during casting or from uncontrolled temperature gradients. The Contractor will be given an opportunity to review and comment on the Engineer's classification of cracks. The Engineer will make the final determination as to whether cracks are nonstructural or structural.

400-21.3.1 Cracking Significance: The Engineer will determine the cracking significance on the basis of total crack area as a percentage of concrete surface area. Cracking shall be categorized as Isolated, Occasional, Moderate or Severe according to the criteria in Tables 1 and 2. Computations for purposes of determining cracking significance shall be done on a LOT by LOT basis where a LOT is made up of not more than 100 square feet of concrete surface area on bridge substructures, or not more than 400 square feet of bridge deck. Where cracking is localized, the LOT will be reduced to encompass only the immediate area of cracks. Individual evaluation and repairs will be performed on a LOT by LOT basis as directed by the Engineer.

The area to be used in Tables 1 or 2 is the summation of the product of the crack length times the average crack width of all the cracks in a LOT computed in square feet.

The Engineer will identify cracks that are not representative of the overall typical cracking of the LOT(s) and evaluate these separately.

The Contractor will be given an opportunity to review and comment on the Engineer's determination of cracking significance. The Engineer will make the final determination of cracking significance with regard to Tables 1 and 2.

400-21.4 Resolution: Repair nonstructural cracks in accordance with Tables 1 or 2 where applicable. For disposition of structural cracks provide a structural evaluation and written recommendation by a Specialty Engineer.

Where Table 1 or 2 requires investigation to determine adequate repair or rejection, either replace the defective concrete or engage a Specialty Engineer to determine the structural and durability significance of the cracking and develop recommended repair methods for approval of the Engineer.

Cracks shown in Table 1 or 2 with no repair methods listed are considered unacceptable and the affected portions of the structure are required to be removed and replaced.

The Engineer will make the final determination of whether the cracked concrete shall be repaired or replaced, and must approve repair methods prior to start of the work.

No additional compensation or contract time shall be allowed for repairing or replacing cracked concrete that was caused by inadequate curing effort or inadequate construction practice as determined by the Engineer.

Table 2
CAST-IN-PLACE BRIDGE DECK

		Crack Total Area (In Percent of Concrete Surface) ⁽¹⁾											
		<0.005%			0.005%-0.017%			0.017%-0.029%			>0.029%		
		Isolated			Occasional			Moderate			Severe		
		Environment			Environment			Environment			Environment		
Crack Width ⁽²⁾ (inch)	SA	MA	EA	SA	MA	EA	SA	MA	EA	SA	MA	EA	
	Up to 12 feet AMHW	$x \leq 0.004$	NT	NT	PS	NT	PS	PS	PS	PS	PS		
$0.004 < x \leq 0.008$		NT	NT	EI/M ⁽³⁾	NT	PS	EI/M ⁽³⁾	EI/M ⁽³⁾	EI/M ⁽³⁾	EI/M ⁽³⁾			
$0.008 < x \leq 0.012$		NT	PS	EI/M	PS	EI/M	EI/M	EI/M	EI/M				
$0.012 < x \leq 0.016$		PS	PS	EI/M	PS	EI/M							
$0.016 < x \leq 0.020$		PS	PS	EI	EI								
$0.020 < x \leq 0.024$		PS	EI	EI		Investigate to Determine Appropriate Repair ^(4,5) or Rejection					Reject and Replace		
$0.024 < x \leq 0.028$		PS	EI										
$0.028 < x$													
12 feet plus AMHW or over Land	Crack Width	SA	MA	EA	SA	MA	EA	SA	MA	EA	SA	MA	EA
	$x \leq 0.004$	NT	NT	PS	NT	NT	PS	PS	PS	PS			
	$0.004 < x \leq 0.008$	NT	NT	PS	NT	PS	EI/M ⁽³⁾	PS	EI/M ⁽³⁾	EI/M ⁽³⁾			
	$0.008 < x \leq 0.012$	NT	NT	EI/M	PS	PS	EI/M	EI/M	EI/M				
	$0.012 < x \leq 0.016$	NT	PS	EI/M	PS	EI/M							
	$0.016 < x \leq 0.020$	NT	PS	EI	PS	Investigate to Determine Appropriate Repair ^(4,5) or Rejection							

