**Supplemental Specification**
**2008 Standard Specification Book**

**SECTION 03055**

# PORTLAND CEMENT CONCRETE

**Delete Section 03055 and replace with the following:**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Materials and procedures for producing Portland cement concrete.

### 1.2 RELATED SECTIONS Not Used

### 1.3 REFERENCES

A. AASHTO M 6: Standard Specification for Fine Aggregate for Portland Cement Concrete

B. AASHTO M 80: Standard Specification for Coarse Aggregate for Portland Cement Concrete

C. AASHTO M 154: Standard Specification for Air-Entraining Admixtures for Concrete

D. AASHTO M 157: Standard Specification for Ready-Mixed Concrete

E. AASHTO M 194: Standard Specification for Chemical Admixtures for Concrete

F. AASHTO M 295: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

G. AASHTO T 325: Estimating the Strength of Concrete in Transportation Construction by the Maturity Tests

H. ASTM C 150: Standard Specification for Portland Cement

I. ASTM C 595: Standard Specification for Blended Hydraulic Cements

J. ASTM C 1157: Standard Performance Specification for Hydraulic Cement

K. ASTM C 1240: Standard Specification for Silica Fume for Used in Cementitious Mixtures

L. ASTM C 1567: Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)

M. ASTM C 1602: Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

N. American Concrete Institute (ACI) Standards

O. Precast/Prestressed Concrete Institute (PCI)

P. UDOT Materials Manual of Instruction

Q. UDOT Minimum Sampling and Testing Requirements Manual

R. UDOT Quality Management Plan

## 1.4 DEFINITIONS Not Used

## 1.5 SUBMITTALS

A. Furnish to the Resident Engineer and Region Materials Engineer a mix design for each class of concrete to be used.

1. Mix designs will be approved based on results of trial batches or on history from UDOT project(s) within the last year.
2. Use the same components in the trial batches that are to be used in the project. Accelerators and site-added air-entrainment can be incorporated in the trial batch but are not required. The Contractor assumes responsibility for the compatibility of all admixtures with the mix design and their potential effects on concrete properties
3. Personnel performing and witnessing trial batches, and performing compressive and flexural strength testing, must be UDOT TTQP Concrete and Concrete Strength Testing qualified.
4. The Department or its representative may witness the trial batch.
5. Mix concrete trial batches as specified in UDOT Materials Manual of Instruction Part 8-974: Guidelines for Portland Cement Concrete Mix Design.
6. Compressive and flexural strength testing for verification of trial batches will be performed by an AASHTO accredited laboratory, approved through the UDOT Laboratory Qualification Program.

B. Provide test results verifying the coarse and fine aggregate used meets this section, article 2.3

C. For any proposed mix design, provide test results for potential reactivity of coarse and fine aggregates in accordance with the requirements of the UDOT Quality Management Plan for Ready-Mix Concrete

D. When using potentially reactive aggregates in a mix design, provide results from appropriate testing to determine the ability of the combinations of cementitious materials and aggregates to control the reactivity

E. Submit verification that cement used is from a pre-qualified supplier. See this Section, article 2.2, paragraph E.

F. Submit verification that fly ash or other pozzolan used is from a pre-qualified supplier. See this Section, article 2.6, paragraph A.1.d.

G. Submit verification that the batch plant meets the requirements of the UDOT Quality Management Plan for Ready-Mix Concrete.

H. Submit cold and/or hot weather plans as required in Article 3.4, Limitations.

## 1.6 ACCEPTANCE

A. Acceptance is in accordance with UDOT Minimum Sampling and Testing Requirements.

B. When concrete is below specified strength and does not have a separate strength pay factor:
1. Department may accept item at a reduced price.
2. The pay factor will be applied to the portion of the item that is represented by the strength tests that fall below a specified strength.
3. Department will calculate the pay factor as follows based on 28 day compressive strength:

| **Psi below specified strength:** | **Pay Factor:** |
|---|---|
| 1 – 100 | 0.95 |
| 101 – 200 | 0.90 |
| 201 – 300 | 0.85 |
| 301 – 400 | 0.80 |
| More than 400 | Reject |

4. The Engineer may accept a “reject” lot based on an engineering analysis and concurrence from the Region Materials Engineer. If a reject lot is allowed to remain in-place, apply a pay factor of 0.50.

## PART 2 PRODUCTS

### 2.1 CONCRETE CLASSES AND MIX REQUIREMENTS

A. Meet the requirements in Table 1.

Table 1

| Concrete Classes and Mix Requirements | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Class** | **Coarse Aggregate or Sieve Size** | **Max. Water/ Cementitious Ratio** | **Min. Cementitious Content ($lb/yd^3$)** | **Slump (Inch) See Article H for further Criteria** | **Air Content Percent (%)*** | **Mix Design Compress *f '*cr (Psi)** | **28 Day Minimum Compress *f '*c (Psi) **** |
| AA(AE) | 2" to No. 4 | 0.44 | 564 | 1 to 3.5 | 4.0 - 7.0 | 5200 | 4000 |
| | 1-½" to No. 4 | 0.44 | 564 | 1 to 3.5 | 4.5 - 7.5 | 5200 | 4000 |
| | 1" to No. 4 | 0.44 | 611 | 1 to 3.5 | 5.0 - 7.5 | 5200 | 4000 |
| | ¾" to No. 4 | 0.44 | 611 | 1 to 3.5 | 5.0 - 7.5 | 5200 | 4000 |
| A(AE) | 1-½" to No. 4 | 0.53 | 470 | 1 to 3.5 | 4.5 - 7.5 | 3900 | 3000 |
| | 1" to No. 4 | 0.53 | 470 | 1 to 3.5 | 4.5 - 7.5 | 3900 | 3000 |
| | ¾" to No. 4 | 0.48 | 517 | 1 to 3.5 | 4.5 - 7.5 | 3900 | 3000 |
| B or B(AE) | | 0.62 | 376 | 2 to 5 | --<br>3.0 - 6.0 | 3250 | 2500 |

* Values listed represent in-place air content. Make necessary adjustments for impacts to air content due to placement.

** For *f '*c over 4000 psi, design and proportion mixes according to ACI Manual of Concrete Practice 301: Specifications for Concrete and project specific criteria.

B. Minimum strength is based on a coefficient of variation of 10 percent, and one test below the minimum strength per 100 tests.

C. Maximum nominal size of coarse aggregate:
1. Not larger than $^1/_5$ the narrowest dimension between sides of forms.
2. Not larger than ⅓ the depth of slabs.
3. Not larger than ¾ the minimum clear distance between reinforcing bars or between bars and forms, whichever is less.

D. Do not exceed water/cementitious ratio.

E. Calculate the water/cementitious ratio (w/c) according to the following formula:

$$\frac{W}{C} = \frac{\text{Water}}{\text{Cement + Pozzolan}}$$

F. Do not exceed 30 percent total pozzolan in any mix unless approved or otherwise specified.

G. Use 94 lb additional cementitious material per cubic yard when concrete is deposited in water than the design requires for concrete placed above water.

H. Use Table 1 to determine the slump requirements when not using water-reducing admixtures.
   1. Slump requirements when using low range water reducers: 1 inch to 5 inches for all classes of concrete.
   2. Slump requirements when using high range water reducers: 4 inches to 9 inches for all classes of concrete.

## 2.2 CEMENT

A. Use type II Portland cement or blended hydraulic cement unless otherwise specified. (ASTM C 150, ASTM C 595, ASTM C 1157)

B. Portland Cement
   1. Follow Tables 1 and 3 in ASTM C 150.
   2. Follow the requirements of Table 2 of ASTM C 150 for low-alkali cement.

C. Blended Hydraulic Cement.
   1. When blended hydraulic cement is substituted for Portland cement:
      a. Use ASTM C 1567 to verify that expansion is less than 0.1 percent at 16 days.
      b. Refer to the equivalent cements listed in Table 2.
   2. Do not exceed 30 percent total pozzolan limit when adding flyash to a blended hydraulic cement.
      a. Submit documentation of the total pozzolan content with the mix design.

Table 2

| **Portland Cement/Blended Hydraulic Cement Equivalencies** | | |
|---|---|---|
| **ASTM C 150 (Low Alkali)** | **ASTM C 595** | **ASTM C 1157** |
| Type I | IP | GU |
| Type II | IP (MS) | MS |
| Type III | - | HE |
| Type V | - | HS |

D. Do not use cement that contains lumps or is partially set.

E. Use cement from the list of UDOT qualified suppliers list maintained by the UDOT Materials Quality Assurance Section.

F. Do not mix cements originating from different sources.

G. Do not use air-entrained cement.

H. Department will sample and test the cement in accordance with UDOT Quality Management Plan 502: Cement.

## 2.3 AGGREGATE

A. Coarse Aggregate for Normal Concrete Mixes
1. Use coarse aggregate meeting AASHTO M 80 physical properties. Use one of the gradations found in Table 3.
2. Do not exceed percentages of deleterious substances as outlined in AASHTO M 80, Table 2, for Class A aggregates.

Table 3

| **Aggregate Gradations - Percent Passing (by weight)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Aggregate or Sieve Size (inches)** | **2½** | **2** | **1½** | **1** | **¾** | **½** | **⅜** | **No. 4** |
| 2 to No. 4 | 100 | 95-100 | | 35-70 | | 10-30 | | 0-5 |
| 1½ to No. 4 | | 100 | 95-100 | | 35-70 | | 10-30 | 0-5 |
| 1 to No. 4 | | | 100 | 95-100 | | 25-60 | | 0-10 |
| ¾ to No. 4 | | | | 100 | 90-100 | | 20-55 | 0-10 |

B. Fine Aggregate for Normal Concrete Mixes
1. Use fine aggregate meeting AASHTO M 6 physical properties. Use the gradation found in Table 4.
2. Do not exceed percentages of deleterious substances as outlined in AASHTO M 6, Table 2, for class A aggregates, using option “b” for material finer than the No. 200 sieve.

Table 4

| **Gradation** | |
|---|---|
| **Sieve Size** | **Percent Passing (by weight)** |
| ⅜ inch | 100 |
| No. 4 | 95 to 100 |
| No. 16 | 45 to 80 |
| No. 50 | 10 to 30 |
| No. 100 | 2 to 10 |

## 2.4 WATER

A. Use potable water or water meeting ASTM C 1602, including Table 2.

B. Screen out extraneous material when pumping water from streams, ponds, lakes, etc.

## 2.5 ADMIXTURES

A. Air Entrainment: as specified. Meet AASHTO M 154, including Section 5.

B. Water Reducing Agents: Meet AASHTO M 194.
   1. High Range Water Reducer (HRWR): Submit a written plan for approval with the trial batch that shows proper attention will be given to ingredients, production methods, handling and placing.
   2. Do not use calcium chloride.

C. Accelerators: Meet AASHTO M 194
   1. Use non-chloride accelerators.

D. Set Retarding Admixtures: Meet AASHTO M 194.
   1. Establish the effective life of the set-retarding admixture by trial batch if set retarding admixtures are required due to haul times exceeding the time limitations in this Section, article 3.4, paragraph A.
   2. Do not exceed any manufacturer recommendations for the use of the set retarding admixture.
   3. Do not re-dose the concrete with additional set retarding admixture.
   4. Add set retarding admixture at the batch plant at the time of initial batching operations.
   5. Show on batch tickets the amount of admixture used.
   6. Time of placement is established by the trial batch and supersedes the requirements in this Section, article 3.4, paragraph A.

E. Site-added air-entrainment. (Meet AASHTO M 154)
   1. Limit the use of site-added air-entraining agents to one addition (regardless of quantity) per load
   2. Use pre-measured admixtures.
   3. Record amount used on batch ticket.
   4. Rotate the drum at least 30 revolutions at the mixing speed recommended by the manufacturer.

## 2.6 POZZOLAN

A. Fly Ash:
   1. Class F, as specified. Conform to AASHTO M 295 except table 2.
      b. Loss on Ignition (LOI): not to exceed 3 percent.
      c. Maximum allowable CaO content: not to exceed 15 percent.
      d. Use fly ash from the list of UDOT pre-qualified sources maintained by the UDOT Materials Quality Assurance.
      e. Label the storage silo for fly ash to distinguish it from cement.
      f. Use different size unloading hoses and fittings for cement and fly ash.
   2. Fly ash may be sampled and tested for compliance at any time.

B. Natural Pozzolan (Class N)
   1. Conform to AASHTO M 295.
   2. May use instead of fly ash provided that the expansion, according to ASTM C 1567, does not exceed 0.1 percent.

C. Silica Fume: Conform to ASTM C 1240.

# PART 3 EXECUTION

## 3.1 PREPARATION

A. Aggregate stockpiles:
   1. Construct stockpile platforms so that subgrades are prevented from intruding into aggregates.
   2. Build stockpiles at least two days before use.
   3. Provide an operator and front-end loader to help the Engineer take aggregate samples.
   4. Aggregate may not be accepted more than 30 days before use.
   5. Provide separate stockpiles for coarse and fine aggregates.
   6. Construct stockpiles to minimize segregation of aggregates
   7. Allow washed aggregates to drain to uniform moisture content before use (12 hours minimum).

## 3.2 BATCH MATERIALS

A. Meet AASHTO M 157.

B. Hand Mixing:
   1. Only Class B concrete may be hand mixed.
   2. Hand-mixed batches cannot exceed 0.5 $yd^3$.

3. Hand mix on a watertight platform.
4. Spread the aggregate evenly on the platform and thoroughly mix in the dry cement until the mixture becomes uniform in color.

C. Truck-Mixed Concrete (Dry-Batch):
1. Do not load trucks in excess of their rated mixing capacity, or 63 percent of the drum gross volume, or less than 2 $yd^3$.
2. The truck rating plate must be readable.

## 3.3 MIX DESIGN

A. Design mixes to meet the requirements of this Section and project specific criteria.
B. Design the cementitious system to mitigate potential alkali-aggregate reactivity.
1. When using fly ash, use a minimum of 20% by weight of the total cementitious system.
C. Use only concrete mixes that have been approved by the Region Materials Engineer.
D. Obtain concurrence from the Resident Engineer for the project specific application of an approved mix

## 3.4 LIMITATIONS – GENERAL

A. Timing. Unless otherwise specified, place concrete:
1. Within 90 minutes of batching when the air temperature is below 80 degrees F.
2. Within 75 minutes of batching when the air temperature is between 80 and 85 degrees F.
3. Within 60 minutes of batching when the air temperature is above 85 degrees F.
4. Prior to initial set.

B. Concrete Temperature: Unless otherwise specified, place concrete when the concrete temperature is between 50 and 90 degrees F.

C. Pumping and Conveying Equipment
1. Do not use equipment or a combination of equipment and the configuration of that equipment that causes a loss of entrained air content that exceeds one half of the range of air content allowed by specification.
2. Contractor is responsible for verification and monitoring of air loss.

D. Cold Weather: Comply with the following regulations for placing concrete when the temperature is forecast to fall below 40 degrees F within 14 days of placement.
   1. Do not use chemical “anti-freeze” additives in the concrete. (Note: This does not apply to normal accelerators.)
   2. Provide all necessary cold weather protection for in-place concrete (cover, insulation, heat, etc.)
   3. Protect the concrete from freezing until a compressive strength of at least 3,500 psi has been achieved, determined by either:
      a. Maturity method: Refer to AASHTO T 325
      b. Field cure cylinders
   4. Adequately vent combustion-type heaters that produce carbon monoxide.
   5. When applying external heat, maintain moist conditions to avoid excessive loss of moisture from the concrete.
   6. When removing heat, limit the drop in temperature of concrete surfaces to 20 degrees F during any 12-hour period until the surface temperature of the concrete reaches that of the atmosphere.
   7. Determine the concrete temperature with a surface thermometer insulated from surrounding air.
   8. Do not proceed with the placement of concrete until the temperature of all contact surfaces is 36 degrees F and ambient temperature is ascending
   9. Cease operations when the ambient temperature is 45 degrees F and decreasing.
   10. Remove and replace concrete damaged by frost action at no additional cost to the Department.
   11. Do not use material containing frost or lumps.

E. Hot Weather: Cool all surfaces that will come in contact with the concrete to below 95 degrees F.

## 3.5 CYLINDER STORAGE DEVICE

A. Provide and maintain cylinder storage device.
   1. Maintain cylinders at a temperature range of 60 degrees F to 80 degrees F for the initial 16-hour curing period.
   2. Do not move the cylinders during this period.
   3. Equip the storage device with an automatic 24-hour temperature recorder that continuously records on a time-temperature chart with an accuracy of ±1 degree F.
   4. Have the storage device available at the point of placement at least 24 hours before placement.
   5. Engineer stops placement of concrete if the storage device cannot accommodate the required number of test cylinders.

6. Use water containing hydrated lime if water is to be in contact with cylinders.
7. A 24-hour test run may be required.

END OF SECTION

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**SPECIAL PROVISION**

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**SECTION 03154S**

# CONCRETE BRIDGE DECK REMOVAL

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Description of the work including removal of the bridge deck, use of reinforcing and shear connectors in conjunction with the planned replacement of the bridge deck, and lists the necessary materials and equipment to complete the work as shown on the plans. This specification does not include bridge deck removal where the supporting structure is not salvaged.

B. Requirements for protecting adjacent travelways, property, and the environment.

### 1.2 RELATED SECTIONS

A. Section 01554: Traffic Control

### 1.3 REFERENCES

A. ANSI/AASHTO/AWS D1.5 Bridge Welding Code

### 1.4 DEFINITIONS

A. Continuous multi-span steel girder bridges:
   1. Negative moment regions: Generally the areas near the interior supports (piers).
   2. Positive moment regions: All other areas of the bridge, generally away from the interior supports.

B. Hydraulic Breaker: A powerful percussion hammer fitted to an excavator for demolishing concrete structures powered by the hydraulic system on the excavator, often referred to as a Hoe Ram.

C. Hydraulic Shear: A process of removing concrete using a machine that can cut through relatively thin reinforced concrete elements.

D. Longitudinal Saw Cut: A saw cut that is along a line that is parallel to the supporting girders.

E. Saw Cut: A process of cutting through reinforced concrete with a circulating saw. Often the saw blade has a diamond edge to improve cutting.

F. Transverse Saw Cut: A saw cut along a line that is generally perpendicular to the supporting girders (or along the skew for bridge decks that are skewed less than 20 degrees).

## 1.5 SUBMITTALS

A. Demolition Plan
  1. Submit a demolition plan to the Engineer for approval depicting the proposed methods of deck removal. Submit the plan a minimum of 30 days prior to the commencement of work.
     a. Submit five sets half-size, 11½ x 17 inch sheets with a 1½-inch blank margin on the left-hand edge.
     b. Place the project designation data in the lower right-hand corner of each sheet.
     c. Comply with all requirements of applicable environmental permits.
     d. Comply with the construction timeframes specified in Section 01554.
     e. Include a written sequence of the specific steps for demolition.
     f. Include a work area plan, depicting utilities overhead and below the work area, drainage inlet structures, protective measures, etc.
     g. Include details of all equipment that will be used for the deck removal, paying special attention to the methods of removing the deck directly over the girders and adjacent to expansion joints that are to remain without causing damage.
     h. Include details of all equipment used to lift large portions of the deck such as cranes, excavators, lifting slings, sling hooks, jacks. Include as a minimum, crane locations, operation radii, lifting calculations.
     i. Include details of debris shield used to protect adjacent travelways, property and areas of the environmental specified for protection.
     j. Include details of debris protection and containment including calculations of containment structures.

k. Include calculations that demonstrate the satisfactory stability and strength of the bridge under all anticipated loads and removal methods. Account for the loss of composite action as the bridge deck is being removed.
l. Include procedures for repairing the top girder flange if damage occurs (nicks, dents, spalls).
m. Include methods of disposal of debris from the deck removal including final disposal site. Comply with all local, state and federal regulations.
n. Prepare the plan under the seal of a Professional Engineer licensed in Utah.
o. Engineer reserves the right to retain the plan up to 14 calendar days without granting an increase in the number of working days on the project. This is reduced to 7 days when the drawings are submitted electronically. This right applies each time the plans are submitted.

## PART 2 PRODUCTS

### 2.1 ACCEPTABLE EQUIPMENT

A. Sawcutting:
1. Use saws capable of cutting through concrete and reinforcing steel.
2. Use water to facilitate the cutting operation. Collect the runoff water if there are roadways or environmentally sensitive areas under the bridge.

B. Hydraulic Breakers:
1. Do not use a hydraulic breaker with a blunt tip in the vertical direction within six inches of a bridge girder or underlying structure walls that will remain.
2. Use wide, cross-cut chisel bits oriented on a flat angle over steel girder flanges to remove concrete and shear connectors if it will not cause damage to the girder.
3. Specialized pavement removal buckets may be used to lift sections of slabs that have been pre-cut.

C. Pneumatic Hammer:
1. Pneumatic hammers may be used to remove concrete over beams if they will not cause damage to the girder.

D. Hand Held Cutting Tools:
1. Cutting torches of varying types may be used to cut existing reinforcing and shear connectors that are specified to be removed.

2. Use hand-held grinding equipment to remove portions of shear connectors.

E. Other equipment:
1. Other equipment may be used if it will not cause damage to the girder.

## PART 3 EXECUTION

### 3.1 BRIDGES OVER ROADWAYS AND RAILROADS

A. Provide the necessary workers, materials, and equipment at the site as needed to proceed with the removal work in an expeditious manner prior to closing the roadway to traffic to accommodate the deck removal.

B. Comply with all Maintenance of Traffic specifications.

C. Coordinate all work with Railroad. Provide railroad flaggers as required.

D. Pursue work promptly without interruptions while the roadway is closed to public traffic. Debris from deck removal operations may be allowed to fall directly onto the roadway below if pavement and structures are adequately protected.

E. Install protective debris shields if required.

F. Install protective debris shield for utilities if required.

G. Repair damage to girders, framing, utilities, adjacent travelways, and property.

### 3.2 BRIDGES OVER ENVIRONMENTALLY SENSITIVE AREAS

A. Provide the necessary equipment and shielding to prevent debris from falling into area below the bridge. This includes the collection of water used during deck removal.

B. Locate cranes away from sensitive areas as specified in the project environmental documents.

C. Install protective debris shield for utilities if required.

D. Repair damage to girders, framing, utilities, adjacent travelways, property and areas of the environmental specified for protection.

### 3.3 ACCEPTABLE PROCEDURES FOR ACCELERATED DECK REMOVAL

A. The following procedures may be used for the rapid removal of bridge decks. The Engineer responsible for the development of the demolition plan will carefully review and consider any procedures. Provide adequate strength and stability of the bridge per AASHTO requirements during all phases of the deck removal. Use operating level bridge rating calculations for the short-tem saw cuts described below.

1. Prior to bridge closure:
    a. Locate the reinforcing elevations at various locations along the bridge prior to closure. Use coring, drilling, chipping, or other means to locate the reinforcing. Minimize the size of exploratory holes.
    b. Partial depth transverse pre-demolition saw cutting of the bridge deck is allowed for simple span bridges and positive bending moment areas of continuous span bridges. A 50 percent cut of the deck depth may be cut during off-peak closures within one week of the complete removal of the bridge deck. Use a minimum spacing of cuts of approximately four feet. Traffic may be allowed on the deck in the interim period between the saw cutting and the full deck removal. There will be a potential for concrete to spall under the saw cuts after the bridge is re-opened to traffic. Design a debris shield for spall containment.
    c. Vertical cuts through the parapet will be allowed within one week of the full deck removal provided that the cuts are less than two inches wide.
    d. Full removal of parapets prior to bridge closure will be allowed if the deck overhang is protected with a properly anchored temporary traffic barrier.
2. After bridge closure:
    a. Partial depth transverse saw cuts used prior to the bridge closure may be extended through the full thickness after bridge closure. Continuously monitor the extension of the saw blade from under the deck during the cutting operation to prevent cutting into the top of the flange of the girders. Maintain radio or visual contact between the monitoring personnel and the cutting crew.
    b. Longitudinal saw cuts above the centerline of the girder top flange will be allowed provided that the depth of the saw cut is limited to just below the bottom mat of reinforcing steel.
    c. Lift slab sections using cranes or pavement removal buckets mounted on hydraulic excavators.

d. Remove the concrete over the girder flange on steel girder bridges with hand operated pneumatic hammers or hydraulic breakers equipped with a wide cross cut chisel bit set to a flat angle to shear off the shear connectors. Alternate methods of concrete removal over the girders may be used with prior approval from the Engineer. Modify the removal process if any damage occurs to the top flange.

e. Remove the concrete over the girder on concrete girder bridges with hand operated pneumatic hammers. Use 50 pound or smaller chipping hammers within six inches of the girder flange edge.

## 3.4 REPAIR OF DAMAGED FLANGES

A. The demolition plan Engineer is responsible for anticipating potential damage to the top flange of the girders and developing appropriate repair procedures prior to demolition. The following guidelines can be used for the repairs.

1. Simple span steel girder bridges:
    - a. Do not repair minor dents and nicks in the top flange. Minor dents are defined as less than ½ inch deep. Minor nicks are defined as less than ¼ inch deep. Repair bent flanges if damaged beyond these limits. Repair nicks and gouges if damaged beyond these limits.
    - b. Repair any bent transverse vertical stiffeners of connection plates.
    - c. Leave remnants of the shear connectors in place. Remove a sufficient amount or all of the connectors to allow placement of the new deck.
    - d. Repair any sawcut that penetrates the top flange. Welding of the sawcut is allowed using an approved welding procedure that meets the requirements of ANSI/AASHTO/AWS D1.5 Bridge Welding Code.
    - e. Report any damage beyond these limits to the Engineer. Develop special repair procedures for these situations and obtain approval prior to commencement of the repair procedure.
2. Continuous multi-span steel girder bridges:
    - a. There are two different areas on a continuous steel bridge that require different repair approaches. The negative and positive moment regions are shown on the plans.
    - b. Treat the positive moment region areas as simple span bridges.

c. Negative moment regions:
   1) Do not repair minor dents. Minor dents are defined as less than ½ inch deep. Repair bent flanges if damaged beyond these limits.
   2) Repair any bent transverse vertical stiffeners of connection plates.
   3) Repair all nicks and gouges in the top flange in negative moment regions. Grind out nicks that are less than ¼ inch deep by grinding in a direction parallel to the girder span. Repair deeper nicks and gouges by welding using an approved welding procedure that meets the requirements of ANSI/AASHTO/AWS D1.5 Bridge Welding Code. Grind all welds flush with the surface of the top flange by grinding in the direction parallel to the girder span.
   4) Remnants of the shear connectors may be left in place. Remove a sufficient amount or all of the connectors to allow for placement of the new deck.
   5) Repair any saw cut that penetrates the top flange. Welding of the saw cut will be allowed using an approved welding procedure that meets the requirements of ANSI/AASHTO/AWS D1.5 Bridge Welding Code. Treat the weld repair as a tension flange splice. Grind all welds flush with the surface of the top flange by grinding in the direction parallel to the girder span.

3. Concrete girder bridges:
   a. Do not repair minor spalls in the top flange provided that the area is to be filled with concrete or grout in the completed bridge deck. Minor is defined as less than 1½ inch deep. Repair larger spalls using an approved patching material.
   b. Repair any cracks in the top flange using epoxy injection crack repair methods.
   c. Do not repair saw cuts that are less than ¼ inch deep. Repair saw cuts that are deeper than ¼ inch by chipping out the area and patching with an approved patching material.
   d. Report any damage beyond these limits to the Engineer. Develop special repair procedures for these situations and obtain approval prior to commencement of the repair procedure.

END OF SECTION

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**SPECIAL PROVISION**

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**SECTION 03251S**

# POST TENSIONING

**Add Section 03251:**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Furnish, install, post-tension and grout prestressing steel for precast elements and beam in accordance with the details shown on the plans and the requirements of this Specification.

B. Furnish and install any appurtenant items necessary for the particular prestressing system used, including but not limited to ducts, anchorage assemblies, supplementary reinforcing bars, and grout used for pressure grouting ducts.

### 1.2 RELATED SECTIONS Not Used

### 1.3 REFERENCES

A. AASHTO M 85: Portland Cement

B. AASHTO M 203: Steel Strand, Uncoated Seven-Wire for Prestressed Concrete

C. AASHTO M 204: Uncoated, Stress-Relieved Steel Wire for Prestressed Concrete

D. AASHTO M 235: Epoxy Resin Adhesives

E. AASHTO M 275: Uncoated High Strength Steel Bar Prestressed Concrete

F. AASHTO LRFD Bridge Design Specifications, current edition

G. Federal Specification MIL-P-3420

H. U.S. Army Corps of Engineers Method CRD-C79

## 1.4 DEFINITIONS

A. Job site or site: The location where the prestressing steel is to be installed whether at the bridge site or a removed casting yard.

## 1.5 SUBMITTALS

A. Shop Drawing: Furnish to the Engineer
   1. Five sets half-size, 11½ inch by 17 inch sheets, with a 1½ inch blank margin on the left-hand edge. Place the State project designation data in the lower right-hand corner of each sheet. The shop drawings must be sealed by a Registered Utah Professional Engineer in the State of Utah.
   2. Include in the shop drawings:
      a. Anchorage and bearing
      b. Tendon placement
      c. Anchorage local-zone and general-zone reinforcement
      d. Jacking forces and initial stresses
      e. Stressing operation and equipment data
      f. All material specifications such as tendons, ducts, and grout
      g. Grouting operation and equipment data
      h. Safety procedures
      i. Elongations and tolerances
      j. All required computations based on the AASHTO LRFD Bridge Design Specifications
      k. Computations and a typical tendon force diagram for all types of tendons after friction and anchor set losses based on an expected actual friction coefficient for the system to be used
   3. The Engineer reserves the right to retain these drawings up to 14 calendar days without granting an increase in the number of working days on the project. This duration is reduced to 7 days when the drawings are submitted electronically. This right applies each time the drawings are submitted or re-submitted. The Department will reject units fabricated before receiving written approval.

B. Furnish details for proper use of materials listed in this Section, article 2.1 and accessory materials in connection with shop and working drawings.

C. Supply a certification stating the manufacturer’s minimum guaranteed ultimate tensile strength of the sample with each sample of prestressing steel wires, bars, or strands. Refer to this Section, article 2.3, paragraph A.

D. For Stressing Jacks refer to this Section, article 3.1, paragraph B.
  1. Furnish certified calibration charts by an independent laboratory with each jack and gauge used on the project.
  2. Provide certified calibration charts at the start of the work and every 12 months thereafter, or as requested by the Department.
  3. Provide calibration charts that are done while the jack is in the identical configuration as will be used on the site, e.g., same length hydraulic lines.

F. Stressing Tendons friction refer to this Section, article 3.1, paragraph D.
  1. Submit computations that show a typical tendon force after friction and anchor set losses diagram on the shop drawings based on an expected actual friction coefficient for the system to be used.

## PART 2 PRODUCTS

### 2.1 PRESTRESSING STEEL

A. Materials:
  1. Uncoated, 7-wire strand.
    a. Use Grade 270 for strands
    b. Have low relaxation properties unless otherwise noted on the Plans.
    c. Refer to AASHTO M 203.
  2. Uncoated high strength deformed bars, Type II. Use Grade 150 bars according to AASHTO M 275.
  3. Uncoated, stress relieved wire according to AASHTO M 204.

B. The Department will review and approve the use and location of bar couplers entering into the pre-stressing work.
  1. Use assembled bar units that develop at least 95 percent of the manufacturer's minimum specified ultimate tensile strength where bars are extended by the use of couplers.
  2. Use bars tested in an unbonded state without exceeding anticipated set.
  3. Use couplings for tendons that do not reduce the elongation at rupture below the requirements of the tendon itself.

### 2.2 PRESTRESS ANCHORAGES

A. Secure all prestressing steel at the end of elements by means of permanent type anchoring devices.

1. Use anchorages that develop at least 95 percent of the minimum specified ultimate tensile strength of the prestressing steel, tested in an unbonded state without exceeding the anticipated set.
2. Supply certified copies of test results to the Department at no additional cost for the anchorage system used.
3. Arrange the anchorage so that the prestressing force in the tendon can be verified prior to removal of the stressing equipment.

B. Use an anchoring device that effectively distributes the load to the concrete conforming to the following requirements:
1. Do not exceed the yield point bending stresses of the plates or assemblies or cause visible distortion in the anchorage plate when 95 percent of the ultimate strength of the tendon is applied during the pulling of the prestressing steel.

C. Recess the anchoring devices so that the ends of the prestressing steel and all parts of anchoring devices will be at least 2 inches inside the end surface of the element.
1. Repair and seal the recess area following post-tensioning in accordance with the details noted on the Plans.

## 2.3 SAMPLES FOR MATERIAL TESTING

A. Test according to the applicable ASTM Specifications for the prestressing material used.
1. Test samples from each size and each heat of prestressing bars, from each manufactured reel of prestressing steel strand, from each coil of prestressing wire, and from each lot of anchorage assemblies and bar couplers to be used.

B. Assign an individual lot number and tag for all bars of each size from each mill heat, all wire from each coil, and all strand from each manufactured reel to be shipped to the site.
1. Assign the individual lot number and tag in such a manner that each such lot can be accurately identified at the job site.
2. Reject all unidentified prestressing steel, anchorage assemblies or bar couplers received at the site if there is a loss of positive identification of these items at any time.

C. Test the following samples of materials and tendons:
1. Test for each heat or reel for wire or bars, three seven ft long samples and for strand, three five ft long samples, of each size.
2. The release of any material will not preclude subsequent rejection if the material is damaged in transit or later damaged or found to be defective.

## 2.4 TESTING

A. Tendon Modulus of Elasticity: Bench test two samples of each size and type of longitudinal strand or wire tendon or both to determine the modulus of elasticity prior to stressing the initial tendon for the purpose of accurately determining the tendon elongations while stressing.
   1. Use a test procedure that consists of stressing the tendon at an anchor assembly with the dead end consisting of a load cell.
   2. Tension the test specimen to 80 percent of ultimate in 10 increments, and then detension from 80 percent of ultimate to 0 in 10 increments. Record the gauge pressure, elongation and load cell force for each increment. Furnish the data to the Department.
   3. Re-evaluate the theoretical elongations shown on the post-tensioning working drawings using the results of the tests and corrected as necessary.
   4. Perform additional tests after the initial testing.
   5. Space these tests evenly throughout the duration of the contract.

B. Elongation Results: Provide test results from previous jobs of similar length to the Department at no additional cost for the purpose of accurately verifying the assumed friction loss in a strand/wire tendon.

## 2.5 PROTECTION OF PRESTRESSING STEEL

A. Protect all prestressing steel against physical damage and rust or other results of corrosion at all times from manufacture to grouting or encasing in concrete.
   1. Prestressing steel that has sustained physical damage at any time will be rejected.
      a. Any reel that is found to contain broken wires will be rejected and the reel replaced.
      b. Use wire that is bright and uniformly colored, having no foreign matter or pitting on its surface.
   2. Package prestressing steel in containers or shipping forms for protection of the steel against physical damage and corrosion during shipping and storage.
      a. Use a corrosion inhibitor, which prevents rust or other results of corrosion, placed in the package or form, or use a corrosion inhibitor carrier type packaging material, or applied directly to the steel.
      b. Use a corrosion inhibitor that has no deleterious effect on the steel or concrete or bond strength of steel to concrete.
      c. Use inhibitor carrier type packaging material that conforms to the provisions of Federal Specification MIL-P-3420.
      d. Packaging or forms damaged from any cause will be immediately replaced or restored to original condition.

3. Use shipping package or form that is clearly marked with a statement that the package contains high-strength prestressing steel, and the care to be used in handling, and the type, kind and amount of corrosion inhibitor used, including the date when placed, safety orders and instructions for use.
    a. Use Low Relaxation (Stabilized) strand that is specifically designated per requirements of AASHTO M 203. All strands not so designated will be rejected.

B. Minor rust, which may form on the surface of the prestressing steel within ten calendar days after installation, will not be cause for rejection.
    1. Prestressing steel installed, tensioned and grouted in this manner, all within ten calendar days, will not require the use of corrosion inhibitor in the duct following installation of the prestressing steel.
    2. Use a corrosion inhibitor in the ducts for post-tensioning steel installed as above but not grouted within ten calendar days.
    3. This steel is subject to all the requirements in this section pertaining to corrosion protection and rejection because of rust.

## 2.6 DUCTS

A. General:
    1. Use duct enclosures embedded in the concrete for prestressing steel that are made with galvanized ferrous metal.
        a. Use ducts, other than steel pipe, that is corrugated, mortar tight, and capable of withstanding concrete pressures without deforming or permitting the entrance of cement paste during the placing of concrete.
        b. Use ducts that can be accurately bent and placed at the locations shown on the plans.
        c. Secure and fasten the ducts in place to prevent movement.
    2. Use ducts for multi-strand tendons that have a minimum diameter which provides an inside area at least 2 ½ times the net area of the prestressing steel.
        a. Use ducts that have properties compatible with the assumed design values given in the plans.
    3. Use ducts that are capable of positively preventing the entrance of cement paste and water from concrete, especially at splices such as at joints between precast segments.
        a. Use ducts that do not cause electrolytic action or deteriorate.

B. Metal Ducts:
    1. Use rigid ducts that are fabricated with either welded or interlocked seams.
    2. Use ducts that can be bent as shown on the plans without crimping or flattening and have sufficient strength to maintain their correct alignment during placing of concrete.

3. Provide joints between sections of ducts that have positive metallic connections which do not result in angle changes at the joints.

C. Vent Pipes:

1. Provide all ducts or anchorage assemblies for permanent prestressing with pipes or other suitable connections at each end for the injection of grout after prestressing.
    a. Vent ducts over 195 feet in length at the high points of the tendon profile when there is more than a six inch variation in the vertical position of the duct.
    b. Use vents that are ½ inch minimum diameter galvanized standard pipe or suitable plastic pipe.
    c. Use connections to ducts that can be made with metallic or plastic structural fasteners.
    d. Use waterproof tape at all connections to include vent and grouting pipes.
    e. Use plastic components that do not react with the concrete or enhance corrosion of the prestressing steel, and are free of water-soluble chlorides.
    f. Use vents that are mortar tight, taped as necessary, that provide means for injection of grout through the vents and for sealing the vents.
    g. Remove ends of steel vents at least two inches below the concrete surface after the grout has set.
    h. Remove ends of plastic vents to the surface of the concrete after the grout has set.
2. Use grout injection pipes that are fitted with positive mechanical shut-off valves.
    a. Use vents and ejection pipes that are fitted with valves, caps or other devices capable of withstanding the pumping pressures.
    b. Do not remove or open valves and caps until the grout has set.

D. Installation:

1. Install ducts that are securely tied in position, carefully inspected, and repaired before placing of the concrete is started.
2. Use care during the placing of the concrete to avoid displacing or damaging the ducts.
3. Support ducts at intervals of not more than four ft.
4. Show the method and spacing of supports on the shop drawings.
5. Install the ducts so that the tolerance on the location of the tendons is plus or minus ¼ inch at any point, except at the high and low points.
    a. The Tolerance at the high point is plus ¼ inch and minus $^{1}/_{8}$ inch.

b. The tolerance at the low point is plus $^1/_8$ inch and minus ¼ inch.

6. After installation in the forms, seal the ends of ducts all times to prevent entry of water and debris.

## 2.7 GROUT

A. Use grout that consists of Portland cement and water.
1. The grout may contain admixtures if approved by the Contractor’s designer.
2. Use Portland cement that is Type II and conforms to the requirements of AASHTO M 85.
3. Use cement for grouting that is fresh and does not contain any lumps or other indication of hydration or “pack set.”
4. Use water in the grout that is potable, clean, and free of injurious quantities of substance known to be harmful to Portland cement, or prestressing steel.
5. Use microsilica solids that total a minimum of 5 percent and a maximum of 6 percent of the cementitious materials of the grout (by mass).

B. Admixtures may be used if they impart the properties of low water content, good flowability, minimum bleed and expansion if desired.
1. Use admixtures with a formulation that contains no chemicals in quantities that may have harmful effect on the prestressing steel or cement.
2. Do not use admixtures that contain any chlorides, fluorides, sulphites and nitrates.
3. Use admixtures in accordance with the instructions of the manufacturer.

C. Aluminum powder of the proper fineness and quantity or other approved gas evolving material that is well dispersed through the other admixture may be used to obtain a maximum of 5 percent unrestrained expansion of grout.

# PART 3 EXECUTION

## 3.1 STRESSING TENDONS

A. Stresses
1. Tension all post-tensioning steel by means of hydraulic jacks so that the force of the prestressing steel will not be less than the value shown on the approved shop drawings.

a. Do not exceed 80 percent of the specified minimum ultimate tensile strength of the prestressing steel during the stressing of the tendons.
b. Anchor the prestressing steel at stresses (initial stresses) that will result in the ultimate retention of permanent forces of not less than those shown on the approved shop drawings.
c. Do not exceed 74 percent of the specified minimum ultimate tensile strength of the prestressing steel after anchor set.
d. Consider permanent force and permanent stress as the force and stress remaining in the prestressing steel after all losses, including creep and shrinkage of concrete, elastic shortening of concrete, relaxation of steel, losses in post-tensioned prestressing steel due to sequence of stressing, friction and take-up of anchorages, and all other losses peculiar to the method or system of prestressing.

2. Remove and replace the strand (or strands) if more than 2 percent of the tendon individual strand wires break during the tensioning operation.

B. Stressing Jacks

1. Use jacks to stress tendons that are equipped with a pressure gauge for determining the jacking pressure.
a. Use pressure gauges that have an accurate reading dial at least 6 inches in diameter.
b. Use gauges at each jack that are calibrated as a unit with the cylinder extension in the approximate position that it will be at final jacking force prior to stressing the initial tendon.
c. At the option of the Contractor, calibrations subsequent to the initial ram calibration by a load cell may be accomplished by the use of a master gauge.
d. Use a protective waterproof container for the master gauge that is capable of protecting the calibration of the master gauge during shipment to a laboratory.
e. Provide a quick-attach coupler next to the permanent gauge in the hydraulic line, which enables the quick and easy installation of the master gauge to verify the permanent gauge readings.
f. Keep the master gauge for the duration of the Project.
g. Any repair of the rams, such as replacing the seals or changing the length of the hydraulic lines, is cause for recalibration of the ram with a load cell.
h. No extra compensation will be allowed for the initial or subsequent ram calibrations or for the use and required calibrations of a master gauge.

2. Do not apply post-tensioning forces until the concrete has attained the specified compressive strength as determined by the concrete cylinder tests.

C. Elongations

1. Conduct the tensioning process such that tension being applied and the elongation of the post-tensioning steel can be measured at all times.
2. The Department will prepare and retain a permanent record of gauge pressures and tendon elongations.
3. Verify that the tendon force measured by gauge pressure agrees within 7 percent of the theoretical elongation for the post-tensioned elements.
    a. If these tolerances are not achieved, check the entire operation, and determine and remedy the source of error before proceeding with the work.
4. Measure elongations to the nearest $^{1}/_{16}$ inch.
5. Furnish equipment for tensioning the tendons from the manufacturer of the system (tendons and anchorages).
6. Resolve discrepancies between measured elongations and theoretical elongations as necessary by use of additional bench tests, friction tests, equipment re-calibration, or refinement of measurement procedures.
7. Achieve acceptance by force verification lift-off tests showing that the measured force is within minus 1 percent and plus 5 percent of the required force if the measured elongations fall outside of the above defined tolerances.

D. Friction

1. Prepare the design plans based on the assumption of friction and wobble coefficients as noted on the Plans.
2. Show the expected friction coefficient on the shop drawings for all types of tendons.
3. Water-soluble oil or graphite may be used as a lubricant when friction needs to be reduced.
4. Flush lubricants from the duct as soon as possible after stressing is completed by use of water pressure.
5. Flush the ducts again just prior to the grouting operations.
6. Blow-dry the ducts immediately after flushing with oil free air each time the ducts are flushed.

## 3.2 GROUTING

A. General

1. Grout the annular space between the duct and the tendons after the tensioning of all tendons has been completed and the prestressing steel has been anchored.
2. Protect the tendons against corrosion as specified in this Section, article 2.5, and by a plug at each end to prevent the passage of air.
3. Leave plugs in place until the tendon is grouted.

B. Equipment
1. Use grouting equipment that includes a mixer capable of continuous mechanical mixing that will produce a grout free of lumps and un-dispersed cement.
2. Use equipment that is able to pump the mixed grout in a manner that will comply with all provisions hereinafter specified.
3. Use accessory equipment that will provide for accurate solid and liquid measures to batch all materials.
4. Use pumps that are a positive displacement type and are able to produce an outlet pressure of at least 150 psi.
5. Use pumps that have seals adequate to prevent introduction of oil, air, or other foreign substance into the grout, and to prevent loss of grout or water.
6. Use a pressure gauge having a full-scale reading of no greater than 300 psi placed at some point in the grout line between the pumping outlet and the duct inlet.
7. Use grouting equipment that contains a screen having clear openings of $^{1}/_{8}$ inch maximum size to screen the grout prior to its introduction into the grout pump.
   a. If a grout with an admixture is used, a screen opening of $^{3}/_{16}$ inch is satisfactory.
8. Use equipment that has gravity feed to the pump inlet from a hopper attached to and directly over it.
9. Keep the hopper at least partially full of grout at all times during the pumping operation to prevent air from being drawn into the post-tensioning duct.
10. Use grout equipment under normal conditions that is capable of continuously grouting the longest tendon on the project in not more than 20 minutes.

C. Mixing
1. Add water to the mixer first, followed by Portland cement and admixture, or as required by the admixture manufacturer.
2. Mix for a duration of time to obtain a uniform thoroughly blended grout, without excessive temperature increase or loss of expansive properties of the admixture.
3. Agitate the grout continuously until it is pumped.
4. Do not add water to increase grout flowability that has been decreased by delayed use of the grout.

5. Use proportions of materials based on tests made on the grout before grouting is begun, or may be selected based on prior documented experience with similar materials and equipment and under comparable field conditions (for example weather or temperature).
6. Use a water content that is the minimum necessary for proper placement.
7. Do not exceed a water-cement ratio of 0.45 or approximately 5 gallons of water per sack (94 lb) of cement.
8. Establish the water content required by Type II cement for a particular brand based on tests.
9. Determine the pumpability of the grout in accordance with the U.S. Army Corps of Engineers Method CRD-C79.
10. Do not use an efflux time of the grout sample immediately after mixing of less than 11 seconds.

D. Grout Operations

1. Open all grout and high point vent openings when grouting starts.
    a. Allow grout to flow from the first vent after the inlet pipe until any residual flushing water or entrapped air has been removed, at which time the vent should be capped or otherwise closed.
    b. Close remaining vents in the same manner.
    c. Do not exceed a pumping pressure of 250 psi at the tendon inlet.
    d. Perform normal operations at 75 psi.
        1) If the actual grouting pressure exceeds the maximum recommended pumping pressure, grouting may be injected at any vent which has been, or is ready to be, capped as long as a one-way flow of grout is maintained.
        2) If this procedure is used, then fit the vent used for injection with a positive shutoff.
    e. Immediately flush the grout out of the duct with water when one-way flow of grout cannot be maintained as outlined above.
    f. Pump the grout through the duct and continuously waste the grout at the outlet pipe until no visible slugs of water or air are ejected.
    g. Pump the grout so that the efflux time of the ejected grout is not less than the injected grout.
    h. Close the outlet, inlet, or both so that the tendon remains filled with grout.
    i. Do not remove or open plugs, caps, or valves thus required until the grout has set.

2. Keep ducts free of water to avoid damage due to freezing in temperatures below 32 degrees F.
    a. Keep the temperature of the concrete 35 degrees F or higher from the time of grouting until job cured 2 inch cubes of grout reach a minimum compressive strength of 800 psi.
    b. Keep grout below 90 degrees F during mixing or pumping.
        1) If necessary, cool the mixing water.
3. Terminate vertical or nearly vertical tendon grout tubes in reservoirs at the uppermost point in lieu of positive shut off.
    a. Use reservoirs that have a sufficient capacity to store all bleed water to enable its re-absorption into the grout.
    b. Maintain the reservoirs until the grout is set and the bleed water absorbed.

## 3.3 PROTECTION OF END ANCHORAGE

A. Clean exposed end anchorages, strands, and other metal accessories of rust, misplaced mortar, grout, and other such materials as soon as possible after tensioning and grouting is completed.
    1. Apply a heavy unbroken coating of an epoxy bonding compound to all such dry metal surfaces immediately following the cleaning operation.
    2. Use epoxy bonding compound conforming to AASHTO M 235, Class III.

B. Use tight fitting forms that can be installed and held in place securely against the previously placed concrete.
    1. Make a patch with a non-shrink grout mix to protect the anchorage after application of the epoxy bonding agent.
    2. Use Embeco, Chem-Comp, Five Star, Pour Rock or approved equal non-shrink grout.
    3. Use only non-chloride bearing non-shrink grout mixes for anchorage protection.

END OF SECTION

July 10, 2009

**SPECIAL PROVISION**

**F-I70-3(50)112**
**PIN 6625**

**SECTION 03312S**

# STRUCTURAL CONCRETE-LIGHTWEIGHT

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Finish and proportion lightweight Portland cement concrete which is composed of Portland cement, lightweight coarse aggregate, fine aggregate, admixtures if used, and water proportioned and mixed as specified in this section.

### 1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 03211: Reinforcing Steel and Welded Wire

C. Section 03310: Structural Concrete.

D. Section 03390: Concrete Curing.

E. Section 03395: Surface Preparation and Concrete Coating.

### 1.3 REFERENCES

A. AASHTO M 6: Fine Aggregate for Portland Cement Concrete

B. AASHTO M 195: Lightweight Aggregates for Structural Concrete

C. ASTM C 330: Lightweight Aggregates for Structural Concrete

D. ASTM C 567: Standard Test Method for Determining Density of Structural Lightweight Concrete.

## 1.4 DEFINITIONS

A. Structural Concrete – Lightweight – a concrete mixture with all attributes equal to that of structural concrete with exception to weight. Dry unit weight is limited to a maximum of 110 pcf.

## 1.5 SUBMITTALS

A. Refer to Section 03055.
   1. Furnish a mix design based on the recommendations of the lightweight aggregate manufacturer. List the mix design data for type, brand weight, and absolute volume of each ingredient for each type and strength of concrete proposed for use.
   2. Furnish certified copies of the manufacturer's test reports showing the fresh concrete unit weight. Furnish fresh concrete with a unit weight of not more than ±110 pounds per cubic yard variance from the concrete unit weight reported in the test reports.
   3. Provide a concrete mix designs on trial batch test results or on the past history (same materials used in previous mix designs within the past year).

## 1.6 ACCEPTANCE

A. Refer to Section 03055.

# PART 2 PRODUCTS

## 2.1 CEMENT

A. Refer to Section 03055.

## 2.2 AGGREGATES

A. Coarse Aggregate
   1. Use lightweight aggregates which are rotary kiln expanded shale or clay having a surface sealed by firing. Do not crush coarse aggregate after firing except that a small amount of aggregate, ¾" in size and smaller, may be crushed to the extent to produce the required coarse aggregate grading. Use coarse aggregate ¾" maximum size.

2. The splitting tensile strength and the drying shrinkage requirements of ASTM Designation: C 330 do not apply.
3. Use aggregate with shrinkage characteristics of lightweight concrete such that the drying shrinkage of lightweight concrete produced therefrom when tested in accordance with California Test 537 or equivalent is not more than 0.02% after 14 days of drying.
4. Use aggregate with creep characteristics of lightweight concrete such that the shortening of lightweight concrete produced therefrom when tested in accordance with ASTM Test C 512 or equivalent is not more than 0.08% after 28 days of loading. Use an applied force of a sustained compressive pressure of 40% of the actual tested concrete strength applied 28 days after casting cylinders.
5. Use lightweight aggregates that have not more than 5% loss when tested for soundness in accordance with Section 03055.
6. Gradations – refer to AASHTO M 195, Table 1, gradation band ½ inch to $^{3}/_{16}$ or ¾ inch to $^{3}/_{16}$ inch.
7. Use sieve screen with square openings as specified. (AASHTO M 92)
8. Deleterious Substances – refer to Section 03055
9. Soundness, Wear, and Reactivity – refer to Section 03055.

B. Fine Aggregate
1. Use a lightweight fine aggregate or natural sand or manufactured sand fine aggregate, or a combination thereof, as required to comply with the air-dry unit mass requirements of this section.
2. Gradations – refer to Section 03055.
3. Deleterious substances – refer to Section 03055.
4. Soundness, Wear, and Reactivity – refer to Section 03055.

## 2.3 WATER

A. Refer to Section 03055.

## 2.4 ADMIXTURES

A. Refer to Section 03055.

## 2.5 MIX DESIGN

A. Provide Class AA (AE) concrete, unless specified otherwise.

B. Furnish aggregate weights for materials in surface dry condition including moisture absorbed in the aggregate, or oven-dry condition, or for the condition proposed for use, and adjust at the time of batching to compensate for surface moisture and for absorbed moisture.

C. Limit the absolute volume of the coarse aggregate to that volume which permits the mixing, transportation, placing, consolidating and finishing of the concrete without segregation. For site-cast concrete, absolute volume of coarse aggregate cannot exceed 0.37 cubic yards per cubic yard of concrete.

D. Provide lightweight Portland cement concrete with air-dry unit weight finished for each mix design in a single mass of 110 pounds per cubic foot. Determine the air-dry weight in accordance with ASTM C 567, except use a drying time of 90 days.

E. Use the same constituents in the trial batches that are to be used in the project including coarse and fine aggregate, water, source and type of cement, air-entraining agent, fly ash, etc.

## 2.6 REINFORCING STEEL AND WELDED WIRE

A. Refer to Section 03211.

## 2.7 JOINTS AND SEALERS

A. Refer to Section 03310.

## 2.8 BACKER ROD

A. Refer to Section 03310.

## 2.9 RIGID PLASTIC FOAM

A. Refer to Section 03310.

## 2.10 CURING COMPOUND

A. Refer to Section 03310.

## 2.11 FORMS

A. Refer to Section 03110.

## 2.12 MISCELLANEOUS STEEL ITEMS

F. Galvanize all miscellaneous steel items permanently cast into structural
concrete elements (AASHTO M 111).

## PART 3 EXECUTION

### 3.1 PREPARATION

A. Refer to Section 03055.

B. Form liner preparation:
   1. Coordinate with form designer for form work, form liner and tie spacing.
   2. Verify lines and levels of formwork and form liner patterns are within allowable tolerances.
   3. Clean form liner before each use. Do not use damaged liner when continued use or repair would diminish the aesthetics of the work.
   4. Apply release agent according to manufacturer's directions. Schedule concrete pour immediately after application of release agent to avoid precipitation, dust, and debris. Protect reinforcing steel from exposure to release agents.

C. Form liner installation:
   1. Store and use form liner panels at temperatures between 40 degrees F and 140 degrees F.
   2. Prevent cement paste from bleeding form liner joints, form liner accessories' joints, and tie holes.
   3. Anchor liner to form on centers not to exceed 18 inches. Decrease centers as necessary to accommodate form stripping pressures without damaging liner intended for multiple use.

D. Concrete placement:
   1. Thoroughly vibrate concrete to achieve consolidation, and minimize voids. Internally vibrate into previous lift to avoid lift lines. Avoid vibrator contact wit the form liner.

### 3.2 BATCHING MATERIALS

A. Refer to Section 03055

B. Batch lightweight fine aggregates and natural sand by weight. Batch lightweight coarse aggregate either by weight or by volumetric methods. If volumetric methods are used, the batching equipment will include provisions whereby the Department may check the weight of each size of aggregate in the batch.

C. Uniformly pre-wet or pre-saturate the aggregates in such a manner that uniform penetration of the concrete will be maintained. Pre-saturate by thermal, vacuum or equivalent methods for lightweight aggregate in concrete which is to be pumped.

D. Proportion Portland cement, aggregates, water, and admixtures to produce lightweight Portland cement concrete not less than 565 pounds nor more than 840 pounds of cement per cubic yard.

## 3.3 TRANSPORTING

A. Refer to Section 03055.

## 3.4 LIMITATIONS – GENERAL

A. Refer to Section 03055.

## 3.5 LIMITATIONS – COLD WEATHER

A. Refer to Section 03055.

## 3.6 LIMTATIONS – HOT WEATHER

A. Refer to Section 03055.

## 3.7 FIELD QUALITY CONTROL

A. Refer to Section 03055.

END OF SECTION

July 6, 2009

**SPECIAL PROVISION**

**F-I70-3(50)112**
**PIN 6625**

**SECTION 03339S**

# PRECAST CONCRETE DECK PANEL

**Delete Section 03339 in its entirety and replace with the following:**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. This work consists of furnishing, erecting, and installing all precast concrete deck panels including all necessary materials and equipment to complete the work as shown on the plans. The use of cast-in-place concrete is not an acceptable alternative for precast panels.

B. Procedures for preparing and installing structural non-shrink grout.

C. Placing structural non-shrink grout into the camber strips, filling the shear stud blockouts and, all other blockouts in the bridge precast concrete deck panels to produce a finished deck.

D. Procedures relating to preparing bridges for widening and grinding deck panels.

E. Procedures relating to installing new shear studs on top flanges of existing steel girders and installing shear connectors to the top flanges of existing concrete or prestressed beams as shear studs.

F. Procedures for full depth precast concrete deck panel.

### 1.2 RELATED SECTIONS

A. Section 02982: Bridge Concrete Grinding

B. Section 03055: Portland Cement Concrete

C. Section 03211: Reinforcing Steel and Welded Wire

D. Section 03251S: Post Tensioning Concrete

E. Section 03310: Structural Concrete

F. Section 03312S: Structural Concrete - Lightweight

G. Section 03372: Thin Bonded Polymer Overlay

## 1.3 REFERENCES

A. AASHTO M 235: Standard Specification for Epoxy Resin Adhesives

B. AASHTO M 169: Standard Specification for Steel Bars, Carbon and Alloy, Cold-Finished

C. AASHTO T 106: Compressive Strength of Hydraulic Cement Mortar

D. AASHTO T 160: Length Change of Hardened Hydraulic Cement Mortar and Concrete

E. AASHTO T 161: Standard Method of Test for Resistance of Concrete to Rapid Freezing and Thawing

F. AASHTO T 260: Standard Method of Test for Sampling and Testing Chloride Ion in Concrete and Concrete Raw Materials

G. AASHTO/AWS D1.5 2008 Bridge Welding Code

H. ASTM A 108: Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

I. ASTM A 109: Standard Specification for Steel Carbon Cold-rolled Strip

J. ASTM A 706: Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

K. ASTM C 666: Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing

L. ASTM C 882: Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear

M. ASTM C 494: Standard Specification for Chemical Admixtures for Concrete

N. ASTM E 1512: Standard Test Methods for Testing Bond Performance of Bonded Anchors

O. ANSI/AWS C 6.1-89: American Welding Society's Recommended Practices for Friction Welding

P. PCI Design Handbook, Fifth Edition with all Interims and Errata

Q. UDOT Quality Management Plan

## 1.4 DEFINITIONS NOT USED

## 1.5 SUBMITTALS

A. Submit the following to the Engineer for written approval:
   1. Shop Drawings:
      a. Submit five sets half-size, 11 x 17 inch sheets with a 1½ inch blank margin on the left-hand edge.
      b. Place the project designation data in the lower right-hand corner of each sheet.
      c. Prepare shop drawings stamped by a Professional Engineer licensed in Utah.
      d. Show all lifting inserts, hardware or devices, and location on the shop drawings for the Engineer's approval.
      e. Show type and size of longitudinal post-tensioning anchorage assembly and ducts. Design local zone reinforcing for the anchorage assembly.
      f. Submit a Certificate of Compliance for non-shrink grout to the Engineer for approval.
      g. Do not order materials or begin work until receiving final approval of the shop detail drawings.
      h. Do not deviate from the approved shop drawings unless authorized in writing. Contractor is responsible for costs incurred due to faulty detailing or fabrication.
      i. The Engineer reserves the right to retain these drawings up to 14 calendar days without granting an increase in the number of working days on the project. This duration is reduced to 7 days when the drawings are submitted electronically. This right applies each time the drawings are submitted or re-submitted. The Department will reject units fabricated before receiving written approval.
   2. Erection Plans:
      a. Submit five sets half-size, 11 x 17 inch sheets with a 1½ inch blank margin on the left-hand edge.
      b. Place the project designation data in the lower right-hand corner of each sheet.
      c. Prepare drawings and supporting calculations stamped by a Professional Engineer licensed in Utah.
      d. Check that all handling and erection bracing conform to Chapter 5 of the PCI Design Handbook.

e. Include the following at a minimum on the erection plans:
    1) Minimum clearances of reinforcing to panel edges.
    2) Locations and details of lifting devices including supporting calculations. Design all lifting devices based on the no cracking criteria in Chapter 5 of the PCI Design Handbook
    3) Type and amount of any additional reinforcing required.
    4) Calculations showing that tensile stresses on both faces do not exceed the modulus of rupture during the handling, fabrication, shipping, and erection of the panel.
    5) Minimum compressive strength attained prior to handling the panels.
    6) Load distribution.
    7) Cables and lifting equipment.
    8) Details of vertical adjusting hardware.

f. Include details showing the erection and installation of the proposed deck panels in accordance with the design plans.

g. Submit Erection Plan drawings including the following minimum information:
    1) Crane and pick locations
    2) Crane charts
    3) Panel erection and sequence

h. Submit to the Engineer for review a proposed method for forming the camber strips and installing the structural non-shrink grout, sequence, and equipment for grouting operation. Obtain approval prior to placing structural non-shrink grout begins.

i. Submit a method of forming closure pours at joints between precast panels.

j. The Engineer reserves the right to retain these drawings up to 14 calendar days without granting an increase in the number of working days on the project. This duration is reduced to 7 days when the drawings are submitted electronically. This right applies each time the drawings are submitted or re-submitted.

3. Refer to Section 03252 for additional submittal requirements

4. Submit substitutions for self-consolidating concrete (SCC) mix designs to the Engineer for approval as an alternate to the structural concrete for the precast deck panels.

B. Submit for Materials. Refer to this Section, article 2.1.

1. Supply test data such as slump, air voids, or unit weight after 7, 14, and 28 days for fresh concrete and compressive strengths for the hardened concrete.

C. Submit for High Early Strength Concrete. Refer to this Section, article 2.1, paragraph G.
   1. Submit material data information that states the percentage of each component used.
   2. Provide substantive data at least two weeks prior to use that demonstrates the ability of the material to meet the specification requirements with the proposed mix design regardless of the type of high early strength concrete proposed.

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. Mild Reinforced Panel: Use Class AA (AE) concrete for precast concrete deck panels as specified in Section 03312S and on the plans.

B. Deck Panel: Use Class AA (AE) concrete according to Section 03312S.

C. Use coated reinforcing steel as specified in Section 03211.

D. Use mechanical threaded couplers when specified for precast concrete deck panel reinforcing according to Section 03211.
   1. Do not use lap splices for mild reinforcement or post-tension bars within the panel.
   2. Lap splices are acceptable in cast-in-place closure pours.

E. Use structural non-shrink grout for camber strips, shear stud blockouts, keyway blockouts, and other blockouts shown on the plans.
   1. Use a mix design according to Section 03055 if adding more than 15 lb of coarse aggregate (size No. 8) or larger per 50 lb bag of structural non-shrink grout.
   2. Mix structural non-shrink grout just prior to use according to the manufacturer’s instructions.
   3. Use non-shrink, gray grout concrete containing no calcium chloride or admixture containing calcium chloride or other ingredient in sufficient quantity to cause corrosion to steel reinforcement.
   4. Follow manufacturer’s recommendation for corrosion inhibitor admixture dosage.
   5. Use quick-setting, rapid strength gain, non-shrink, and high-bond strength grout.
   6. Warranty the in-place structural non-shrink grout performance and workmanship for two years.
   7. Repair or refund at the Department’s option any bonding failures that occur during the warranty period.
   8. Refer to Table 1 for structural non-shrink grout requirements.

**Table 1**

| Structural Non-Shrink Grout | | | |
|---|---|---|---|
| ***Properties** | **Requirements** | **ASTM** | **AASHTO** |
| Accelerated Weathering | As Specified in ASTM or AASHTO | C 666 | T 260 |
| Compressive Strength | >5,000 psi @ 28 days | | T 106 |
| Accepted Bond Strengths | >1,000 psi @ 24 Hours | C 882 | |
| Test Medium | <3% White Utah Road Salt | | T 161 |
| Accepted Weight Loss | <15% @ 300 Cycles | | T 161 |
| Length Change | No expansion after 7 days | | T 160 |

*Certified test results from a private AASHTO accredited testing laboratory will suffice for acceptance.

F. High Early Strength Concrete for closure pours: Use one of the following methods:
   1. Design a high early strength concrete mix and obtain the Engineer's approval.
      a. Use air-entraining, portland cement, fine and coarse aggregates, admixtures, water, and additives.
      b. Use between 4 to 7 percent-entrained air.
      c. Develop a mix that can attain a 6-hour compressive strength of 2,500 psi and a 7-day compressive strength of 4,000 psi.
      d. Develop a mix that contains shrinkage compensating additives such that there will be no separation of the closure pour concrete from the adjacent precast concrete.
      e. Use a shrinkage-compensating additive that produces expansion in the high early strength concrete of no more than 3 percent.
   2. A proprietary concrete mix that meets the same physical requirements as those stated above may be used

G. Use a UDOT Certified Concrete Precaster or a pre-qualified project site caster for concrete products according to the Department Quality Management Plan: Precast-Prestressed Concrete Structures.

H. Do not strip the forms before the precast panels have obtained a minimum compressive strength of 500 psi.

I. Post-Tensioning: Do not begin stressing operations until the concrete reaches the strength and age designated on the plans. Stress strands within 72 hours of panel placement and transverse joint grouting.

J. Design and show all post-tensioning hardware and blockouts if required. Manufactured designed proprietary hardware is acceptable with the Engineer’s approval.

## 2.2 CONCRETE CORROSION INHIBITOR ADMIXTURE

A. The concrete corrosion inhibitor admixture will contain a minimum of 30 percent calcium nitrite by mass and formulated to meet ASTM C 494 requirements for Type C, accelerating admixture.

B. Use a dosage rate of 4 gal/yd$^3$ unless otherwise directed by the manufacturer.

C. Use the admixture in all new concrete and grout placed.

## 2.3 POST TENSIONING AND SHEAR CONNECTORS

A. Refer to Section 03251S: Post Tensioning Concrete for bar, strand, grout and other requirements.

B. Fabricate new shear studs from cold-drawn bars, Grades 1015, 1018 or 1020, conforming to AASHTO M 169 standard quality, and have a minimum tensile strength of 60.0 ksi.
1. Use headed anchor studs for shear connectors conforming to dimensions showing on the plans.
2. Use steel conforming to the requirement of AASHTO M 169.
3. Automatically end weld studs in the shop or field with equipment designed for stud welding operations.
4. Use equipment having capacity adequate for the size of stud welded.

C. Use a low carbon grade suitable for welding that will conform to ASTM A 109 for the caps if steel, flux-retaining caps are used.

D. Concrete girders:
1. Use T- Headed bars consisting of deformed rebar with steel plates friction-welded to one end of the rebar.
2. Use deformed rebar that conforms to ASTM A 706, Grade 60.
3. Cut plate heads for T-Headed bars from flats of hot-rolled steel conforming to ASTM A 108.
4. Use an approved epoxy grout to develop minimum pullout strength in T-headed bar anchorage as shown on the Plan.

## 2.4 ADHESIVE DOWELED ANCHORS

A. Use epoxy resin adhesive for anchors that conform to AASHTO M 235.

## 2.5 QUALITY ASSURANCE

A. The Department pre-qualifies pre-cast and site-cast fabricators according to the UDOT Quality Management Plan: Pre-cast/Prestressed Concrete Structures. Only fabricators pre-qualified in Category Two will be accepted.

B. Permanently mark each precast unit with date of casting and supplier identification. Stamp markings in fresh concrete.

C. Prevent cracking or damage during handling and storage of precast units.

D. Defects and Breakage of Prestressed and Non-prestressed Elements:
   1. Elements that sustain damage or surface defects during fabrication, handling, storage, hauling, or erection are subject to review and rejection.
   2. Write proposed repair procedures and obtain approval before performing repairs.
   3. Repair work must reestablish the element’s structural integrity, durability, and aesthetics to the satisfaction of the Engineer.
   4. Determine the cause of any damage and take corrective action.
   5. Failure to take corrective action leading to similar repetitive damage is cause for rejection of the damaged elements.
   6. Cracks that extend to the nearest reinforcement plane and fine surface cracks that do not extend to the nearest reinforcement plane but are numerous or extensive are subject to review and rejection.
   7. Full depth cracking and breakage greater than twelve inches in length are cause for rejection.

E. Construct panels to tolerances shown on the plans.

# PART 3 EXECUTION

## 3.1 FABRICATION

A. Do not place concrete in the forms until the Engineer has inspected and approved the placement of all materials in the deck panels.

B. Finish the precast concrete deck panels following Section 03310.

C. Wet cure the deck panels for 14 consecutive days. This cure is to begin immediately after performing the final finish.
   1. Wet cure panels by covering all exposed surfaces with wet burlap, cotton mats, or both, and plastic sheets.

## 3.2 NEW SHEAR STUDS ON EXISTING STEEL GIRDERS AND CONCRETE BEAMS

A. Installation of the Shear Connectors
   1. Install shear connectors at the locations shown on the plans.
   2. Weld shear studs to steel girders or plates embedded in prestressed concrete according to AWS specifications.
      a. Adjust studs as necessary to provide clearance for bolts in existing bolted splices.
      b. Use method and equipment recommended by the manufacturer of the studs and approved by the Engineer.
      c. Field weld studs using friction welding. Conform to the approved quality control manual and the American Welding Society's Recommended Practices for Friction Welding ANSI/AWS C.6.1-89.
   3. Field drill holes in the top flange of existing concrete and prestressed concrete beams and install shear studs according to manufacturer's recommendations.
      a. Use method and equipment recommended by the manufacturer of the studs, epoxy grout, as approved by the Engineer.

## 3.3 PLACING PRECAST CONCRETE DECK PANELS

A. Fully brace concrete beams or steel girders prior to placing panels.

B. Place the precast concrete deck panels as shown on the plans or approved working drawings.

C. Adjust leveling devices to bring panels to the elevations shown on the Plans. Torque all leveling devices to within 15 percent of each other to ensure proper distribution of panel weight to the supporting beams.

D. Prevent shifting of the precast concrete deck panels during the joining of all the deck panels.

## 3.4 LONGITUDINAL POST TENSIONING

A. Cure precast panels 28-days before tensioning of any post-installed cables or rods.

B. Clean and remove all debris from blockouts.

C. Set final elevations after all panels are in place.

D. Grout shear keyway between panels.

E. Do not post tension until the shear key grout has attained a compressive strength of 500 psi (based on manufacturer's data).

F. Install strands as shown on the plans.

G. Fully tension and grout all ducts according to Section 03251S.

H. Visually inspect the shear stud installation and connection details. Place structural non-shrink grout in the girder camber strips and shear stud blockouts in a continuous operation complete without voids.

## 3.5 INSTALLATION OF HEADED T BARS AND ANCHORS

A. Adhesive doweled anchors:
   1. Use reinforcing, bar dowels, reinforcing bars, threaded rods, bolts etc. as shown in the plans and adhesive dowel into concrete.
   2. Weld heads on bars according to the requirements of the AASHTO/AWS D1.5 2008 Bridge Welding Code.
   3. Drill, brush, clean all holes, and install all anchors according to manufacturer's published recommendations as well as all applicable building codes or Engineering reports.
   4. Inspection is required for installation of reinforcement or threaded rods.
   5. Install adhesive anchors and test according to the epoxy anchor test schedule and as follows:
      a. Testing through the blockout is at the Contractor's risk. Repair damaged beams, girders, and panels as instructed by the Engineer. Panel may be rejected if not repaired as instructed.
      b. Test 25 percent of the first 40 anchors installed and 10 percent of all anchors installed thereafter.
      c. Test the previous ten installed anchors and the next five installed anchors if any failures occur.
      d. Allow anchors to cure 48 hours prior to testing.
      e. Tension test according to ASTM E 1512.
      f. Provide minimum capacity as defined in Table 2 below.

**Table 2**

| Epoxy Anchor Test Schedule For Anchors Installed in Hard Rock Concrete (2000 psi min. Strength) | | | | | |
|---|---|---|---|---|---|
| **Reinforcing bars ($f_y$ = 60 ksi)** | | | **Bolts or threaded rods ($f_y$ = 36 ksi)** | | |
| Bar size | Minimum embedment | Tension test load (0.9fy) | Anchor diameter | Minimum embedment | Tension test load* |
| #4 | 6 inches | 10800# | ⅜ inch | 5 inches | 3384# |
| #5 | 7 inches | 16700# | ½ inch | 7 inches | 5400# |
| #6 | 9 inches | 23800# | ⅝ inch | 8 inches | 9390# |
| #7 | 10 inches | 32400# | ¾ inch | 10 inches | 13530# |
| #8 | 12 inches | 42700# | ⅞ inch | 12 inches | 18417# |
| #9 | 13 inches | 54000# | 1 inch | 13 inches | 24050# |
| #10 | 16 inches | 68600# | 1¼ inch | 15 inches | 37580# |
| #11 | 18 inches | 84200# | | | |

Notes: * allowable loads equal 1/2 test load values

## 3.6 PREPARATION AND INSTALLATION OF STRUCTURAL NON-SHRINK GROUT

A. Clean and remove all debris from the camber strips and blockouts prior to placement of the structural non-shrink grout.

B. Keep bonding surfaces free from laitance, dirt, dust, paint, grease, oil, rust, or any contaminant other than water.

C. Pre-test grout material installation under field conditions in a grout pocket and camber strip mock-up prior to construction of the deck to determine grout flowability and whether subsequent cracking will occur. Include in the mock-up at least two shear connector pockets and a camber strip that is of the same configuration as the actual bridge.
   1. The Engineer will determine the required corrective action.
   2. Proceed with grouting process at the Engineer's direction.

D. Saturate surface dry (SSD) all surfaces receiving structural non-shrink grout.

E. Mix and place product following manufacturer's recommendations for preparation and installation.

F. Place structural non-shrink grout in the girder camber strips and shear stud blockouts in a continuous operation within a panel after all panels and shear studs are fully installed.

G. Form the girder camber strips as shown on the plans after shear studs are installed at the locations shown on the plans.
   1. Grout the shear stud blockouts and girder camber strips using structural non-shrink grout.

H. Do not allow voids in the grout for the girder camber strips and shear stud blockouts.

I. Do not apply superimposed dead loads or live loads to the precast concrete deck panels until the structural non-shrink grout in the shear stud blockouts and the girder camber strips has reached a strength of 500 psi based on manufacturer's published data.

J. Cure structural non-shrink grout per manufacturer's recommendation.
   1. Contact the manufacturer's representative for advice on how to reduce heat such as wet curing or adding retarding admixture if the heat of hydration is excessive.

K. Repair or refund at the Department's option any bonding failures that occur during the warranty period.

L. Finish grout flush or a maximum of ⅛ inch above adjacent panels.
   1. Correct blockout and void profiles in excess of ⅛ inch higher than the adjacent panel through surface grinding
   2. Correct blockout and void profiles blow the top of the adjacent panels through removal and replacement of the blockout or void.
   3. Pay for any corrections to the finish of the blockout or void at no additional compensation.

## 3.7 DECK GRINDING

A. Profile grind the deck and approaches after all panels are in place, grouting is complete, and design strength is achieved according to Section 02982.

## 3.8 SURFACE PREPARATION

A. Prepare deck and approach slabs and place Polymer Overlay, Type 1. Refer to Section 03372.

END OF SECTION