Benson Bridge (005031F) Rehabilitation

<table>
<thead>
<tr>
<th>Item #</th>
<th>Description</th>
<th>Unit</th>
<th>Estimated Quantity</th>
<th>Unit Price</th>
<th>Total</th>
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<tbody>
<tr>
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<td>Mobilization</td>
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<td>1</td>
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<tr>
<td>03154</td>
<td>Hydro-Demolition, Class B</td>
<td>Square Foot</td>
<td>6,110</td>
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<tr>
<td>03211</td>
<td>Reinforcing Steel - Coated</td>
<td>Pound</td>
<td>1,280</td>
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<td>$3,840</td>
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<td>Foot</td>
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<td>03372</td>
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<td>03924</td>
<td>Parapet Repair</td>
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<td>05832</td>
<td>Strip Seal Expansion Joint Modification</td>
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<td>Total</td>
<td>Subtotal</td>
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<td>Construction Contingency</td>
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<td></td>
<td>Preliminary Engineering</td>
<td>Lump Sum</td>
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<td></td>
<td>Construction Engineering</td>
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<td>$41,050</td>
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<td></td>
<td>Project Total</td>
<td>$658,250</td>
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<td></td>
<td></td>
</tr>
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</table>
MEMORANDUM

DATE: August 13, 2019
TO: Cache County Council of Governments
CC: Josh Runhaar, Cache County Director of Development Services
FROM: Joey Laprevote, J-U-B Engineers, Inc.
SUBJECT: CCCOG Funding Application for Benson Bridge Rehabilitation

Council Members,

It is my pleasure to submit for your consideration an application for funding of the Benson Bridge Rehabilitation project on behalf of Cache County.

I verify that the plans, specifications, and estimate for the project meet the professional standard of practice for a 90% stage. As this is a structural preservation project, the work is primarily dictated by specifications and the plans depict the work in a schematic nature only.

This project will address deficiencies such as deterioration of the concrete deck and other concrete bridge elements that, left untreated, pose a public safety issue. The project will also take measures to protect these elements from future damage.

Cache County is committed to the majority of the project funding to ensure the longevity of this bridge. By assisting the County and approving its funding application, we can make the fiscally responsible decision to repair the bridge now rather than wait until further deterioration necessitates a costly bridge replacement.

Thank you for your consideration,

Joey Laprevote, PE
Bridge Engineer
SPECIFICATIONS AND CONTRACT DOCUMENTS

FOR

CACHE COUNTY CORPORATION

Benson Bridge Rehabilitation

August 2019

90% Submittal

J-U-B Project Number: 57-19-001-030
SECTION 00 00 30
TABLE OF CONTENTS

CACHE COUNTY, UTAH
BENSON BRIDGE REHABILITATION

BIDDING AND CONTRACT DOCUMENTS
(Not all are included in 90% Submittal)

<table>
<thead>
<tr>
<th>Reference Number</th>
<th>Title</th>
<th>No. of Pages</th>
</tr>
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<tr>
<td>00 00 30</td>
<td>Table of Contents</td>
<td>1</td>
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<tr>
<td>00 11 16</td>
<td>Advertisement for Bids</td>
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<tr>
<td>00 21 13</td>
<td>Instructions to Bidders</td>
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<tr>
<td>00 41 00</td>
<td>Bid Form</td>
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<td>00 43 13</td>
<td>Bid Bond</td>
<td>2</td>
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<tr>
<td>00 45 13</td>
<td>Qualifications Statement</td>
<td>10</td>
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<tr>
<td>00 51 00</td>
<td>Notice of Award</td>
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<tr>
<td>00 52 00</td>
<td>Agreement</td>
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<td>00 61 00</td>
<td>Notice to Proceed</td>
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<td>00 61 10</td>
<td>Certificate of Substantial Completion</td>
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<td>00 61 13.13</td>
<td>Performance Bond</td>
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<td>00 61 13.16</td>
<td>Payment Bond</td>
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<td>00 63 36</td>
<td>Field Order</td>
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<td>00 63 49</td>
<td>Work Change Directive</td>
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<td>00 63 63</td>
<td>Change Order</td>
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<td>00 70 00</td>
<td>Technical Specifications</td>
<td>112</td>
</tr>
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</table>

DRAWINGS

STANDARD DRAWINGS
Structures Design and Detailing Manual, 2017, Utah Department of Transportation (not attached).


CONSTRUCTION PLANS
Cache County – Benson Bridge Rehabilitation Plans prepared by J-U-B Engineers, Inc.
TECHNICAL SPECIFICATIONS

All work to be completed on this project is to be governed by:


The required specification for each bid item is listed in the Engineer’s Estimate and the Measurement and Payment document. If a work item is not sufficiently covered by the indicated specification, follow the specifications in the order listed below:

UDOT Standards and Specifications
References to “Department” refer to Cache County

Cache County Manual of Roadway Design & Construction Standards

http://utah.apwa.net/PageDetails/11118
PAGE INTENTIONALLY LEFT BLANK
Measurement and Payment

Section 01501: Mobilization

<table>
<thead>
<tr>
<th>#</th>
<th>Mobilization</th>
<th>Lump</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount Paid</td>
<td>When Paid</td>
<td></td>
</tr>
<tr>
<td>The lesser of 25% of Mobilization or 2.5% of contract</td>
<td>With first estimate</td>
<td></td>
</tr>
<tr>
<td>The lesser of 50% of Mobilization or 5% of contract</td>
<td>With any estimate following completion of 5% of contract</td>
<td></td>
</tr>
<tr>
<td>The lesser of 75% of Mobilization or 7.5% of contract</td>
<td>With any estimate following completion of 10% of contract</td>
<td></td>
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<tr>
<td>The lesser of 100% of Mobilization or 10% of contract</td>
<td>With any estimate following completion of 20% of contract</td>
<td></td>
</tr>
<tr>
<td>Amount bid in excess of 10% of contract price.</td>
<td>Project Acceptance - Final</td>
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Section 03154: Hydro-Demolition

<table>
<thead>
<tr>
<th>#</th>
<th>Hydro-Demolition, Class B</th>
<th>Square Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Measure quantities by the dimensions shown.</td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>Includes procurement of all environmental and construction permits.</td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>Includes protection of adjacent areas and containment of debris.</td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>Includes survey of existing bridge deck to re-establish deck surface.</td>
<td></td>
</tr>
<tr>
<td>E.</td>
<td>Includes testing and calibration of equipment.</td>
<td></td>
</tr>
<tr>
<td>F.</td>
<td>Includes preparation of concrete to be removed and all proceeding classes of hydro-demolition.</td>
<td></td>
</tr>
<tr>
<td>G.</td>
<td>Includes repair of all blow-throughs and other damage to the structure outside the limits of demolition.</td>
<td></td>
</tr>
<tr>
<td>H.</td>
<td>Includes pretreatment, removal, and disposal of debris and wastewater.</td>
<td></td>
</tr>
<tr>
<td>I.</td>
<td>Includes equipment and labor necessary to complete the work.</td>
<td></td>
</tr>
<tr>
<td>J.</td>
<td>Department will make no separate payment for hand removal methods.</td>
<td></td>
</tr>
</tbody>
</table>

Section 03211: Reinforcing Steel and Welded Wire

<table>
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<tr>
<th>#</th>
<th>Reinforcing Steel – Coated</th>
<th>Pound</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Do not include the mass of the coating or the specified test bars as computed weight.</td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>Department will not make allowances for extra reinforcing steel required to provide lap splices that are requested by the Contractor.</td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>Department will not make allowances for clips, chairs, wire, or other materials used for fastening reinforcement in place.</td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>Includes drilling holes, epoxy adhesive, and testing for dowelled anchors.</td>
<td></td>
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</table>

Section 03310: Structural Concrete

<table>
<thead>
<tr>
<th>#</th>
<th>Structural Concrete – Low Shrinkage</th>
<th>Cubic Yard</th>
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</thead>
<tbody>
<tr>
<td>A.</td>
<td>Measure quantities by the dimensions shown.</td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>Do not measure concrete required to fill over breakage of excavation for footings, walls, or slabs.</td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>Department will not deduct for volume occupied by pipes (other than culverts), reinforcing steel, piles, metal grillage, anchors, conduits, or weep holes.</td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>Department will pay for reinforcing steel for structures separately, unless otherwise noted.</td>
<td></td>
</tr>
<tr>
<td>E.</td>
<td>Department will make no separate payment for structural excavation.</td>
<td></td>
</tr>
<tr>
<td>F.</td>
<td>Includes roadway painting of deck surface.</td>
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Section 03311: Bridge Deck Joint Closure

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<th>Joint Closure</th>
<th>Square Foot</th>
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<tr>
<td>A.</td>
<td>Measure the joint closure length along the centerline of existing joint for the full width of the bridge deck including parapets. The width of joint closure is the distance between the saw cuts measured perpendicular to the centerline of the joint.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>Includes removal of and disposal of existing concrete and joint material.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>Includes placement of new concrete, reinforcement and other materials required to complete the work.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>Includes equipment and labor necessary to complete the work.</td>
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Section 03372: Thin Bonded Polymer Overlay

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<td>Includes the cost of the two part polymer resin, aggregate, labor, and incidental items required to install the Thin Bonded Polymer Overlay. This also includes the cost any repairs that are needed in compliance to the warranty letter.</td>
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Section 03924: Structural Concrete Repair

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<th>039247030</th>
<th>Bent Cap Repair</th>
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<td></td>
<td>Includes girder jacking (when shown), preparation for delamination repair, delamination repair, epoxy injection, and all materials, equipment, and labor necessary to complete the item.</td>
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<table>
<thead>
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<th>Diaphragm Repair</th>
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<tr>
<td>A.</td>
<td>Measurement is between girders.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>Includes preparation for delamination repair, delamination repair, epoxy injection, and all materials, equipment, and labor necessary to complete the item.</td>
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<table>
<thead>
<tr>
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<th>Girder End Repair</th>
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<td>Includes girder jacking (when shown), preparation for delamination repair, delamination repair, epoxy injection, corrosion cleaning and protection, and all materials, equipment, and labor necessary to complete the item.</td>
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<table>
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<th>Parapet Repair</th>
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<tr>
<td>A.</td>
<td>Length of the parapet repair is measured along the toe of the parapet or curb.</td>
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<tr>
<td>B.</td>
<td>Includes preparation for delamination repair, delamination repair, epoxy injection, and all materials, equipment, and labor necessary to complete the item.</td>
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<table>
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<td>A.</td>
<td>Measured as total length of cracks designated by the Engineer to be epoxy injected.</td>
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<tr>
<td>B.</td>
<td>For cracks extending around corners of members, the crack length is measured on both faces.</td>
<td></td>
<td></td>
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<tr>
<td>C.</td>
<td>Includes epoxy injection, and all materials equipment and labor necessary to complete the item.</td>
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Section 05832: Strip Seal Expansion Joint

<table>
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<th>058327020</th>
<th>Strip Seal Expansion Joint Modification</th>
<th>Foot</th>
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<tbody>
<tr>
<td>A.</td>
<td>Includes all labor, equipment and materials required to modify existing expansion joints.</td>
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<td></td>
</tr>
<tr>
<td>B.</td>
<td>Measured from out-to-out of deck along the center line of the joint.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>The Department will make no separate payment for required inspection and testing.</td>
<td></td>
<td></td>
</tr>
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</table>
SECTION 01501

MOBILIZATION

PART 1  GENERAL

1.1  SECTION INCLUDES

A.  Mobilization and preparatory work necessary to become ready to perform the work.

1.2  RELATED SECTIONS  Not Used

1.3  REFERENCES  Not Used

1.4  DEFINITIONS  Not Used

1.5  SUBMITTALS  Not Used

1.6  GENERAL

A.  Includes the moving of personnel, equipment, supplies and incidentals to each work site before beginning the work.
B.  Includes the establishment of offices, buildings, and other facilities necessary for the work.
C.  Includes labor and operations which must be performed before beginning other items under the Contract.
D.  Includes removal of personnel, equipment, and supplies from each work site at the completion of the work.
E.  Includes work that is not included with other items under the Contract such as cleanup and restoration of disturbed areas.

PART 2  PRODUCTS  Not Used

PART 3  EXECUTION  Not Used

END OF SECTION
SECTION 03055
PORTLAND CEMENT CONCRETE

PART 1     GENERAL

1.1     SECTION INCLUDES
A. Portland Cement Concrete.

1.2     RELATED SECTIONS
A. Section 03390: Concrete Curing

1.3     REFERENCES
A. AASHTO M 6: Fine Aggregate for Hydraulic Cement Concrete
B. AASHTO M 80: Coarse Aggregate for Hydraulic Cement Concrete
C. AASHTO M 85: Portland Cement
D. AASHTO M 154: Air-Entraining Admixtures for Concrete
E. AASHTO M 157: Ready-Mixed Concrete
F. AASHTO M 194: Chemical Admixtures for Concrete
G. AASHTO M 295: Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
H. AASHTO M 307: Silica Fume Used in Cementitious Mixtures
I. AASHTO T 160: Length Change of Hardened Hydraulic Cement Mortar and Concrete
J. AASHTO T 325: Estimating the Strength of Concrete in Transportation Construction by Maturity Tests
K. AASHTO T 358: Surface Resistivity Indication of Concrete’s Ability to Resist Chloride Ion Penetration
L. ASTM C 150: Portland Cement
M. ASTM C 595: Blended Hydraulic Cements
N. ASTM C 1157: Hydraulic Cement

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

P. ASTM C 1602: Mixing Water Used in the Production of Hydraulic Cement Concrete

Q. American Concrete Institute (ACI) Manual of Concrete Practice

R. UDOT Materials Manual of Instruction

S. UDOT Minimum Sampling and Testing Requirements

T. UDOT Quality Management Plan

1.4 DEFINITIONS

A. Cold Weather Protection Period: The required time during which the concrete is maintained at or above a specific temperature to prevent freezing of the concrete and to ensure the necessary strength development for structural safety.

1.5 SUBMITTALS

A. Mix design for all A and AA concrete classes to be used for approval.
   1. The Department approves concrete mix designs based on trial batch test results or on Department project history.
   2. Include at least the following:
      a. The proposed mix design.
      b. Target slump value.
      c. Trial batch test results.
      d. Test results verifying that coarse and fine aggregates meet this Section, Article 2.2, paragraph B.
      e. Test results for the proposed mix design for potential reactivity of coarse and fine aggregates according to UDOT Quality Management Plan 506: Ready-Mix Concrete.
      f. Test results demonstrating the ability of the combinations of cementitious materials and aggregates to control the reactivity when using potentially reactive aggregates in a mix design.
      g. Written plan for admixtures. Refer to this Section, Article 2.2, paragraph D.
h. Well-graded combined aggregate gradation for the mix design when used.
   1) Provide targets for each required sieve (listed in Tables 5 and 6) for control and acceptance.
   2) Submit the coarseness factor, 0.45 power chart, percentage retained (8-18 gradation chart) or a combination of methodologies.
   3) Identify the aggregate size and number of component stockpiles.
   4) Provide gradations for each component stockpile and the target percentages of each stockpile used to achieve the total combined gradation.

B. Mix design, manufacturer’s product data, or manufacturer’s labeling for Class B concrete for approval.

C. Cold Weather Concreting Plan and Hot Weather Concreting Plan for review.
   1. Include the following:
      a. Detailed procedures for the placement, protection, curing, and temperature monitoring of concrete during cold and hot weather.
      b. Procedures to be implemented upon abrupt changes in weather conditions or equipment failures.
      c. Refer to this Section, Article 3.1, paragraph D for cold weather concreting requirements and Article 3.1, paragraph E for hot weather concreting requirements.
   2. Allow the Engineer 10 calendar days to review the plans.
      a. The Engineer may grant an increase in contract time when this review and approval time is exceeded.
      b. This review period applies each time the plans are submitted.
   3. Do not begin cold weather concreting before the Cold Weather Concreting Plan is approved.
   4. Do not begin hot weather concreting before the Hot Weather Concreting Plan is approved.
   5. Not required for precast concrete members provided by prequalified suppliers. Refer to this Section, Article 3.1, subparagraph D1 for cold weather. Refer to this Section, Article 3.1 paragraph E3 for hot weather.

1.6 ACCEPTANCE

A. Acceptance for strength, air entrainment, and slump is according to UDOT Minimum Sampling and Testing Requirements.
B. The Department may accept the item at a reduced price when concrete is below specified strength and does not have a separate strength pay factor.

1. The pay factor will be applied to the quantity of the pay item that is represented by the strength tests that fall below a specified strength.

2. Department will calculate the pay factor using Table 1 based on 28 day compressive strength.

<table>
<thead>
<tr>
<th>AA(LS), AA(PS), AA(ES) AA(P) Concrete Classes</th>
<th>AA(AE), A(AE), Concrete Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSI below Specified Strength</td>
<td>Pay Factor</td>
</tr>
<tr>
<td>1-100</td>
<td>0.95</td>
</tr>
<tr>
<td>101-200</td>
<td>0.90</td>
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<tr>
<td>201-300</td>
<td>0.85</td>
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<tr>
<td>301-400</td>
<td>0.80</td>
</tr>
<tr>
<td>More than 400</td>
<td>Reject</td>
</tr>
</tbody>
</table>

3. The Engineer may accept a “reject” lot based on an engineering analysis. The Department applies a 0.50 pay factor if a reject lot is allowed to remain in-place.
PART 2 PRODUCTS

2.1 CONCRETE CLASSES AND MIX REQUIREMENTS

A. Use only concrete mixes that have a Department approved mix design.
1. Refer to the requirements in Table 2.

<table>
<thead>
<tr>
<th>Class</th>
<th>Coarse Aggregate Size</th>
<th>Maximum Water / Cementitious Ratio</th>
<th>Maximum Percent Shrinkage at 28 days AASHTO T 160</th>
<th>Chloride Ion Penetration AASHTO T 358 Table 1</th>
<th>Air Content Percent (%) *</th>
<th>Mix Design Compressive Strength f’c (psi)</th>
<th>28 Day Minimum Compressive Strength f’c (psi) **</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA(LS) 1” to No. 4 3/4” to No. 4</td>
<td>0.40</td>
<td>Low to Negligible</td>
<td>5.0 - 7.5</td>
<td>5,200</td>
<td>4,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA(PS) 3/4” to No. 4</td>
<td>0.40</td>
<td>N/A</td>
<td>N/A</td>
<td>5.0 - 7.5</td>
<td>6,200 or f’c +1200</td>
<td>5,000 or as shown</td>
<td></td>
</tr>
<tr>
<td>AA(P) 2” to No. 4 1 1/2” to No. 4 1” to No. 4 3/4” to No. 4</td>
<td>0.44</td>
<td>0.042</td>
<td>N/A</td>
<td>4.0 - 7.0 4.5 - 7.5 5.0 - 7.5</td>
<td>5,200</td>
<td>4,000</td>
<td></td>
</tr>
<tr>
<td>AA(ES)*** 1 1/2” to No. 4 1” to No. 4 3/4” to No. 4</td>
<td>0.44</td>
<td>0.03</td>
<td>N/A</td>
<td>4.5 - 7.5 5.0 - 7.5</td>
<td>5,200</td>
<td>4,000</td>
<td></td>
</tr>
<tr>
<td>AA(AE) 2” to No. 4 1 1/2” to No. 4 1” to No. 4 3/4” to No. 4</td>
<td>0.44</td>
<td>N/A</td>
<td>N/A</td>
<td>4.0 - 7.0 4.5 - 7.5 5.0 - 7.5</td>
<td>5,200</td>
<td>4,000</td>
<td></td>
</tr>
<tr>
<td>A 1 1/2” to No. 4 1” to No. 4 3/4” to No. 4</td>
<td>0.53 0.53 0.48</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>3,900</td>
<td>3,000</td>
<td></td>
</tr>
<tr>
<td>A(AE) 1 1/2” to No. 4 1” to No. 4 3/4” to No. 4</td>
<td>0.53 0.53 0.48</td>
<td>N/A</td>
<td>N/A</td>
<td>4.5 - 7.5</td>
<td>3,900</td>
<td>3,000</td>
<td></td>
</tr>
<tr>
<td>B or B(AE)</td>
<td>0.62</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A 3.0 - 6.0</td>
<td>3,250</td>
<td>2,500</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 Notes:
* Values listed represent in-place air content. Make necessary adjustments for impacts to air content due to placement.
** For f’c over 4,000 psi, design and proportion mixes according to ACI Manual of Concrete Practice 301: Specifications for Concrete and project specific criteria. Use air content percent in Table 2 for these mixes according to the class specified and the coarse aggregate size.
*** For Class AA(ES), achieve at least 3,000 psi at 24 hr.
B. Maximum nominal size of coarse aggregate:
   1. Not larger than $\frac{1}{5}$ the narrowest dimension between sides of forms.
   2. Not larger than $\frac{1}{4}$ the depth of slabs.
   3. Not larger than $\frac{3}{4}$ the minimum clear distance between reinforcing bars or between bars and forms, whichever is less.

C. Do not exceed water/cementitious ratio.
   1. Calculate the water/cementitious ratio ($w/c$) by weight according to the following formula:

   $\frac{w}{c} = \frac{\text{Water}}{\text{Cement + Pozzolan}}$

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

E. Use 94 lb additional cementitious material per cubic yard to the amounts determined in the mix design for concrete deposited in water.

F. Slump tolerance
   1. Establish the target slump by mix design trial batch.
   2. The target slump tolerance is the acceptable variation from the maximum target slump.
   3. Do not exceed a 9 inch slump.

<table>
<thead>
<tr>
<th>Target Slump Tolerance (inch)</th>
<th>Target Slump</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 inches or less</td>
</tr>
<tr>
<td>Plus tolerance</td>
<td>0</td>
</tr>
<tr>
<td>Minus tolerance</td>
<td>1 ½ inches</td>
</tr>
</tbody>
</table>

2.2 MATERIALS

A. Cement
   1. Use Type II Portland Cement or equivalent according to Table 4 unless otherwise specified. Type III Portland Cement or equivalent may be used for precast items.
   2. Blended Hydraulic Cement
      a. Blended hydraulic cement substituted for Portland Cement:
         1) Use ASTM C 1567 to verify that expansion is less than 0.1 percent 14 days after the zero reading.

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January 1, 2017
2) Refer to the equivalent cements listed in Table 4.
   
   b. Do not exceed 30 percent total pozzolan limit when adding fly ash to a blended hydraulic cement.

1) Submit documentation of the total pozzolan content with the mix design.

### Table 4

**Portland Cement/Blended Hydraulic Cement Equivalencies**

<table>
<thead>
<tr>
<th>AASHTO M 85 (Low Alkali)</th>
<th>ASTM C 595</th>
<th>ASTM C 1157</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Type I</td>
<td>IP, IL, IT</td>
<td>GU</td>
</tr>
<tr>
<td>Type II</td>
<td>IP(MS), IT(MS)</td>
<td>MS</td>
</tr>
<tr>
<td>Type III</td>
<td>-</td>
<td>HE</td>
</tr>
<tr>
<td>*Type V</td>
<td>IP(HS), IT(HS)</td>
<td>HS</td>
</tr>
</tbody>
</table>

*Use only when specified

3. Do not mix cements originating from different sources.
4. Do not use air-entrained cement.

**B. Aggregate**

1. **Coarse Aggregate**
   
   a. Use coarse aggregate that meets AASHTO M 80 physical properties. Use one of the gradations in Table 4.
   
   b. Do not exceed percentages of deleterious substances as specified in AASHTO M 80, Table 2, for Class A aggregates.

### Table 5

**Coarse Aggregate Gradations - Percent Passing (by weight)**

<table>
<thead>
<tr>
<th>Aggregate Size (inches or sieve size)</th>
<th>2½</th>
<th>2</th>
<th>1½</th>
<th>1</th>
<th>¾</th>
<th>½</th>
<th>⅛</th>
<th>No. 4</th>
<th>No. 200</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 to No. 4</td>
<td>100</td>
<td>95-100</td>
<td>35-70</td>
<td>10-30</td>
<td>0-5</td>
<td>0-1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1½ to No. 4</td>
<td>100</td>
<td>95-100</td>
<td>35-70</td>
<td>10-30</td>
<td>0-5</td>
<td>0-1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to No. 4</td>
<td>100</td>
<td>95-100</td>
<td>25-60</td>
<td>0-10</td>
<td>0-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>¾ to No. 4</td>
<td>100</td>
<td>90-100</td>
<td>20-55</td>
<td>0-10</td>
<td>0-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. **Fine Aggregate**
   
   a. Use fine aggregate that meets AASHTO M 6 physical properties. Use the gradation in Table 5.
b. Do not exceed percentages of deleterious substances as specified in AASHTO M 6, Table 2, for class A aggregates, using option “b” for material finer than the No. 200 sieve.

<table>
<thead>
<tr>
<th>Table 6</th>
<th>Fine Aggregate Gradation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size</td>
<td>Percent Passing (by weight)</td>
</tr>
<tr>
<td>¾ inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>95 to 100</td>
</tr>
<tr>
<td>No. 16</td>
<td>45 to 80</td>
</tr>
<tr>
<td>No. 50</td>
<td>10 to 30</td>
</tr>
<tr>
<td>No. 100</td>
<td>2 to 10</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 to 3.0</td>
</tr>
</tbody>
</table>

3. A well-graded combined aggregate gradation may replace the gradation requirements in Tables 5 and 6.
   a. Proportion combined aggregates using any combination of the 0.45 power chart, the 8-18 percent-retained and the Coarseness Factor charts in the UDOT Materials Manual of Instruction, Section 975: Guidelines for Well-Graded Combined Aggregate Gradations.
      1) Determine a combined gradation for the mix design. Provide targets for each sieve size (3/4", ½", 3/8", #4, #8, #16, #30, #50, #100)
      2) Maintain gradations within zone II of the coarseness factor chart.
      3) Allow a variance of sieve targets as determined by Table 7 for acceptance.

<table>
<thead>
<tr>
<th>Table 7</th>
<th>Tolerances for a Well Graded Combined Aggregate Gradation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size</td>
<td>Percent Passing Allowable Tolerance</td>
</tr>
<tr>
<td>¾&quot;, ½&quot;, 3/8&quot;</td>
<td>± 10%</td>
</tr>
<tr>
<td>#4, #8</td>
<td>± 5%</td>
</tr>
<tr>
<td>#16, #30, #50</td>
<td>± 4%</td>
</tr>
<tr>
<td>#100, #200</td>
<td>± 3%</td>
</tr>
</tbody>
</table>

C. Water
1. Use potable water or water that meets ASTM C 1602, including Table 2.

D. Admixtures
1. Do not use calcium chloride.
2. Air Entrainment according to AASHTO M 154, including Section 5.
3. Water Reducing Agents
   a. Refer to AASHTO M 194.
   b. High Range Water Reducer (HRWR) – Submit a written plan for approval with the trial batch that details ingredients, production methods, handling, and placing.


5. Set Retarding and Hydration Stabilizing Admixtures – Refer to AASHTO M 194.
   a. Establish and inform the Engineer of the effective life of the set-retarding or stabilizing admixture by trial batch if admixtures are required due to haul times exceeding the time limitations in this Section, Article 3.3, paragraph A.
   b. Do not exceed manufacturer’s recommendations for the use of the set retarding admixture.
   c. Do not re-dose the concrete with additional set retarding admixture.
   d. Add admixture at the batch plant at the time of initial batching operations.
   e. Show on batch tickets the amount of admixture used.
   f. Time of placement is established by the trial batch and supersedes the requirements in this Section, Article 3.3, paragraph A.

   a. Limit the use of site-added air-entraining agents to one addition per load, regardless of quantity.
   b. Use pre-measured admixtures.
   c. Record amount used on batch ticket.
   d. Rotate the drum at least 30 revolutions at the mixing speed recommended by the manufacturer.

E. Pozzolan
1. Fly Ash
   a. Class F according to AASHTO M 295 except Table 2.
      1) Loss on Ignition (LOI) Not to exceed 3 percent.
      2) Allowable CaO content Not to exceed 15 percent.
      3) Label the storage silo for fly ash to distinguish it from cement.
      4) Use different size unloading hoses and fittings for cement and fly ash.

2. Natural Pozzolan (Class N)
   a. Refer to AASHTO M 295.
   b. May use instead of fly ash provided that the expansion does not exceed 0.1 percent. Refer to ASTM C 1567.

3. Silica Fume
   a. Refer to AASHTO M 307.
2.3 MIX DESIGN

A. Design mixes to meet the requirements of this Section and project specific criteria.

B. The Contractor assumes responsibility for the compatibility of admixtures with the mix design and their potential effects on concrete properties.

C. Design the cementitious system to mitigate potential alkali-aggregate reactivity.
   1. Use at least 20 percent pozzolan by weight of the total cementitious system.

D. Obtain approval from the Engineer for the project specific application of an approved mix design.

2.4 TRIAL BATCHES

A. Use the same components in the trial batches that will be used in the project.
   1. Accelerators and site-added air-entrainment can be incorporated in the trial batch but are not required.

B. Use Department certified TTQP Concrete and Concrete Strength Testing personnel to perform trial batches and strength tests.

C. The Department or its certified representative may witness the trial batch.

D. Mix concrete trial batches according to the UDOT Materials Manual of Instruction 974: Guidelines for Portland Cement Concrete Mix Design Trial Batches.

E. Use a Department qualified laboratory to verify trial batch compressive and flexural strength testing.

2.5 AGGREGATE STOCKPILES

A. Construct stockpile platforms so that subgrades are prevented from intruding into aggregates.

B. Build stockpiles at least two days before use.

C. Provide an operator and front-end loader to help the Engineer take aggregate samples.
D. Provide separate stockpiles for coarse and fine aggregates.
E. Construct stockpiles to minimize segregation of aggregates
F. Allow washed aggregates to drain to uniform moisture content before use (12 hours minimum).

2.6 BATCH MATERIALS

A. Batch Tolerances. Refer to AASHTO M 157.
   1. Cementitious Material: ± 1 percent of the required mass
   2. Aggregate: ± 2 percent of the required mass
   3. Total Water: ± 3 percent of the required mix amount

B. Truck-Mixed Concrete (Dry-Batch)
   1. Do not load trucks in excess of their rated mixing capacity, 63 percent of the drum gross volume, or less than 2 yd³.
   2. The truck rating plate must be readable.

PART 3 EXECUTION

3.1 LIMITATIONS

A. Timing – Deliver, place, and consolidate concrete as follows unless otherwise specified:
   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.

B. Concrete Temperature – Place concrete when the concrete temperature is between 50 and 90 degrees F unless otherwise specified.

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 ½ of the range of air content allowed by specification.
   2. Contractor is responsible to verify and monitor air loss.
   3. Replace, reconfigure, or repair equipment that does not meet the requirements of this Section, Article 3.1, paragraph C1
D. Cold Weather – Comply with the following when placing, finishing, curing, and protecting concrete exposed to cold weather during the protection period. Cold weather applies when the temperature is forecast to fall below 35 degrees F during the protection period.

1. Provide necessary cold weather protection for placing, finishing, curing and protecting in-place concrete such as covers, insulation, and heat.
   a. Follow the authorized Cold Weather Concreting Plan when placing cast-in-place concrete.
   b. Follow the prequalified supplier’s approved Quality Control Plan when fabricating precast concrete members.

2. Concrete materials
   a. Do not use chemical anti-freeze additives in the concrete. This does not apply to normal accelerators. Refer to AASHTO M 194.
   b. Remove and replace concrete damaged by frost action at no additional cost to the Department.
   c. Do not use material containing frost or lumps.

3. Determine the concrete compressive strength by one of the following methods:
   a. Field cured cylinders cured and protected the same as the concrete being protected.
   b. Maturity method. Refer to AASHTO T 325.

4. Maintain the temperature of the concrete at or above 50 degrees F during and after placement until the end of the protection period.
   a. Measure the specified concrete temperature at the concrete surface. Use surface thermometers insulated from the surrounding air.

5. Placing concrete
   a. Do not place concrete during adverse weather including rain, snow, and high winds without adequate protection approved by the Engineer.
   b. Do not proceed with the placement of concrete if the temperature of all contact surfaces, including reinforcement, is less than 36 degrees F or greater than 95 degrees F.
   c. Cease placement operations when the ambient temperature is 40 degrees F and decreasing unless adequate precautions are taken according to the approved Cold Weather Concreting Plan.

6. Protection of in-place concrete
   a. Maintain the concrete above 50 degrees F during placement and until the end of the protection period.
      1) The protection period is the time required for the concrete to reach a compressive strength of at least 3,500 psi.
2) Extend the duration of the protection period at least 24 hr beyond the termination of the cure before exposing the concrete to freezing temperatures when curing by the water method. Refer to Section 03390.

b. Comply with the following when heating is required.

1) Adequately vent combustion-type heaters that produce carbon monoxide.

2) Position heaters and ducts so the hot dry air does not cause areas of the concrete surface to overheat or dry.

3) Keep concrete surfaces moist to avoid excessive loss of moisture from the concrete when applying external heat.

7. Termination of protection

a. Limit the drop in temperature of concrete surfaces to 40 degrees F during any 24 hour period when removing cold weather protection until the surface temperature of the concrete reaches that of the ambient air temperature.

E. Hot Weather – Comply with the following when placing, finishing, curing, and protecting concrete exposed to hot weather during the protection period.

1. Hot weather limitations apply at any time of the year when a combination of high ambient temperature, high concrete temperature, low relative humidity, and high wind speed have the potential to impair the quality of freshly mixed or hardened concrete by accelerating the rate of moisture loss and the rate of cement hydration, or otherwise causes detrimental results.

2. Monitor site conditions, including air temperature, relative humidity, and wind speed, to assess the need for evaporation control measures.

a. Begin monitoring no later than 1 hour before beginning concrete placing operations.

b. Continue to monitor site conditions at intervals of 20 minutes or less until required curing procedures are applied.

3. Provide necessary hot weather protection.

a. Follow the approved Hot Weather Concreting Plan when placing cast-in-place concrete.

b. Follow the prequalified supplier’s approved Quality Control Plan when fabricating precast concrete members.
c. Initiate evaporation control measures when concrete and air temperatures, relative humidity of the air, and wind speed have the capacity to evaporate free water from the fresh concrete surface at a rate equal to or greater than 0.2 lb/ft²/hr.

1) Determine the evaporation rate of surface moisture using the NRMCA Nomograph in Appendix B of ACI 305.1.

4. Cool all surfaces that will come in contact with the concrete to below 95 degrees F

3.2 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. Stop placement of concrete if the storage device is not provided or cannot accommodate the required number of test cylinders. Cylinder strength results may not be disputed if storage devices are not provided.

6. Use water containing hydrated lime if water is to be in contact with cylinders.

7. The Engineer may require a 24 hour test run to determine the storage device capability to maintain and record temperature.

END OF SECTION
SPECIAL PROVISION

SECTION 03154S

HYDRO-DEMOLITION

Add Section 03154:

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Concrete removal, and surface preparation on existing bridge decks and approach slabs using hydro-demolition.

1.2  RELATED SECTIONS

A. Section 01571: Temporary Environmental Controls
B. Section 01721: Survey
C. Section 03211: Reinforcing Steel and Welded Wire

1.3  REFERENCES

A. ASTM D 3963: Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars
B. ASTM D 4580: Standard Practice for Measuring Delaminations in Concrete Bridge Decks by Sounding

1.4  DEFINITIONS

A. Class A - Removal of concrete from top surface of deck to the surface of the top mat of reinforcement.
B. Class B - Removal of concrete from the top surface of deck to a depth defined in the plans between the top and bottom mats of reinforcement.
C. Class C - Removal of concrete from top surface of deck to the bottom surface of the deck.
D. Deck - In this section deck refers to the bridge deck and approach slab.
1.5  SUBMITTALS

A. Hydro-demolition Narrative for review. Include at least the following:
   1. A wastewater control and disposal plan. Refer to this Section, Article 3.4.
      a. Use methods to ensure that wastewater is free of concrete particles, sediment, and hydrocarbons.
      b. Clearly state the minimum requirements and thresholds that must be met before wastewater disposal.
      c. Define how all wastewater generated by the hydro-demolition operation will be contained, stored, tested and disposed of. Refer to Section 01571.
      d. Describe equipment to be used including, but not limited to: hydro-demolition units, vacuum trucks, and storage tanks.
      e. Describe location of equipment, water storage, and wastewater storage during hydro-demolition process.
      f. Describe how solids produced during hydro-demolition process will be disposed of.
   2. Estimated production rate and list of equipment and manpower required to maintain this production rate.
   3. Certifications of equipment operators provided by the equipment manufacturer that the operator has been trained and certified in the proper and safe use of the equipment.
   4. Provide experience for a minimum of 5 structures of similar size or larger.
      a. Provide contact name and phone number of owner’s representative for reference projects.
      b. Provide information that describes the bridge, including length and width, crossing feature, area of hydro-demolition, and depth of hydro-demolition.
      c. Provide length of time required to complete the hydro-demolition work.

B. Working Drawings
   1. Drawings for Temporary Works for review.
      a. Include detailed plans for bracing deck overhang during hydro-demolition operation.
      b. Shoring for hydro-demolition equipment that is required to be supported on a partial thickness deck.

C. Bridge Deck Survey when specified.
   1. Provide survey data of the existing deck in a format easy for the Engineer to use.
   2. Include grade breaks and flowline of barrier or gutter elevations.
   3. Survey points to be taken at a 20 ft interval along the length of the bridge deck and approach slabs.
4. When plans do not contain horizontal or vertical alignment information or elevations refer to this Section, Article 3.1 Paragraph F.

D. List of operating parameters determined during on-site testing and calibration of equipment including pressure, water flow, total traverse time and forward index distance. Submit this information to the Engineer within 24 hours of testing procedure.

E. Waste water test results prior to transportation of water.

PART 2 PRODUCTS

2.1 MATERIALS

A. Water – Use water containing no hazardous or toxic materials.

B. Reinforcing Steel – Refer to Section 03211.

2.2 EQUIPMENT

A. Hydro-Demolition
   1. Provide a complete concrete removal system capable of removing concrete to the depth shown using high-velocity water jet streams acting under continuous automatic control.
   2. Use equipment capable of removing rust, scale, and corrosion from exposed reinforcement designated to remain in place.
   3. Use rotating water jets at an angle of 60 degrees or less as measured from the deck surface.
   4. The equipment must be self-propelled and capable of controlling these functions:
      a. Water pressure
      b. Rotation of the nozzle head
      c. Distance of the nozzle in relation to the concrete surface
      d. Limits of transverse and longitudinal movement of the nozzle
      e. Speed of the nozzle in transverse and longitudinal directions
   5. Provide accurate working pressure gauges at hydro-demolition pumps.
   6. The equipment must have means to control the tolerance of concrete removal to within ±3/8 inch of the removal depth shown.
   7. Maintain an inventory of common wear parts and replacement accessories for the equipment on the job site.
B. Jackhammer
   1. 30-lb class
   2. 15-lb class

PART 3 EXECUTION

3.1 GENERAL

A. Follow authorized wastewater control and disposal plan.

B. Provide water tight falsework to contain all dislodged material within the removal area. Protect the public from flying debris both on and under the worksite.

C. Prevent wastewater from leaving deck surface including through deteriorated expansion joints, deck drains, and holes in deck.

D. Protect the parapets that are to remain from damage.

E. Clean areas of the prepared surface that have been contaminated by oil or other materials which are detrimental to a good bond as a result of the contractor's operations.

F. Perform bridge deck survey before starting demolition when plans do not contain horizontal and vertical alignment information or elevations.
   1. Refer to Section 01721.
   2. Survey is required to re-establish deck surface.

G. Do not perform hydro-demolition when temperatures are expected to drop below 40 degrees F without the written approval of the Engineer.

H. Only use equipment operator(s) that are trained in the correct and safe operation of the hydro-demolition equipment.

3.2 TEST AND CALIBRATE HYDRO-DEMOLITION EQUIPMENT

A. Testing and calibration procedure is only required when Class A or B concrete removal is required.

B. Demonstrate in two test areas that the equipment, manpower, and method of operations are capable of producing the desired results and estimated production rates.
   1. Test Area 1 - A 50 square foot area of deteriorated concrete.
   2. Test Area 2 - A 50 square foot area of sound concrete
   3. Obtain approval from the Engineer for the test areas before testing.
C. Document the parameters used at each test area for removal of deteriorated and sound concrete. Use these parameters for production rates.

D. Maintain parameters once the operation parameters of the hydro-demolition process are defined and satisfactorily demonstrated.

E. Verify parameters every 30 feet along the cutting path once the operation parameters of the hydro-demolition process are defined as satisfactorily demonstrated. Document readings and recalibrate equipment as needed in order to ensure unsound concrete has been removed.

F. Periodically review and adjust as necessary the equipment to maintain the quality of removal demonstrated in the test areas.

3.3 DECK REMOVAL

A. Start on one end of the bridge and perform Class A, B, and C concrete removal sequentially across the deck. Do not move equipment back across deck to perform additional work without Engineer's approval.
   1. Only perform hydro-demolition in the areas that the Engineer has defined or sound the concrete according to ASTM D 4580 when required.
   2. Where the Class of concrete removal is not defined, start removal on the outside corner of the removal limits and work sequentially across the deck.
   3. Depth of Class B concrete removal need not exceed a depth 1 inch greater than the minimum depth shown on the plans, even if still above the top mat of reinforcement.

B. Use jackhammers or other hand removal methods only in areas that are inaccessible to the hydro-demolition machine or to square off Class C concrete removal areas or blow throughs as approved by the Engineer.
   1. For concrete that is at or above the top mat of reinforcing steel, use a 30-lb class jackhammer.
   2. Use a 15-lb class jackhammer or less in all other locations.
   3. Operate jackhammer at an angle no greater than 45 degrees as measured from the deck surface.
   4. Hand removal methods are performed at no additional cost to the Department.

C. Completely clean exposed reinforcing steel to be free of rust, scale, and corrosion. Refer to this Section, Article 3.5.
D. Water and Debris Removal
   1. Remove water and debris concurrent with the demolition operation to prevent slurry from drying and rebonding to the surface or reinforcing steel.
   2. Provide vacuum cleanup during the hydro-demolition.
   3. Water and debris becomes the property of the Contractor.
      a. Legally disposed of wastewater and debris.

E. Deck Blow Through
   1. Immediately stop the operation and notify the Engineer and make the necessary adjustments if removal blows completely through the deck.
      a. Use sandbags or other methods to stop the flow of water through the hole.
   2. Form the underside of deck using formwork large enough to cover the hole with a 6 inch minimum overlap on all sides.
   3. Remove the forms as soon as the concrete is set.

3.4 WASTEWATER

A. Do not allow water to accumulate on the bridge unless shown.
   1. Do not allow water to accumulate to a depth greater or an area larger than what is shown.

B. Collect water and debris from the removal operations using storage tanks or lined retention basins.

C. Do not transport water from bridge location until the waste water is treated to minimum requirements.
   1. The pH is between 6.5 to 8.5.
   2. The TSS is of a concentration of 100 mg/L or less.
   3. Provide test results for each truck load of waste water.

D. Contain and treat wastewater so that the minimum thresholds required by permits are met. Dispose of wastewater once established thresholds are met.

E. Penalties
   1. Penalties are assessed against the Contractor in the amount of $500 for each calendar day or portion thereof the project is not in compliance with all required permits and regulations. The penalties assessed are increased to $1,000 per day if the Contractor remains in non-compliance after three days and increased to $1,500 per day if the Contractor remains not in compliance after seven days.
   2. Any fined issued by regulatory agencies against the Department are added to the penalty assessed to the Contractor.
3. No extension of contract time is allow for any delay resulting directly or indirectly from a violation of environmental requirements.

3.5 REINFORCING STEEL

A. Do not cut or damage reinforcing steel designated to remain. Use methods acceptable to the Engineer to repair or replace reinforcing steel damaged by concrete removal operation.

B. Provide new rebar splices of equivalent size to existing rebar wherever a section loss greater than 25 percent occurs.
   1. Provide a lap splice length at each end of the bar equal to 32 times the bar diameter.
   2. Refer to Section 03211.

C. Adequately support exposed reinforcing steel left unsupported by the hydro-demolition process to maintain clear cover shown on the plans and protect the reinforcing steel from construction operations.

D. Repair damage to epoxy coated reinforcing steel coatings for bars to remain in place when required by the Engineer.
   1. Refer to ASTM D 3963.

3.6 PROTECTION

A. Protect adjacent areas and the public from debris during removal operations.

B. Prevent debris from falling onto pedestrian areas, traffic areas, railroad tracks, streams, rivers, or other environmentally sensitive areas.

C. Do not perform hydro-demolition directly overhead of live traffic unless falsework system is in place and will capture all water and debris from the operation.

D. Do not place equipment or store material on the deck after hydro-demolition until new structural concrete has cured.

3.7 CLEAN UP

A. Remove water containment features.

B. Sweep roadway and pedestrian facilities.

C. Pressure wash roadway, pedestrian, drainage facilities and other facilities adjacent to the bridge to remove dried on concrete slurry.
D. Pressure wash the bottom of the deck surface and girders to remove concrete slurry staining.

3.8 LIMITATIONS
A. Do not use water used in any step of the hydro-demolition process in the concrete mix or to cure concrete.

END OF SECTION
SECTION 03211

REINFORCING STEEL AND WELDED WIRE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reinforcing steel, steel welded wire reinforcement, dowelled anchors, T-headed bars, mechanical couplers, and grouted splice couplers.

B. Coating for reinforcing steel, steel welded wire reinforcement, and dowelled anchors.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. AASHTO M 31: Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

B. AASHTO M 55: Steel Welded Wire Reinforcement, Plain, for Concrete

C. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

D. AASHTO M 235: Epoxy Resin Adhesives

E. AASHTO T 106: Compressive Strength of Hydraulic Cement Mortar (Using 50-mm or 2-in Cube Specimens)

F. ASTM A 108: Steel Bar, Carbon and Alloy, Cold-Finished

G. ASTM A 493: Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging

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

I. ASTM A 767: Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

J. ASTM A 775: Epoxy-Coated Steel Reinforcing Bars

K. ASTM A 934: Epoxy-Coated Prefabricated Steel Reinforcing Bars

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January 1, 2017
L. ASTM A 955: Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement
M. ASTM A 970: Headed Steel Bars for Concrete Reinforcement
N. ASTM E 1512: Testing Bond Performance of Bonded Anchors
O. American Welding Society (AWS) Standards
P. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Working Drawings
   1. Detailed shop drawings for review of the following:
      a. Field bending procedure if required. Provide the seal of a Professional Engineer (PE) or Professional Structure Engineer (SE) licensed in the State of Utah.
      b. Mechanical butt splice shop drawings when proposed details differ from the plans and specifications.
         1) Show number and location of mechanical butt splices.
         2) Provide two samples of mechanical butt splices and test to destruction in the presence of the Engineer.

B. Material Submittals
   1. Certificates of Compliance from the manufacturer.
   2. Samples for verification testing to meet the testing requirements of AASHTO M 31, ASTM A 706, and ASTM A 955, respectively.
   3. Continuous butt welded reinforcing hoops.
      a. Manufacturer’s Quality Control (QC) procedures for the hoop fabrication for review. Include the following as a minimum:
         1) The pre-production procedures for the qualification of material and equipment.
         2) The methods and frequencies for performing QC procedures during production.
         3) The calibration procedures and calibration frequency for all equipment.
         4) The welding procedure specification (WPS) for resistance welding.
         5) The method for identifying and tracking lots.
      b. Two samples of welded splices for verification testing.
4. Grouted Splice Couplers
   a. Independent test report confirming coupler compliance for each supplied coupler size with the following:
      1) Develop 150 percent of the specified yield strength of the connected bar.
      2) Determine by testing the amount of time and grout compressive strength required to provide 100 percent of the specified minimum yield strength of the attached reinforcing bar. Use this value to determine when to release bracing.
      3) Use the same grout in the testing that will be used in the construction.
      4) Requirements for the grout including required strength gain to develop the specified minimum yield strength of the connected reinforcing bar.

5. Epoxy adhesive material data sheet and recommended installation instructions.

1.6 QUALITY ASSURANCE

A. The Department may witness coating processes for project work.

PART 2 PRODUCTS

2.1 REINFORCING STEEL

A. Deformed or plain carbon steel bars.
   1. Refer to AASHTO M 31, Grade 60.

B. Deformed or plain low-alloy steel bars.
   1. Refer to ASTM A 706, Grade 60.

C. Deformed or plain stainless steel bars.
   1. Refer to ASTM A 955, Type XM-28.

2.2 WIRE AND WIRE REINFORCEMENT

A. Refer to AASHTO M 55 for cold drawn steel wire.

B. Refer to AASHTO M 55 for steel welded wire reinforcement.
2.3 T-HEADED BARS

A. Use T-headed bars consisting of deformed rebar with steel plates friction welded to one end of the rebar. Friction welding conforms to the authorized quality control manual and AWS C6.2, Friction Welding of Metals.
   1. Headed Bars that meet the requirements of ASTM A 970 may be substituted.

B. Use deformed rebar according to ASTM A 706, Grade 60.

C. Cut plate heads for T-headed bars from flats of hot-rolled steel according to ASTM A 108.

2.4 COATINGS

A. Epoxy Coating.
   1. Refer to ASTM A 775 or ASTM A 934.

B. Galvanized Coating.
   1. Refer to AASHTO M 111.

C. Coat bars as described.
   1. Maintain epoxy coating thickness between 8 and 12 mils.
   2. Maintain galvanized coating thickness according to ASTM A 767.
   3. Coat bars after bending unless the fabricator can show that satisfactory results can be obtained by coating before bending.
   4. Do not use bent bars with visible cracks or damage in the coating.

2.5 DOWELLED ANCHORS

A. Use epoxy resin adhesive according to AASHTO M 235, Type V, Grade 3.

B. Use reinforcing steel, bolts, and anchors as shown.

2.6 BAR SUPPORTS AND TIE WIRE

A. Provide epoxy coated, galvanized, plastic coated, or plastic bar supports and tie wire for reinforcing steel other than stainless steel that meet the following requirements:
   1. Meet the requirements of Table 1.
   2. Remove contaminants that affect the adhesion of the coating to the wire.
   3. Use an electrostatic spray method, fluidized bed, or flocking to apply an epoxy coating.

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4. Apply plastic coating by spraying, dipping, or using as a powder.
5. Galvanized coating thickness is according to AASHTO M 111.
6. Maintain the thickness of epoxy or plastic coatings of at least 5 mils with no maximum.
7. Use patching material according to the manufacturer’s recommendation to repair damaged coating.
   a. Use patching material that is compatible with the coating and that is inert in concrete.
   b. Do not repair hanger marks on the coated bar supports that result from the coating application process. Hanger marks are not considered damaged coating.
8. Use 16 gauge coated tie wire.

B. Precast concrete block bar supports that conform to the following:
   1. Provide minimum 28-day compressive strength of 2,500 psi.
   2. Use three inch thick supports with sides ranging from 4 to 6 inches with a minimum contact area of 24 in².

C. Provide bar supports and tie wires for use with stainless steel bars that meet the following:
   1. Meet the requirements of Table 1.
   2. Provide bar supports that are plastic or stainless steel conforming to the requirements of ASTM A 493, Type 316.
   3. Provide tie wires that are plastic or stainless steel conforming to the requirements of ASTM A 493, Type 316, annealed.

2.7 MECHANICAL SPLICE COUPLER

A. Service strength bars:
   1. Reinforcing steel splice coupler shown by tests to be capable of developing in tension 125 percent of the specified yield strength of the reinforcing bar.

B. Ultimate strength bars:
   1. Use where shown.
   2. Reinforcing steel splice coupler shown by tests to be capable of developing in tension 150 percent of the specified yield strength of the reinforcing bar.

C. Coat the coupler with the same coating as the reinforcing steel being spliced.

D. Use stainless steel splice coupler with stainless steel reinforcement.
2.8 GROUTED SPLICE COUPLER

A. Use grouted splice couplers to join precast elements as shown.
   1. Provide couplers that use cementitious grout placed inside a steel casting. Grout is part of the proprietary system and is provided by the coupler manufacturer.
   2. Use threaded connections at the Contractor’s option for the portions of the coupler that are placed within the precast element if the strength of the coupler meets or exceeds the requirements of this Section.

B. Use one of the following grouted splice coupler manufacturers according to the requirements of this Section. Refer to http://www.udot.utah.gov/go/standardsreferences for information on the following providers:
   1. NMB Splice Sleeve
      Splice Sleeve North America, Inc.
      38777 West Six Mile Road, Suite 205
      Livonia, MI 48152
   2. Sleeve-Lock Grout Sleeve System
      Dayton Superior Corporation
      1125 Byers Road
      Miamisburg, OH 45342
   3. Lenton Interlok
      Pantair USA
      34600 Solon Road
      Solon, OH 44139

C. Use grouted splice couplers that provide 150 percent of the specified yield strength of the connected bar.

D. Use grout supplied by the manufacturer of the coupler and that matches the certified test report for the coupler.

E. Use the same coating system as used for the reinforcing steel.
   1. Use grouted splice couplers that join the reinforcing steel without removal of the epoxy coating on the spliced bar when using epoxy coated reinforcing steel.

2.9 CONTINUOUS RESISTANCE BUTT WELDED HOOPS

A. Weld only reinforcing steel conforming to ASTM A 706 as shown.
   1. Use butt welded splices for continuous hoops.

B. Refer to AWS D1.4: Structural Welding Code - Reinforcing Steel.
C. Perform welding only by an AWS certified welder.

D. Change welding procedures to reflect chemical composition of the steel.
   1. Welders must have correct mill test report (chemical analysis) from the heat in which the steel was made.

E. Use only a welded splice capable of transferring the minimum ultimate tensile strength of the reinforcing bar from one bar to the other.

F. Apply coating after all welding has been completed.

2.10 FABRICATION

A. Use Department Prequalified Suppliers for all reinforcing steel products.

B. Bend reinforcement to the shapes as shown. Refer to CRSI Manual of Standard Practice.

C. Do not heat the bars during the bending operations.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Protect the bars and the coating during handling and storage.
   1. Use systems with padded contact areas when handling epoxy coated bars.
   2. Pad all bundling bands for epoxy coated bars.
   3. Lift all bundles with strong-back, multiple supports, or a platform bridge.
   4. Do not drop or drag bars.

B. Repair damaged coating.
   1. Epoxy Coated
      a. Meet requirements of ASTM A 775 Appendix A.2 for repair material.
      b. Follow manufacturer recommendations for repairs.
      c. Do not use bars with total damaged surface area of epoxy coating greater than 2 percent in any 1 ft section.
      d. Do not use bars with 5 percent or greater damage to total surface area during all stages of work.
   2. Galvanized
      a. Use Inorganic Zinc Rich Paint with 65 to 69 percent zinc by weight or greater than 92 percent by weight metallic zinc in dry film for repair material.

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b. Follow manufacturer recommendations for repairs.

c. Reject bars with total damaged surface area of coating greater than 2 percent in any 1 ft section.

d. Reject any bars with 5 percent or greater damage to total surface area during all stages of work.

C. Store bars above the ground surface on wooden or padded supports.
   1. Place timbers between bundles when stacking is necessary.
   2. Space the supports close enough to prevent sags in the bundles.

D. Cover epoxy coated reinforcing steel with an opaque covering upon delivery to the project site.
   1. Protect epoxy coated reinforcing steel that has been partially embedded in concrete or placed in formwork.
      a. Cover with an opaque covering before 30 days exposure to sunlight.
   2. Place the opaque coverings to provide air circulation and prevent condensation on the reinforcing steel.

E. Ship, handle, and store stainless reinforcing steel so it does not come in contact with carbon steel.
   1. Cover stainless reinforcing steel with tarps during outdoor storage.
   2. Separate bundles of stainless reinforcing steel from other types of reinforcing steel with wooden spacers.
   3. Store stainless reinforcing steel on wooden supports off the ground or floor.

3.2 PLACEMENT

A. Maintain a clean surface keeping all reinforcement free from loose mill scale, loose or thick rust, dirt, paint, oil, or grease.

B. Field bend bars according to the authorized field bending procedures.

C. Place all reinforcement in designated position and securely hold in position while placing and vibrating concrete.
   1. Placing Tolerances
      a. Decks or members 10 inches or less in thickness
         1) Cover: -½ inch, + ¼ inch.
         2) Longitudinal spacing for individual bars: ±1 inch.
            a) Clear spacing between bars: not less than the greater of 1½ inches, 1½ bar diameters, and 1½ times the maximum aggregate size.
         3) Average spacing for 10 bars: +1/16 inch.
            a) Do not use tolerance to decrease number of bars or increase bar spacing.

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b. Members 10 to 20 inches in thickness
1) Cover: ±¼ inch.
2) Longitudinal spacing for individual bars, stirrups, or ties: ±1 inch.
   a) Clear spacing between bars: not less than the greater of 1½ inches, 1½ bar diameters, and 1½ times the maximum aggregate size.
3) Average spacing for 10 bars: +1/16 inch.
   a) Do not use tolerance to decrease number of bars or increase bar spacing.

   e. Length of bar laps -1 inch
   e. Embedment length -1 inch

c. Members greater than 20 inches in thickness
1) Cover: -¹/₄ inch, + ½ inch.
2) Spacing for stirrups or ties: ±3 inches.
   a) Clear spacing between bars: not less than the greater of 1½ inches, 1½ bar diameters, and 1½ times the maximum aggregate size.
3) Longitudinal bar spacing ±3 inches.
   a) Clear spacing between bars: not less than the greater of 1½ inches, 1½ bar diameters, and 1½ times the maximum aggregate size.
4) Average spacing for 20 bars: +¼ inch.
   a) Do not use tolerance to decrease number of bars or increase bar spacing.

D. Tie bars together with ties at intersections except when spacing is less than 9 inches in each direction, in which case tie at alternate intersections.
1. Tie bundled bars together at not more than 6 ft centers.

E. Maintain the required distance from the forms and between layers of reinforcement with prefabricated chairs, ties, hangers, or other devices.

F. Use precast concrete block bar supports only when the concrete is placed in contact with the soil and then only as the support for the bottom mat of bars.

G. Do not tack weld reinforcing bars in place.

H. Overlap at least one panel of welded wire reinforcement sheets to each other and fasten at the ends and edges.

I. Support reinforcing steel for concrete “T” beams, pier caps, approach slabs, and deck slabs on metal chairs or bar supports according to this Section, Article 2.6.

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J. Space chairs for supporting the top steel and bolsters for supporting the bottom steel not more than 4 ft on center of the bar in each direction.

K. Tie deck steel to beams or forms at regular intervals of not more than 5 ft on center along the beams to prevent steel movement during concrete placement.

L. Support reinforcing steel for slabs on grade on metal chairs attached to a sand plate or use precast concrete block supports according to this Section, Article 2.6.

M. Do not place concrete until the Engineer has verified the reinforcement placement and fastening.

N. Place stainless steel reinforcement so that it does not come in contact with carbon steel.
   1. Do not tie stainless steel to uncoated or coated carbon steel reinforcement, galvanized attachments, or galvanized conduits.
      a. Maintain at least 1 inch clearance between the metals using nylon or polyethylene spacers when stainless steel reinforcing or dowels must be near coated or uncoated reinforcing, or galvanized metals. Bind using nylon cable ties.
         1) Maintain at least 1 inch clearance unless insufficient space exists.
            a) Either bar may be sleeved with a 1/8 inch minimum thick insulator material, such as polyethylene, nylon or rubber tube, extending at least 1 inch in either direction past the point of closest contact between the two dissimilar bars.
            b) Sleeves are not allowed for bars that run parallel to each other.

3.3 FIELD CUTTING

A. Saw or shear coated bars that are specified to be cut in the field. Do not flame cut.

B. Repair the coating at the sawed or sheared end using the specified patching or repair material.

3.4 SPlicing

A. Furnish all reinforcing steel in the lengths shown.
B. Do not splice bars except where shown.

C. Stagger splices as far as possible.

D. Place and tie lapped splices in the bars. Maintain the minimum distance to the surface of the concrete shown.

E. Do not allow lap splices in vertical column reinforcing bars unless shown.

F. Do not lap splice No. 14 and No. 18 bars.
   1. Use mechanical splice couplers.

G. Use mechanical splice couplers when shown.
   1. Follow the manufacturer’s published recommendations for equipment and splicing procedures.

3.5 FIELD BENDING

A. Do not field bend reinforcing steel unless shown.

B. Follow the authorized field bending procedures.

C. Use methods that do not damage coatings.

D. Do not heat the bars during the bending operations.

E. Do not bend bars partially embedded in concrete except as shown or pre-approved by the Engineer. Do not field straighten or re-bend fabricated bent bars.

3.6 INSTALLATION OF DOWELED ANCHORS

A. Use doweled anchors according to the following:
   1. Drill, brush, and clean all holes and install all doweled anchors according to manufacturer’s published recommendations, applicable specifications, and as shown.
   2. Do not install doweled anchors until the holes are verified by the Engineer.
   3. Install doweled anchors. Test doweled anchors to 90 percent of the doweled anchor yield strength when shown, and as follows:
      a. Allow anchor adhesives to cure 48 hours before testing.
      b. Tension test according to ASTM E 1512.
3.7 CONNECTION PROCEDURE USING GROUTED SPLICE COUPLERS

A. Use personnel familiar with installation and grouting of splice couplers and that have completed at least two successful projects in the last two years.
   1. Train new personnel within three months of installation by a manufacturer’s technical representative as an acceptable substitution for the experience.

B. Remove and clean all debris from the joints before grout application.

C. Keep bonding surfaces free from laitance, dirt, dust, paint, grease, oil, or any contaminants other than water.

D. Embed rebar anchor dowels to the minimum coupler embedment required by the manufacturer.

E. Saturate Surface Dry (SSD) all joint surfaces before connecting the elements.

F. Use shims to verify that the reinforcing extensions are within the manufacturers recommended tolerance.

G. Maintain a minimum grout and sleeve temperature of 50 degrees F. Monitor the temperature of the covered grouted slice couplers until the temporary bracing is removed.

H. Conform to the manufacturer’s instructions for grout mixing, water to grout ratio, mixing time, and shelf life.

I. Mix structural grout and coupler grout just before use according to the manufacturer's instructions.

J. Follow the manufacturer’s recommendations for coupler installation and grouting.

K. Monitor the grouting operation to verify that all sleeves have been filled.

L. Verify that all sleeves are protected from any vibration, shock, or other excessive movement until temporary bracing is removed.

M. Conform to the following when installing couplers above a horizontal joint:
   1. Determine the thickness of shims to provide the specified elevation within tolerance.
   2. Follow non-shrink grout manufacturer’s recommendations for mixing, joint surface preparation, and application.
3. Place non-shrink grout on the interface between the two elements being joined before setting the element.
   a. Crown the thickness of the grout toward the center of the joint so that the grout can be displaced outward as the element is lowered onto the joint.
   b. Prevent the grout from entering the coupler above elements by using grout dams or seals.
4. Set the element in place.
   a. Engage all couplers in the joint.
   b. Allow the grout to seep out of the joint.
5. Trowel off excess grout to form a neat joint once the element is set, plumbed, and aligned.
   a. Pack grout into any voids around the joint perimeter.
6. Flush out the coupler with clean potable water.
7. Mix the special coupler grout according to the manufacturer’s recommendations for methods and proportions of mix and water.
8. Make four sets of three 2 inch cube specimens for testing.
   a. Cure the specimens according to AASHTO T 106.
   b. Test one set of cubes for compressive strength to determine when to release bracing. Refer to this Section, Article 1.5 paragraph B4a2.
   c. Test one set of cubes at 28 days for acceptance.
   d. Store extra sets for longer term testing if necessary.
   e. Use a Department qualified laboratory to take the samples and perform the tests.
9. Pump the coupler grout into the coupler that is cast into the element.
   a. Start from the lower port.
   b. Pump until the grout is flowing freely from the upper port.
   c. Cap the upper port first and then remove the nozzle to cap the lower port.
10. Cure the joint according to the grout manufacturer’s recommendations.

N. Conform to the following when installing couplers below a horizontal joint:
1. Determine shim thickness to provide the specified elevation within tolerance.
2. Before setting the element:
   a. Mix the coupler grout paying strict attention to the manufacturer’s recommendations for methods and proportions of mix and water.
   b. Clean debris from the interior using compressed air.
      1) Remove any rain water using a vacuum that can remove water from the confined space in the coupler.
   c. Place the coupler grout into the coupler by pouring or pumping.
d. Place grout on the interface between the two elements being joined.
   1) Crown the thickness of the grout toward the center of the joint so that the grout can be displaced outward as the element is lowered onto the joint.

3. Trowel off excess grout to form a neat joint once the element is set, plumbed, and aligned.
   a. Pack grout into any voids around the joint perimeter.

O. Conform to the following when installing couplers in vertical joints (horizontal bar/coupler connection):
   1. Establish a method to provide the specified elevations, alignment, and spacing within tolerance.
   2. Use washers or seals to prevent mixing the joint grout and the coupler grout.
   3. Apply epoxy adhesive to the interface between the two elements being joined.
   4. Set the element in place.
      a. Engage all couplers in the joint.
   5. Flush out the couplers with clean potable water once the element is set, plumbed, and aligned.
   6. Mix the coupler grout paying strict attention to the manufacturer’s recommendations for methods and proportions of mix and water.
   7. Pump the coupler grout into the coupler that is cast into the element.
      a. Start from the port closest to the joint.
      b. Pump until the grout is flowing freely from the other port.
      c. Cap the port farthest from the joint first and then remove the nozzle to cap the other port.
   8. Form the edges of the joint and place grout into the joint.
   9. Cure the joint according to the grout manufacturer’s recommendations.

3.8 FIELD QUALITY CONTROL

A. Inspect coated bars for damage to the coating after the bars are in place and immediately before concrete placement.
# Table 1

## Bar Supports

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Bar Support Illustration</th>
<th>Type of Support</th>
<th>Standard Sizes</th>
<th>Nominal Height</th>
<th>Carbon Steel</th>
<th>Geometry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Top</td>
<td>Legs</td>
</tr>
<tr>
<td>SB¹</td>
<td></td>
<td>Slab Bolster</td>
<td>¾, 1, 1½, and 2 inch heights in 5 ft and 10 ft lengths</td>
<td>All</td>
<td>4 ga.</td>
<td>Corrugated</td>
</tr>
<tr>
<td>BB¹</td>
<td></td>
<td>Beam Bolster</td>
<td>1, 1½, and 2 inch; over 2 inch to 5 inch heights in increments of ¼ inch lengths of 5 ft.</td>
<td>Up to 1½ inch incl.</td>
<td>7 ga.</td>
<td>7 ga.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 1½ inch to 2 inches incl.</td>
<td>7 ga.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 2 inches to 3½ inches incl.</td>
<td>4 ga.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 3½ inch</td>
<td>4 ga.</td>
</tr>
<tr>
<td>BC</td>
<td></td>
<td>Individual Bar Chair</td>
<td>¾, 1, 1½, and 1½ inch heights</td>
<td>All</td>
<td>-----</td>
<td>7 ga.</td>
</tr>
<tr>
<td>JC</td>
<td></td>
<td>Joist Chair</td>
<td>4, 5, and 6 inch widths and ¾, 1, and 1½ inch heights</td>
<td>All</td>
<td>-----</td>
<td>6 ga.</td>
</tr>
<tr>
<td>HC or HPC*</td>
<td>* SAND PLATE NEED NOT BE COATED</td>
<td>Individual High Chair</td>
<td>2 inch to 15 inch heights in increments of ¼ inch.</td>
<td>2 inches to 3½ inches incl.</td>
<td>-----</td>
<td>4 ga.</td>
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<td>Over 3½ inches to 5 inches incl.</td>
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<td>Over 5 inches to 9 inches incl.</td>
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<td>Over 9 inches to 15 inches incl.</td>
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<tr>
<td>CHC</td>
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<td>Continuous High Chair</td>
<td>Same as HC in 5 ft and 10 ft lengths</td>
<td>2 inches to 3½ inches incl.</td>
<td>2 ga.</td>
<td>4 ga.</td>
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<td>Over 3½ inches to 5 inches incl.</td>
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<td>Over 5 inches to 9 inches incl.</td>
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<td>Over 9 inches to 15 inches incl.</td>
<td>2 ga.</td>
</tr>
</tbody>
</table>

Notes and Bar Supports Table, see next page.
Notes:

1. Provide top wire on continuous supports, not otherwise designated as corrugated, which may be straight or corrugated at the option of the manufacturer.

2. Provide minimum wire sizes that are American steel and wire gauges.

3. Provide adequate stability against overturning. The leg spread measured between points of support on the minor axis must be at least 70 percent of the nominal height.

4. Provide adequate stability against overturning. The leg spread measured between points of support on the minor axis must be at least 55 percent of the nominal height.

5. Provide adequate stability against overturning and adequate load capacity. The leg spread measured between points of support on the minor axis must not exceed the minimum and maximum percentages of the nominal height as shown.

<table>
<thead>
<tr>
<th>Nominal Height (inches)</th>
<th>Distance Between Supports as a Percent of Nominal Height</th>
</tr>
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<tr>
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<td>Minimum</td>
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<tr>
<td>Under 4</td>
<td>70</td>
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<tr>
<td>4</td>
<td>70</td>
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<td>6</td>
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<td>8</td>
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<tr>
<td>12</td>
<td>50</td>
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<tr>
<td>Over 12</td>
<td>50</td>
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</tbody>
</table>

END OF SECTION
SECTION 03310

STRUCTURAL CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cast-in-place concrete construction in concrete structures such as bridges, culverts, and miscellaneous structures.

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill
B. Section 02317: Structural Excavation
C. Section 02701: Pavement Smoothness
D. Section 03055: Portland Cement Concrete
E. Section 03056: Self-Consolidating Concrete - SCC
F. Section 03057: Structural Concrete - Lightweight
G. Section 03152: Concrete Joint Control
H. Section 03211: Reinforcing Steel and Welded Wire
I. Section 03390: Concrete Curing
J. Section 07105: Waterproofing Membrane
K. Section 07921: Sealing Existing Concrete Slope Protection Joints

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products
B. AASHTO M 235: Epoxy Resin Adhesives
C. AASHTO LRFD Bridge Construction Specifications Section 3 (Temporary Works)
D. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation

E. UDOT Quality Management Plans

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Working Drawings
   1. Drawings for Temporary Works.
   2. Deck Overhang Bracing for review when shown and when screed rails are supported on forms. Refer to this Section, Article 3.1, paragraph C2.
      a. Include supporting calculations.
      b. Provide the seal of a Professional Engineer or Professional Structural Engineer licensed in the State of Utah on drawings and calculations.

PART 2 PRODUCTS

2.1 CONCRETE

A. Bridge Decks and Approach Slabs:
   1. Class AA(LS). Refer to Section 03055.

B. Concrete Slope Protection:
   1. Class A(AE). Refer to Section 03055.

C. Other Structural Elements:
   1. Class AA(AE), unless described otherwise. Refer to Section 03055
   2. Self-Consolidating Concrete – SCC. Refer to Section 03056.

D. Use the following only where shown.
   1. Class AA(ES). Refer to Section 03055.
   2. Structural Concrete – Lightweight. Refer to Section 03057.
      a. Use the concrete class shown.

2.2 REINFORCING STEEL AND WELDED WIRE

A. Refer to Section 03211.

2.3 JOINT FILLER AND SEALANT

A. Preformed Joint Filler – Refer to Section 03152.
B. Silicone Joint Sealer – Refer to Section 03152.

C. Self Leveling Silicone Joint Sealer – Refer to Section 03152.

D. Joint Sealer (Structures) – Refer to Section 03152.

2.4 BACKER ROD

A. Refer to Section 03152.

B. Size the diameter of the backer rod to a minimum of ¼ inch larger than the groove in which it is placed.

2.5 WATERSTOPS

A. Refer to Section 03152.

2.6 RIGID PLASTIC FOAM

A. Preformed, extruded, cellular polystyrene thermal insulation material that has a water absorption property of 0.3 or less. Refer to ASTM C 578.

2.7 FORMS

A. Plywood, wood, metal, glass, or a combination of these materials.

B. Use mortar-tight concrete forms, true to the dimensions, lines, and grades of the structure and of sufficient rigidity to prevent objectional distortion of the formed concrete surface caused by pressure of the concrete and other loads incidental to the construction operations.

C. Discontinue using a form or forming system that produces a concrete surface with excessive undulations until modifications have been made.

1. Undulations are excessive if they exceed either ¼ inch over 10 feet or \( \frac{1}{270} \) of the center-to-center distance between studs, joints, forms, fasteners, or wales.

D. Countersink all bolt and rivet holes when using metal forms for exposed surfaces so that a plane smooth surface of the desired contour is obtained.

E. Use lumber that is free of knotholes, loose knots, cracks, splits, warps, or other defects that affect the strength or appearance of the structure.

1. Rough lumber may be used for forming surfaces if visible rough surfaces do not show on the final structure.
F. Form exposed element surfaces of a concrete structure with the same forming material or with materials that produce a concrete surface that is uniform in texture, color, and appearance.

G. Do not use stay-in-place metal deck forms unless otherwise specified.

2.8 MISCELLANEOUS STEEL ITEMS

A. Galvanize all miscellaneous steel items permanently cast into structural concrete elements. Refer to AASHTO M 111.

2.9 EPOXY ADHESIVE

A. Refer to AASHTO M 235, Type II.

2.10 WATERPROOFING MEMBRANE

A. Refer to Section 07105

PART 3 EXECUTION

3.1 PREPARATION

A. Falsework
   1. Design and construct falsework according to the AASHTO LRFD Bridge Construction Specifications, Section 3 (Temporary Works).
      a. Design falsework so that loads imposed on existing, new, or partially completed portions of structures due to construction operations do not exceed the load carrying capacity of the structure or portion of the structure.
      b. Brace and tie girders to resist forces that would cause rotation or torsion in the girders from the placing of concrete for diaphragms or decks, or show girders to be adequate for those effects.
      c. Do not weld falsework support brackets or braces to structural steel members or to reinforcing steel.
   2. Footing Construction
      a. Build falsework on a solid footing that is safe against undermining, protected from softening, and capable of supporting imposed loads.
      b. Demonstrate that the soil bearing values do not exceed the supporting capacity of the soil.
      1) Conduct load tests or have soils investigation conducted by a professional engineer licensed in the State of Utah.

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January 1, 2017
c. Use piling or drilled shafts to support falsework that cannot be founded on a solid footing.
d. Space, drive, and remove piles according to the authorized falsework drawings.

3. Construction
a. Use materials able to sustain the stresses required by the falsework design.
b. Use suitable jacks or wedges to set the forms to the grade or camber required, and to prevent settling.
c. Produce a finished structure of the specified camber and built to the lines and grades indicated.

B. Forms
1. Clean the inside surfaces of dirt, mortar, and foreign material before concrete placement.
2. Use form oil that permits the ready release of the forms and does not discolor the concrete.
3. Do not place concrete in the forms until:
a. All work connected with form construction has been completed.
b. All embedded materials have been placed.
c. All dirt, chips, sawdust, water, and other foreign materials have been removed.
d. Inspection and approval have been obtained.
4. Do not use stay-in-place deck forms unless otherwise specified.

C. Footings, Box Culverts, and Headwalls
1. Excavation and Backfill – Refer to Section 02317.
2. The Engineer may direct written changes in dimensions or elevations necessary to secure a satisfactory foundation.
3. Do not dewater by pumping during concrete placement or for 24 hours thereafter unless pumping is outside the enclosure.
4. Do not use well points to dewater footing.

D. Bridge Decks
1. Reinforcing Steel
a. Pass the screed over the area with a screed face device to measure the cover before concrete placement.
b. Relocate and tie reinforcing steel that projects above the specified level before placing the concrete.
c. Adjust and support reinforcing steel that does not meet the placement tolerances defined in Section 03211 before placing the concrete.
2. Screeds  
   a. Firmly support screed rails for bridge deck slabs to prevent movement during concrete placement.  
   b. Support the machine rails on the bridge beams when using a finishing machine.  
   c. Do not place the machine rails on the forms unless the form supports have been strengthened to prevent deflection and the Engineer gives authorization.

E. Miscellaneous Construction  
   1. Drainage and Weep Holes  
      a. Construct drainage and weep holes at locations shown or as directed.  
      b. Place ports or vents for equalizing hydrostatic pressure below low water.  
      c. Use non-corrosive materials for weep hole forms.  
      d. Paint exposed surfaces of metal drains as shown.

2. Anchor Bolts  
   a. Securely and accurately set anchor bolts in bent caps, abutments, or pedestals before the concrete is placed.  
   b. Use templates to maintain location and plumbness.

3.2 PLACE CONCRETE

A. Do not place concrete without authorization from the Engineer.

B. Do not deviate from the deck placing sequence shown without written authorization from the Engineer.

C. The Engineer may postpone placement operations if the concrete cannot be protected during adverse weather.

D. Handling concrete:  
   1. Avoid segregation of the ingredients.  
   2. Arrange chutes, troughs, or pipes used as aids in placing concrete so the concrete does not separate.  
   3. Use metal or metal-lined chutes and troughs. Do not use aluminum.  
   4. Equip chutes with baffle boards or a reversed section at the end of the outlet when placing on steep slopes.  
   5. Extend open troughs and chutes down inside the forms or through holes left in the forms. Terminate the ends in vertical downspouts.  
   6. Thoroughly flush all chutes, troughs, and pipes with water before and after each placement.
7. Do not allow the free fall of concrete to exceed 10 ft for thin walls (maximum 10 inch thickness) or 5 ft for other types of construction without the use of a tremie or a flexible metal spout.
8. Use flexible metal spout sections composed of conical sections not more than 3 ft long, with the diameter of the outlet and the taper of the various sections so the concrete fills the outlet and retards concrete flow.

E. Placing concrete:
1. Deposit concrete as close as possible to its final position without allowing it to flow laterally in the form.
2. Spread fresh concrete in horizontal layers with thickness not greater than what can be compacted with vibrators.
3. Do not use vibrators to flow concrete laterally.
4. Limit placement interruptions to 45 minutes.
5. Place and vibrate each layer before the preceding layer has taken initial set.
6. Do not place concrete in flowing water.

F. Consolidating concrete:
1. Use high frequency internal vibrators to consolidate all concrete for structures except concrete placed under water.
2. Use enough vibrators to consolidate the fresh concrete to the desired degree within 15 minutes after it is deposited in the forms.
3. Supply at least two vibrators for structures involving more than 25 yd$^3$ of concrete.
4. Do not attach vibrators to or against the forms or the reinforcing steel.
5. Do not allow vibrators to penetrate layers of concrete that have taken initial set.
6. Use spades or wedge-shaped tampers to secure a smooth and even texture of the exposed surface.

3.3 PLACE CONCRETE UNDER WATER

A. Place and deposit concrete under water as shown.
B. Seal the forms or cofferdams watertight.
C. Do not pump water while placing concrete or disturb the concrete until it has set at least 24 hours or attained at least 50 percent of the specified 28 day minimum compressive strength based on field cured cylinders.
D. Regulate placing to keep surfaces approximately horizontal at all times.
E. Place the concrete by beginning at one end of the form and progressing in a zig-zag movement from side to side across the length of the form.

F. Place the concrete using a tremie or concrete pumping equipment.

G. Placing concrete with a tremie:
   1. Use an 8 inch to 12 inch diameter steel tube tremie constructed with watertight connections, a hopper to receive concrete, and a device at the bottom to exclude water from entering the tube.
   2. Use support that permits the discharge end to move over the entire top work surface and permits the tremie to be rapidly lowered to stop or retard flow when necessary.
   3. Minimize the number of tremie location shifts for continuous placement.
   4. Keep the tremie tube full to the bottom of the hopper during placement.
   5. Slightly raise the tremie when a batch is dumped into the hopper but do not raise it out of the concrete at the bottom until the batch discharges to the bottom of the hopper.
      a. Re-plug the end and refill the tube with concrete if the concrete seal around the tube is lost.

3.4 PUMP CONCRETE

A. Use a prequalified concrete pumping contractor. Refer to UDOT Quality Management Plan 511 – Concrete Pumping.
   1. Replace pump that causes excessive or erratic loss of air entrainment.
   2. Use a pump that produces a continuous stream of concrete without air pockets.
   3. Do not add water to the concrete in the pump hopper.

B. Do not allow pump vibrations to damage freshly placed concrete.

C. Do not use concrete contaminated by priming or cleaning the pump.

3.5 LIMITATIONS

A. Light the work site so all operations are plainly visible if mixing, placing, or finishing occurs after daylight hours.

B. Keep all traffic off concrete bridges and culverts for 14 days after final concrete placement, until all concrete is fully cured, and until all concrete achieves 100 percent of the specified 28 day minimum compressive strength based on field cured cylinders.
C. Keep all traffic off bridge deck and approach slab closure pours for at least 7 days after final concrete placement, until all concrete is fully cured, and until all concrete achieves 100 percent of the specified 28 day minimum compressive strength based on field cured cylinders.

1. High-early strength concrete used in bridge deck and approach slab closure pours may be opened to traffic at least 3 days after final concrete placement and after concrete achieves 100 percent of the specified 28 day minimum compressive strength based on field cured cylinders.

3.6 **CONSTRUCTION JOINTS**

A. Make construction joints where shown.

B. Obtain Engineer’s authorization when additional construction joints are desired and meet the following requirements:

1. Place and construct without impairing strength and appearance.
2. Place in planes perpendicular to the principal lines of stress and at points of minimum shear.
3. Make monolithic structures by extending the reinforcing across the joint.
4. Avoid construction joints through paneled wing walls or large surfaces that are to be treated architecturally.
5. Make a straight line joint across the face of the pour for the full width of the bridge deck.
6. Leave a rough surface to increase the bond with the concrete placed later.
7. Form tapered sections with an insert so that the succeeding layer of concrete ends in a section at least 6 inches thick.
8. Place a bulkhead from the surface to the top mat of steel to establish a straight vertical face. Shape the concrete below the top steel to a near vertical face in line with the bulkhead.
9. Establish a straight vertical face by saw cutting to a minimum depth of 1 inch when a bulkhead cannot be placed.
   a. Shape the concrete below the saw cut to a near vertical face.

C. Meet the following before resuming concrete placement:

1. Re-tighten forms.
2. Roughen the surface of hardened concrete without leaving loosened particles or damaged concrete.
3. Clean off concrete surface of foreign matter and laitance by sandblasting.
4. Saturate concrete surface with water.
5. Apply epoxy adhesive to face of construction joints.
3.7 CONCRETE SURFACE FINISHING CLASSIFICATIONS

A. Ordinary Surface Finish – A true and uniform finished surface.

B. Rubbed Finish – A surface smooth in texture and uniform in appearance free of form marks and irregularities.

C. Wire Brush or Scrubbed Finish
   1. A finished surface with the cement surface film completely removed and the aggregate particles exposed leaving an even-pebbled texture.
   2. An appearance ranging from fine granite to coarse conglomerate depends on the size and grading of the aggregate used.

D. Floated Surface Finish
   1. Flat work – Strike off and use a floated surface finish.
   2. Bridge decks and approach slabs – machine finish unless otherwise permitted.

3.8 CONCRETE SURFACE FINISHING

A. Give all formed concrete surfaces at least an ordinary surface finish except as specified otherwise.

B. Use other types of finishes as required in addition to the ordinary surface finish.

C. Provide a rubbed finish for repaired surfaces that cannot meet ordinary surface finish requirements due to irregularities, honeycombing, excessive surface voids, discoloration, and other defects.

3.9 CONCRETE SURFACE FINISHING PROCEDURES

A. Ordinary Surface Finish
   1. Remove all fins and projections after removing forms.
      a. Clean, point, and true all honeycomb spots, broken corners or edges, cavities made by form ties, and other holes and defects.
      b. Keep all areas to receive mortar saturated with water for at least 30 minutes before mortar placement.
   2. Use a mortar of cement and fine aggregate for pointing, not more than one hour old, mixed in the proportions used in the grade of concrete being finished.
   3. Cure the mortar patches and rub to blend with surrounding concrete.
4. Tool and free all joints of mortar and concrete.
   a. Leave the full length of the joint filler exposed with clean and true edges.

B. Rubbed Finish
   1. Wet the concrete surface as soon after form removal as conditions permit, paint with grout, and rub with a wooden float until the surface is covered with a lather of cement and water.
      a. A thin grout of one part cement, one part fine sand may be used in the rubbing.
      b. Let this lather set for at least three days then rub lightly with a fine carborundum stone until smooth.
   2. Use a mechanically operated carborundum stone to finish the surface of hardened concrete at least four days after placing.
      a. Finish in the same manner as ordinary surface finish.
         1) Let the lather set for at least 7 days before lightly rubbing with a fine carborundum stone until smooth.
   3. Commercial grade rubbing mortar may be used if authorized by Engineer.

C. Wire Brush or Scrubbed Finish
   1. Scrub the surface with stiff wire or fiber brushes using a solution of muriatic acid – one part acid, four parts water as soon as forms are removed and while the concrete is relatively green.
   2. Wash the entire surface once the scrubbing produces the desired texture.
      a. Use water mixed with 5 percent by volume ammonium hydroxide to remove all traces of the acid.

D. Floated surface finish on flat work other than bridge decks and approach slabs:
   1. Striking Off
      a. Carefully rod and strike off the surface with a strike board following the cross sections and grades shown after compaction.
      b. Allow for camber as required.
      c. Operate the strike board longitudinally or transversely and move it forward with a combined longitudinal and transverse motion so that neither end is raised from the side forms during the process.
      d. Keep a slight excess of concrete in front of the cutting edge at all times.
   2. Floating
      a. Use longitudinal or transverse floating or both to create a uniform surface.
b. Longitudinal floating is required except in places where it is not feasible.

3. Longitudinal Floating
   a. Work the longitudinal float operated from foot bridges with a sawing motion while holding it parallel to the road centerline.
   b. Pass gradually from one side of the pavement to the other.
      1) Move the float forward ½ of its length and repeat operation.
   c. Substitute machine floating if equivalent results are produced.

4. Transverse Floating
   a. Operate the transverse float across the concrete surface by starting at the edge and slowly moving to the center and back again to the edge.
      1) Move the float forward ½ of its length and repeat the operation.
   b. Preserve the crown and cross section of the concrete surface.

5. Straightedging
   a. Test the concrete surface for trueness with a straightedge after the longitudinal floating has been completed and the excess water has been removed while the concrete is still plastic.
   b. Furnish and use an accurate 10 ft straightedge held parallel to the road centerline in contact with the surface.
   c. Check the entire area immediately filling depressions with freshly mixed concrete, then strike off, consolidate, and refinish.
   d. Cut down and refinish high areas.
   e. Continue the straightedge testing and re-floating until the concrete surface is at the required grade and contour.

E. Floated Surface Finish for Bridge Decks and Approach Slabs
    1. Machine finish exposed surfaces unless otherwise permitted.
    2. Finish concrete by striking off and floating the surface.
    3. Allow the Engineer enough time to inspect finishing machines during daylight hours before concrete placement.
    4. Provide lighting facilities that adequately light the work area when placing and finishing operations are not completed during daylight hours.
    5. Extend finishing machine rails beyond both ends of the scheduled placement and allow sufficient distance to permit the float to fully clear the concrete.
6. Use adjustable rails set to provide the finished grade elevations shown, installed to prevent springing or deflection under the weight of the finishing equipment, and placed to operate without interruption over the entire surface being finished.

7. Place screed machine parallel to the abutments and bents within 10 degrees.

8. Support screed rails to prevent movement during placing of the concrete.

9. Attach a measuring device to the screed face and pass it over the area.

10. Place concrete in a uniform heading approximately parallel to the screed machine.

11. Limit the rate of placing to allow enough time to finish the surface before initial set.

12. Continuously place concrete the full length of the structure or superstructure unit unless otherwise shown or authorized.

13. Provide sufficient material, equipment, and manpower to place deck concrete at a rate of at least 25 yd³/hour.

14. Strike off the surface to the required elevations with the finishing machine immediately after placing and consolidating the concrete.

15. Do not add water to the concrete in front of or behind the screed.

16. Obtain authorization for the strike-off method and equipment.
   b. Use equipment capable of finishing concrete within the surface tolerances specified.
   c. Maintain satisfactory consolidation and surface tolerance to prevent shutdown and rejection of the equipment.

17. Furnish a 10 ft straightedge to check the surface tolerance, placed both longitudinally and transversely, immediately behind the screed machine and hand-finished areas.

18. Correct irregularities greater than \( \frac{1}{8} \) inch from the straightedge, before additional placement, and immediately fill depressions with concrete and refinish.

19. Cut down and refinish high areas.

20. Continue straightedge testing and corrective measures until the entire surface is free of observable departures from the straightedge.

F. Final texturing for bridge decks and approach slabs – a textured hardened finish:

1. Use a texture process that produces regular \( \frac{1}{6} \) inch wide transverse grooves spaced randomly from \( \frac{1}{2} \) inch to \( \frac{3}{4} \) inch on centers and \( \frac{1}{6} \) inch deep.

2. Keep the finished surface free from porous spots and surface irregularities.
3. Furnish a work bridge that follows the finishing machine to facilitate texturing and application of the curing compound.
4. Check the surface smoothness for acceptance after the concrete has hardened.
5. Remove irregularities by grinding if the surface deviates more than \( \frac{1}{8} \) inch from a 10 ft straightedge. Refer to Section 02701.
   a. Depth of grinding must be authorized by the Engineer before any grinding operations begin.

3.10 CONCRETE CURING

A. Refer to Section 03390.

3.11 FORM REMOVAL

A. Obtain authorization from the Engineer before removing forms.

B. Remove struts, stays, and braces that hold the forms in correct shape and alignment when no longer necessary.

C. Remove all forms from the concrete surfaces.
   1. Do not use a method of form removal likely to cause overstressing of the concrete.

D. Remove supports to permit the concrete to uniformly and gradually take the stresses due to its own weight.

E. Do not remove forms used in ornamental work, railings, parapets, and exposed vertical surfaces for at least twelve hours after placement.

F. Always remove forms before removing shoring from beneath beams and girders to determine the condition of columns.

G. Removing Falsework
   1. Do not remove falsework supporting the deck of rigid frame structures until the fill has been placed in back of the vertical legs.
   2. Keep falsework and forms in place under slabs, beams, and girders for 14 days after the day of last concrete placement.
      a. Slab forms with a clear space of less than 10 ft may be removed after seven days.
   3. Keep forms and falsework in place in cold weather according to the authorized cold weather concreting plan.
H. Patch formed surfaces within 24 hours after form removal.
1. Cut back and remove all projecting wire or metal devices used for holding the forms in place and that pass through the body of the concrete at least 1 inch beneath the surface of the concrete.
2. Remove lips of mortar and irregularities caused by form joints.
3. Fill small holes, depressions, and voids with cement mortar mixed in the same proportions as that used in the body of the work.
4. Obtain a solid uniform surface by chipping away coarse or broken material to patch larger holes or honeycombs.
   a. Cut away feathered edges to form faces perpendicular to the surface.
   b. Apply epoxy adhesive to patch area according to manufacturer’s recommendations.
   c. Fill the cavity with stiff mortar composed of one part portland cement to two parts sand thoroughly tamped into place.
   d. Pre-shrink the mortar by mixing it approximately 20 minutes.
      1) Vary the time according to manufacturer’s recommendations, temperature, humidity, and other local conditions.
   e. Float the surface of this mortar with a wooden float before initial set.
   f. Keep the patch wet for five days.
   g. Rub patches on exposed surfaces to blend them with surrounding concrete after curing.
   h. Add coarse aggregate to the patching material when patching large or deep areas.
   i. Make a dense, well-bonded, and properly cured patch.

I. Areas with extensive honeycombing will be rejected.

J. Apply the following requirements after fully removing all the closure joint forms if inserts are placed along the bottom edges of the precast concrete deck panels to form the closure pour joints:
1. Cut off cast-in-place anchors at least 1 inch below the face of slab and repair according to this Section, Article 3.12, paragraph H.
2. Fill all voids with dry-pack mortar flush with the bottom of slab.
3. Fill voids created by the removal of re-usable concrete anchors with dry-pack mortar flush with the bottom of slab.
4. Dry-pack mortar will be composed of one part portland cement to two parts sand.

Implementation 01-09-2017
3.12 SUPERSTRUCTURE

A. Deck – Do not place parapet forms or parapet for at least seven days after deck placement and until the deck has attained the specified 28 day minimum compressive strength based on field cured cylinders, or leave all falsework in place and design it to carry all additional loads that are part of the parapet placement process.
   1. Do not allow the installation of the parapet and parapet forms to interrupt the curing of the deck and approach slabs when installed before curing is complete.

B. Slab Span – Place concrete in one continuous operation.

C. Cast-In-Place T-Beams
   1. Place concrete in one or two continuous operations – first to the top of the girder stems and second to completion, unless otherwise shown.
   2. Obtain a bond between the stem and slab that is positive and mechanical and secured by means of shear keys or roughened surface in the top of the girder stem.

D. Do not place the approach slab until the sleeper slab concrete has been in place at least seven days or has attained 75 percent of the specified 28 day compressive strength based on field cured cylinders.

3.13 SUBSTRUCTURE

A. Concrete in Columns and Bent Stems
   1. Allow footing concrete to set until it has attained 75 percent of the specified 28 day minimum compressive strength based on field cured cylinders before placing column forms when column is being placed on a footing.
   2. Place concrete in one continuous operation.
   3. Allow concrete to set at least two days and until it has attained 75 percent of the specified 28 day minimum compressive strength based on field cured cylinders before placing caps.
   4. Do not place concrete in the superstructure until the columns have been stripped and authorized.

B. Substructure Concrete
   1. Do not place the superstructure load on the bents or abutments until they have been in place at least seven days and attained 75 percent of the specified 28 day minimum compressive strength based on field cured cylinders.
C. Do not backfill abutments, wingwalls, and retaining walls until all concrete has been in place at least 7 days and has attained 100 percent of the specified 28 day minimum compressive strength based on field cured cylinders.
   1. Do not interfere with curing.

3.14 BOX CULVERTS

A. Allow base slab and footing to attain 75 percent of the specified 28 day minimum compressive strength based upon field cured cylinders before constructing the remainder of the culvert.

B. Construct side walls and top slab monolithically unless the wall height exceeds 10 ft.
   1. Keep the construction joints vertical and at right angles to the axis of the culvert.

C. Construct shear keys in the top of the side walls for anchoring the top slab when side walls and top slab are not placed monolithically.

D. Construct wingwalls monolithically.

E. Do not backfill until the concrete has been in place at least 7 days and has attained 100 percent of the specified 28 day minimum compressive strength based on field cured cylinders.

F. Apply a waterproofing membrane to the top slab and side walls of all concrete box culverts for the full length of the structures.

3.15 HEADWALLS

A. Allow apron and pipe collar to attain 75 percent of the specified 28 day minimum compressive strength based on field cured cylinders before the remainder of the headwall is constructed.

B. Construct wingwalls monolithically.

C. Do not backfill headwalls and wingwalls until all concrete has been in place at least 7 days and has attained 100 percent of the specified 28 day minimum compressive strength based on field cured cylinders.

3.16 CONCRETE SLOPE PROTECTION

A. Preparing Subgrade
   1. Prepare the area to be paved by smoothing and shaping the berms and slopes and excavating for the cut-off walls.
2. Fill and compact subgrade – Refer to Section 02056.
   a. Furnish extra material to properly finish the slopes when required.
   b. Compact all soft and yielding material resulting in a firm and substantial subgrade of uniform density.
3. Thoroughly spray the area with water before placing the concrete.
4. Obtain the Engineer's authorization for all surfaces before placing concrete.

B. Placing Concrete
1. Do not place concrete upon spongy, frozen, or unstable surfaces.
2. Provide concrete of a consistency that it can be placed on the slopes without deformation.
3. Complete all horizontal grooves and vertical joints as shown.
4. Complete the entire slope protection in one placement if possible or terminate the placement with a construction joint located in the horizontal grooves or vertical joints.
5. Finish concrete using a Floated Surface Finish according to this Section, Article 3.10.

C. Seal Joints and Closures – Refer to 07921.

3.17 RETAINING WALLS

A. Allow footing concrete to set until it has attained 75 percent of its specified 28 day minimum compressive strength based on field cured cylinders before placing wall forms.

B. Do not backfill walls until all concrete has been in place at least 7 days and has attained 100 percent of the specified 28 day minimum compressive strength based on field cured cylinders.

3.18 MISCELLANEOUS CONSTRUCTION

A. Bearing Areas
1. Finish bridge seat bearing areas high and rub or grind to grade level within an allowable tolerance of ±1/16 inch and within a tolerance of ± ¼ inch of the elevation shown.
2. Do not grout under bearing plates.

3.19 CLEANUP

A. Remove falsework and falsework piling to 2 ft below the finished ground line, rubbish, and temporary building materials before final inspection.

END OF SECTION
SECTION 03311
BRIDGE DECK JOINT CLOSURE

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Removal and closure of expansion joints in existing bridge decks and parapets.

1.2  RELATED SECTIONS

A. Section 03055: Portland Cement Concrete
B. Section 03152: Concrete Joint Control
C. Section 03211: Reinforcing Steel and Welded Wire
D. Section 03310: Structural Concrete
E. Section 03390: Concrete Curing

1.3  REFERENCES

A. ASTM A 653: Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
B. ASTM C 307: Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings
C. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation
D. ASTM C 579: Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
E. ASTM C 1339: Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts

1.4  DEFINITIONS  Not Used

1.5  SUBMITTALS

A. Manufacturer’s product data sheets and recommended installation instructions.

Implementation 01-09-2017
PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete
   1. Deck Concrete
      a. Class AA(LS) according to Section 03055.
   2. Other concrete
      b. Class AA(AE) according to Section 03055.
   3. Do not use high early strength concrete, except as shown.

B. Reinforcing Steel
   1. Coated reinforcing steel according to Section 03211.

C. Doweled Anchors
   1. Coated doweled anchors according to Section 03211.

D. Galvanized Sheet Metal
   1. 16 gauge according to ASTM A 653.

E. Rigid Plastic Foam – Type 9 according to ASTM C 578.

F. Epoxy Grout
   1. Provide a minimum compressive strength of 3,000 psi in 24 hours and 5,000 psi in 28 days according to ASTM C 579.
   2. Provide a minimum tensile strength of 2,000 psi according to ASTM C 307.
   3. Provide an effective bearing area of 95% according to ASTM C 1339.

G. Joint Sealer (Structures) – Refer to Section 03152.

H. Backer Rod – Refer to Section 03152.

PART 3 EXECUTION

3.1 PREPARATION

A. Debris Containment
   1. Prevent debris from falling into streams and onto pedestrian areas, traffic areas, and railroad tracks.
3.2 REMOVE CONCRETE

A. Concrete Saw Cuts
   1. Saw cut concrete surface 1 inch deep along perimeter of concrete removal area.

B. Use jackhammer method to remove existing concrete.
   1. Removal of Concrete Slab – Use 90 pound class hand-operated jack hammers or smaller.
      a. Use 45 pound class hand-operated jack hammer or smaller when removing concrete within 6 inches of girders and diaphragms that are to remain.
   2. Operate jack hammers at an angle greater than 45 degrees as measured from the deck surface.

C. Remove existing joint armor steel and existing joint materials.

D. Protect existing electrical conduit from damage where encountered.

E. Remove loose or fractured concrete.

F. Clean existing concrete and steel surfaces.

3.3 REINFORCING STEEL

A. Existing Reinforcing Steel
   1. Thoroughly clean reinforcing steel that will remain in place of corrosion and adhering materials by sandblasting.
   2. Remove and replace any reinforcing steel with 25 percent or greater section loss.
      a. Cut and remove deteriorated existing reinforcing steel bars.
      b. Match the size of the new reinforcing steel bar to the existing bar.
      c. Provide lap lengths as shown.

B. New Reinforcing Steel and Doweled Anchors
   1. Place reinforcing steel after sandblasting operations are complete.
3.4 PLACE CONCRETE

A. Use epoxy grout to create a smooth, flat, uniform surface on concrete girders and diaphragms as shown.
   1. Cure according to manufacturer’s installation instructions.

B. Saturate existing concrete surfaces with water before placing concrete.

C. Form, place, and finish concrete according to Section 03310.

D. Cure concrete according to the requirements for cast-in-place concrete closure pours in bridge decks and approach slabs in Section 03390.

END OF SECTION
SECTION 03372
THIN BONDED POLYMER OVERLAY

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Thin bonded polymer overlay system applied to concrete bridge decks and approach slabs.

B. Removal of existing polymer overlay from concrete bridge decks and approach slabs.

C. Repair of damaged areas of a polymer overlay system.

1.2  RELATED SECTIONS  Not Used

1.3  REFERENCES

A. ASTM C 25: Chemical Analysis of Limestone, Quicklime, and Hydrated Lime

B. ASTM C 88: Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

C. ASTM C 131: Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

D. ASTM C 566: Total Evaporable Moisture Content of Aggregate by Drying

E. ASTM C 579: Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

F. ASTM C 881: Epoxy-Resin-Base Bonding Systems for Concrete

G. ASTM D 570: Water Absorption of Plastics

H. ASTM D 638: Tensile Properties of Plastics

I. ASTM D 790: Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

J. ASTM D 2240: Rubber Property – Durometer Hardness
K. ASTM D 4285: Indicating Oil or Water in Compressed Air
L. ASTM D 4580: Measuring Delaminations in Concrete Bridge Decks by Sounding
M. ASTM D 5821: Determining the Percentage of Fractured Particles in Coarse Aggregate
N. ASTM D 6928: Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
O. ASTM E 274: Skid Resistance of Paved Surfaces Using a Full-Scale Tire
P. American Concrete Institute (ACI)
Q. International Concrete Repair Institute (ICRI)

1.4 DEFINITIONS

A. Polymer Overlay System – A thin bonded polymer overlay applied as a wearing surface consisting of a two-part polymer resin broadcasted with aggregate to refusal before it cures.

B. Installer – The entity preparing the surface and installing and finishing the polymer overlay system.

C. Provider – The manufacturer furnishing the polymer overlay system.

1.5 SUBMITTALS

A. Provider Qualifications for review at least 10 calendar days before ordering material.
   1. Include at least the following:
      a. Company name.
      b. Name and phone number of the Provider’s Technical Support Representative.
      c. List of projects using the submitted products with at least two years of satisfactory performance under similar environmental conditions as the project in which it is to be applied. Refer to this Section, Article 1.6 B. List the following for each project:
         1) Project name
         2) Bridge locations (state routes and bridge identifiers)
         3) Scope of work
         4) Products used
         5) Approximate date of the system opening to traffic.

Thin Bonded Polymer Overlay
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January 1, 2017
B. Materials

1. The following information at least 10 calendar days before ordering material:
   a. Manufacturer’s Product Data Sheets and recommended installation instructions.
   b. Material Safety Data Sheets.
   c. The Provider’s certification stating that the provider is the sole provider of the components of the polymer overlay system and that the components are:
      1) In accordance with this Section.
      2) Fully compatible with one another.
   d. The Installer’s certification with the Provider’s written concurrence that the polymer overlay system is fully compatible with all deck repair materials.

2. Certified test report from an independent nationally recognized laboratory stating that the polymer resins in the polymer overlay system components meet the requirements in this Section.
   a. Test results must be from within a three year period of the submittal.

3. Certified Test Report from an AASHTO accredited testing laboratory confirming the compliance of the aggregate material with the test requirements of this Section.
   a. Test results must be from within a one year period of the submittal.

C. Method for mixing of the polymer resins

1. The Provider’s written concurrence that the selected mixing method is acceptable and compatible with the polymer overlay system.
   2. Mixing ratio of the polymer resins.

D. A warranty letter to the Engineer and the Department Bridge Management Engineer stating that the Contractor guarantees the polymer overlay system against material and installation defects incurred under traffic for a period of 5 years.

1. The guarantee period starts on the date of Physical Completion.
   2. Include in the letter:
      a. State Project Designation
      b. State Project Name
      c. State Structure Numbers
      d. Contractor, Provider, and Installer Name

3. Defects (performance failures) include:
   a. Spalling: Broken or missing pieces of polymer overlay system.
   b. Scaling: Visible, exposed, rough surface texture resulting from a loss of aggregate or resin.
c. Delamination: Visible or audible debonding of the polymer overlay system at the bond line (interface) with the existing bridge receiving surface.
d. Cracking: Visible cracks not reflected from a crack in the existing deck.
e. Loss of skid resistance: Skid resistance less than 40 as measured according to ASTM E 274.

4. The guarantee covers 100 percent of the polymer overlay system materials and installation costs.

5. Removal and replacement of the polymer overlay system for failed sections.

6. The Department will notify the Contractor of defects to be repaired during the guarantee period.
   a. Submit detailed plans and procedures of corrective work according to Provider’s recommendations and obtain the Department’s authorization before commencing work.
   b. Perform corrective work within 60 days of notification.

1.6 QUALITY CONTROL

A. Technical Support Representative
   1. Provide a Technical Support Representative from the Provider onsite during surface preparation and application of the polymer overlay system on the first day the polymer overlay system is installed on a structure.
      a. The Technical Support Representative must have a minimum of 3 years of experience with the system and with guiding and assisting installers in the polymer overlay system installation.
      b. The Technical Support Representative will instruct the workers in proper mixing, application technique, safety precautions, traffic opening time, and environmental requirements.
      c. The Technical Support Representative must be available for consultation but not necessarily present at the job site for the remaining work.
   2. The Department reserves the right to require the Technical Support Representative to be onsite if at any time the Engineer is concerned with the product installation quality.

B. Prior Performance
   1. The selected polymer overlay system must have at least two years of satisfactory performance for non-interstate use and four years of satisfactory performance for interstate use in similar environmental conditions as the project in which it will be applied.
2. Products without the required years of prior satisfactory performance will only be considered for use with approval.
   a. Do not use for bidding purposes.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Polymer Resin
   1. Identify the containers as Part A and Part B and plainly mark with:
      a. Manufacturer’s name
      b. Manufacturer’s address
      c. Name of the product
      d. Mixing proportions and instructions
      e. Lot and batch numbers
      f. Date of manufacture
      g. Quantity
   2. Transport to and store on the job site in a dry, weather protected environment away from moisture, and within the maintained temperature range of 60 to 100 degrees F and according to Provider’s recommended installation instructions.

B. Broadcast Aggregate
   1. Store aggregate in a clean, dry location, protected from rain and other moisture sources.
   2. Protect the aggregate from contaminants on the job site.

C. Handling Liquid Materials
   1. Use protective gloves, clothing, boots, and goggles when directly exposed to the material.
   2. Provide manufacturer’s safety data sheets to workers and inspectors.

PART 2 PRODUCTS

2.1 POLYMER OVERLAY SYSTEM

A. Use a thin bonded polymer overlay system that chemically cures to provide an impervious wearing surface consisting of the following:
   1. Penetrating Crack Filler
   2. Polymer Resin
   3. Broadcast Aggregate

B. Penetrating Crack Filler
   1. Provide a penetrating crack filler as required by the Provider.
C. Polymer Resin
1. Two-part Epoxy-Urethane Co-Polymer (Type 1) that meets the requirements of Table 1.
2. Free of fillers, volatile solvents, and external/conventional flexibilizers.

Table 1

<table>
<thead>
<tr>
<th>PHYSICAL PROPERTIES OF THE CURED POLYMER RESIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property</td>
</tr>
<tr>
<td>Compressive Strength, min. psi</td>
</tr>
<tr>
<td>Tensile Strength, min. psi</td>
</tr>
<tr>
<td>Tensile Elongation, min. percent</td>
</tr>
<tr>
<td>Water Absorption, max. percent by wt.</td>
</tr>
<tr>
<td>Shore D Hardness, min. 77°F</td>
</tr>
<tr>
<td>Gel Time, minutes</td>
</tr>
<tr>
<td>Adhesion to Concrete</td>
</tr>
<tr>
<td>Flexural Yield Strength, min. psi</td>
</tr>
<tr>
<td>Percent Solids</td>
</tr>
</tbody>
</table>

D. Broadcast Aggregate
1. Thoroughly washed and kiln dried to maximum moisture content of 0.2 percent by weight according to ASTM C 566.
2. Use aggregate with the properties shown in Table 2 with aggregate gradation according to the requirements in Table 3, or use aggregate with the properties shown in Table 4 with aggregate gradation according to the requirements in Table 5.

Table 2

<table>
<thead>
<tr>
<th>BASALT OR FLINT AGGREGATE PROPERTIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soundness, ASTM C 88</td>
</tr>
<tr>
<td>LA Abrasion, Grade D, ASTM C 131</td>
</tr>
<tr>
<td>Micro Deval Abrasion, ASTM D 6926</td>
</tr>
<tr>
<td>Mohs Scale Hardness</td>
</tr>
</tbody>
</table>
Table 3

<table>
<thead>
<tr>
<th>BASALT OR FLINT AGGREGATE GRADATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sieve Size</strong></td>
</tr>
<tr>
<td>0.187 inch; No.4</td>
</tr>
<tr>
<td>0.078 inch; No.10*</td>
</tr>
<tr>
<td>0.033 inch; No.20</td>
</tr>
</tbody>
</table>

* 100 percent of the aggregate has at least one mechanically fractured face for materials being retained on the #10 sieve according to ASTM D 5821.

Table 4

<table>
<thead>
<tr>
<th>CALCINATED BAUXITE AGGREGATE PROPERTIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soundness, ASTM C 88</strong></td>
</tr>
<tr>
<td><strong>LA Abrasion, Grade D, ASTM C 131</strong></td>
</tr>
<tr>
<td><strong>Micro Deval Abrasion, ASTM D 6928</strong></td>
</tr>
<tr>
<td><strong>Mohs Scale Hardness</strong></td>
</tr>
<tr>
<td><strong>Aluminum Oxide, ASTM C 25</strong></td>
</tr>
</tbody>
</table>

Table 5

<table>
<thead>
<tr>
<th>CALCINATED BAUXITE AGGREGATE GRADATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sieve Size</strong></td>
</tr>
<tr>
<td>0.187 inch; No.4</td>
</tr>
<tr>
<td>0.132 inch; No.6</td>
</tr>
<tr>
<td>0.046 inch; No.16*</td>
</tr>
</tbody>
</table>

* 100 percent of the aggregate has at least one mechanically fractured face for materials being retained on the #16 sieve according to ASTM D 5821.

2.2 EQUIPMENT

A. Polymer Overlay Removal
   1. Use a diamond tipped grinder or approved method to remove an existing polymer overlay system from the deck.

B. Metered Mixing
   1. Use equipment capable of metering, mixing, and distributing the polymer resin.
      a. Use equipment that features positive displacement volumetric metering pumps controlled by a hydraulic power unit.
      b. Use motionless, in-line mixing.
   2. Use equipment that is approved by the Provider.
C. Hand Mixing
   1. Use equipment that is approved by the Provider.

D. Broadcasting Aggregate
   1. Use mechanical equipment capable of dispensing the aggregate onto the deck in a uniform manner as required by the Provider.

PART 3 EXECUTION

3.1 POLYMER OVERLAY REMOVAL

A. Remove the existing polymer overlay as shown or as required by the Engineer.
   1. Do not damage concrete deck when removing polymer overlay.

3.2 SURFACE PREPARATION

A. Surface Defects
   1. Repair deck surface defects before installing the polymer overlay system.
      a. Use a concrete repair material that meets Provider’s recommendations and is compatible with the polymer overlay system being used.
      b. Use concrete repair materials free of magnesium phosphate.

B. Shot-Blasting
   1. Clean the entire concrete deck surface with steel shot blast to remove oil, dirt, rubber, and other materials that may be detrimental to the polymer overlay bonding and curing according to the Provider’s recommendations.
      a. Use sandblasting equipment or mechanical grinders only in areas that cannot be reached with steel shot-blasting.
         1) Sandblast or grind before shot-blasting. Refer to ASTM D 4285.
      2. Produce a surface relief that meets the International Concrete Repair Institute (ICRI) Surface Preparation CSP 5-7.

C. Traffic
   1. Do not allow traffic on the deck that has been shot-blasted.
   2. Only allow the polymer overlay system equipment on cleaned surfaces.
3.3 APPLICATION

A. Concrete Surface
1. Complete deck repairs and surface preparation before applying the polymer overlay system.
2. Clean the concrete surface and apply a penetrating crack filler as required by the Provider.
3. Do not apply the polymer overlay system when it has rained within 24 hours or is expected to rain within 8 hours of application.
4. Verify the moisture content in the concrete substrate does not exceed 4.0 percent when measured by an electronic meter.
5. Apply the polymer overlay system only when the deck and ambient air temperature is a minimum 50 degrees F and rising.
6. Verify that treated surfaces are dry at the time of second application.

B. Mixing
1. Measure and mix the polymer resin components as recommended by the Provider.
a. Maintain mix ratios according to the Provider's recommendations.
2. Mix polymer resin immediately before dispensing.
3. Verify the mix ratio by volumetric sampling at the beginning of the application, mid operation, and at the end of the application of each layer.
a. Use containers with graduated markings with not less than 5 gallon capacity.
b. Remove the static mixer and dispense each component into separate containers.
   1) Dispense at least five gallons of the primary component for ratio comparison.
   2) Uncontaminated samples may be returned to the reservoirs they were originally dispensed from.
c. The Engineer or Technical Support Representative may request additional sampling.

C. First and Second Layers of Overlay
1. Evenly distribute the polymer resin on the clean, dry deck surface at the rate recommended by the Provider.
a. Use new notched squeegees, $\frac{3}{16}$ inch minimum, on the first lift of every application to verify sufficient thickness of the overlay.

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D. Overlay Thickness
1. Provide the number of layers and application rates of the liquid in each layer according to the Provider’s recommendations.
2. Provide a total overlay thickness of at least 3/8 inch.

E. Time Limits for Broadcast Aggregate
1. Use the following maximum time allowed after application of liquid before broadcasting the aggregate in Table 6 unless directed otherwise by the Provider.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Maximum Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above 90°F</td>
<td>10 minutes</td>
</tr>
<tr>
<td>80°F to 90°F</td>
<td>15 minutes</td>
</tr>
<tr>
<td>70°F to 80°F</td>
<td>20 minutes</td>
</tr>
<tr>
<td>60°F to 70°F</td>
<td>25 minutes</td>
</tr>
<tr>
<td>50°F to 60°F</td>
<td>35 minutes</td>
</tr>
</tbody>
</table>

F. Broadcasting Aggregate
1. Broadcast the aggregate before the polymer begins to gel.
   a. Cover the surface until no wet spots remain.
2. Drop the aggregate vertically so the level of the liquid is not disturbed.

G. Remove Excess Aggregate
1. Completely remove excess and loose aggregate after the overlay has hardened by vacuum or with compressed air before applying subsequent layers according to the Providers recommendations. Refer to ASTM D 4285.
2. Aggregate may be reused for subsequent lifts if it is removed directly into containers, screened to required gradation, and stored free of contaminants.

H. Longitudinal Joints in the Overlay
1. Stagger and overlap joints between successive layers 6 to 12 inches so that no ridges appear between two adjacent lanes.
2. Maintain straight construction joints between adjacent placements and lifts.

I. Traffic
1. Do not allow vehicles on the polymer overlay while it is curing.
2. Allow traffic on the final layer or in between layers after the resin has cured, as determined by the Provider, and after removal of excess and loose aggregate.
   a. Brush blast the surface with shot blast according to the Provider’s recommendations before applying additional layers when traffic has been allowed on the cured surface between layers.

J. Work performed contrary to the Technical Support Representatives instructions will be deemed nonconforming.

3.4 LIMITATIONS

A. New Bridge Decks and Approach Slabs
   1. Cure newly placed concrete for at least 28 calendar days before beginning installation of polymer overlay system.

B. Bridges constructed offline and moved into their final location by self-propelled modular transporters (SPMT)
   1. Apply the polymer overlay system no sooner than 30 calendar days after setting the bridge in its final location.

C. Prevent material and debris from falling into streams, pedestrian areas, live traffic, or railroad tracks.

3.5 POLYMER OVERLAY REPAIR

A. Locate and mark visible polymer overlay repair areas as shown and in the presence of the Engineer.
   1. Sound the polymer overlay around repair area for delamination of the polymer overlay to determine repair limits.
   2. Square off the edges of polymer overlay system repair area six inches beyond the determined limits and parallel to the travel lane.
   3. Saw cut the perimeter of polymer overlay system repair area with a ½ inch deep saw cut.

B. Remove existing polymer overlay within the repair area according to this Section, Article 3.1.
   1. Sound the concrete deck in the repair area for delamination of the concrete deck to determine the need for structural pothole patching. Refer to ASTM D 4580.
C. Prepare the deck surface within the repair area according to this Section, Article 3.2.
   1. Do not substitute sandblasting or mechanical grinding where shot blasting is required.

D. Apply the polymer overlay system within the repair area according to this Section.

END OF SECTION
SECTION 03390

CONCRETE CURING

PART 1    GENERAL

1.1   SECTION INCLUDES

A. Concrete curing materials and methods.

B. This section does not apply to cast-in-place Portland Cement Concrete Pavement and Lean Concrete Base Course.

C. This section does not apply to dry cast precast concrete members, except for precast concrete box and three-sided culvert structures.

1.2   RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 03310: Structural Concrete

1.3   REFERENCES

A. ASTM C 309: Liquid Membrane-Forming Compounds for Curing Concrete

B. ASTM C 1315: Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

C. UDOT Quality Management Plans

1.4   DEFINITIONS    Not Used

1.5   SUBMITTALS

A. Manufacturer’s product data sheets and recommended installation instructions.
PART 2 PRODUCTS

2.1 CURING COMPOUND

A. Refer to this Section, Part 3, Tables 1 and 2.

B. Limit Volatile Organic Compounds (VOC) content to 350 grams / liter maximum.

PART 3 EXECUTION

3.1 CURING MEASURES

A. Prevent drying of exposed concrete surfaces after placing concrete and until applying the selected curing method.
   1. Keep exposed concrete surfaces moist by fogging if the surfaces begin to dry before the selected curing method can be applied.

B. Cure newly placed concrete to prevent loss of water by one or more of the following methods according to this Section.
   1. Forms-in-Place Method (FIPM)
      a. Cure formed surfaces of concrete by retaining the forms in place without loosening for the specified curing period.
      b. Complete the cure using one of the methods specified for the element when forms are removed before completing the specified curing period.
   2. Water Method (WM)
      a. Keep concrete surfaces continuously wet by ponding, spraying, or covering with materials that are continuously and thoroughly wet.
         1) Acceptable materials for covering concrete surfaces include cotton mats, multiple layers of burlap, or other materials that retain water.
         2) Secure the cover materials to prevent wind or other forces from removing them.
         3) Keep the cover materials saturated throughout the curing period.
      b. Do not erode or damage the finish.
      c. Prevent excess water from impacting traffic on in-service roadways.
3. Liquid Membrane-Curing Compound Method (LMCCM)
   a. Thoroughly seal exposed concrete surfaces with a liquid membrane-curing compound immediately after finishing operations are completed for exposed concrete surfaces or immediately after forms are removed and necessary patching is complete when forms are removed before the end of the curing period.
   b. Apply liquid membrane-curing compound uniformly at the rates specified in Tables 1 and 2.
   c. Immediately repair damage to the curing compound film during the specified curing period by re-spraying.

4. Waterproof Cover Method (WCM)
   a. Exposed concrete surfaces must be wet before installing cover.
   b. Cover exposed concrete surfaces with a material that prevents moisture loss from the concrete.
      1) Do not use materials that have lost their waterproof qualities.
      2) Secure cover to prevent displacement by wind.
   c. Use this method only when the covering can be secured adequately to prevent moisture loss.
   d. Maintain the air temperature beneath the cover at not less than 50 degrees F.
      1) The use of insulated blankets is permitted.

5. Steam or Radiant-Heat Method (SRHM)
   a. Use only for precast concrete members manufactured in prequalified plants.
   b. Use a complete steam or radiant heat curing system that includes 24 hour temperature control and monitoring devices.
      1) Use temperature recording devices as necessary to verify that temperatures are uniform throughout the enclosure and within the limits specified.
   c. Steam Heat Curing System
      1) Use a suitable enclosure to contain live steam and minimize moisture and heat losses.
      2) Use low-pressure and saturated steam.
      3) Maintain 90 to 100 percent relative humidity in the curing enclosure.
      4) Do not apply heat directly on the concrete or cause localized high temperatures.
   d. Radiant Heat Curing System
      1) Apply heat by means of pipes circulating steam, hot oil, or hot water, or by electric heating elements.
      2) Use a suitable enclosure to contain the heat.
3) Minimize moisture loss by covering exposed concrete surfaces with plastic sheeting.

e. Waiting Period

1) Do not apply the initial application of heat before the initial set of the concrete except to maintain the minimum temperature within the curing enclosure.

2) Maintain the temperature within the curing enclosure at not less than 50 degrees F.
   a) Live steam or radiant heat may be used to maintain the curing enclosure at the proper minimum temperature.
   b) Keep the concrete wet during this period.

f. Curing Period

1) Increase the temperature within the concrete during the initial application of heat at an average rate not to exceed 40 degrees F per hour until the curing temperature is reached.

2) Do not exceed a concrete temperature of 160 degrees F when applying heat.

3) Maintain the concrete temperature at between 50 degrees F and 160 degrees F.

4) Maintain the curing temperature until the concrete achieves the specified strength for terminating the curing.

5) Decrease the concrete temperature at a rate not to exceed 40 degrees F per hour until reaching a temperature of not more than 20 degrees F above the air temperature to which the concrete will be exposed when discontinuing heat.

g. Transfer the stressing force to the concrete immediately after discontinuing steam curing or radiant heat curing for prestressed members.

C. Prevent exposed concrete surfaces from drying when transitioning between curing methods.

D. Fogging

1. Use fogging when necessary to prevent drying of exposed concrete surfaces.

2. Use fogging equipment with compressed air misters that atomize the water and produce a very fine mist and not a spray.
   a. Use equipment that allows for adjusting the rate of fogging depending on the conditions that are present.
   b. Maintain misters at least 5 ft above the concrete surface and aimed in a direction not lower than horizontal.
c. Do not use fogging to apply excess water to the concrete surface to aid finishing.
d. Do not affect the water/cement ratio of the concrete.
e. Discontinue fogging when a fine coating of water or sheen is visible on the concrete surface.

3. Do not damage the concrete surface.

E. Follow the hot and cold weather limitations according to Section 03055.

3.2 CURING COMPOUND APPLICATION

A. Comply with the following when applying liquid membrane-curing compound to structural elements in bridges, box culverts, headwalls, retaining walls, concrete drainage structures, and concrete slope protection.

1. Do not use curing compounds on surfaces that require a rubbed finish or on surfaces of construction joints against which new concrete will be cast, unless approved.
   a. Completely remove the curing compound before casting new concrete against the surface when curing compound is allowed.

2. Do not use curing compounds on architectural surfaces that require a concrete coating or penetrating concrete sealer and where removal will diminish the texture.

B. Preparation

1. Verify concrete surfaces are ready for curing.
   a. Complete all patching and surface finishing before applying curing compound.

2. Prepare concrete surfaces and apply curing compound according to product manufacturer’s recommendations. Refer to Tables 1 and 2 for application rates.

3. Keep surfaces moist until the curing compound is applied.

3.3 CURE CAST-IN-PLACE CONCRETE

A. Cure all formed surfaces using the FIPM.

B. Cure exposed surfaces of newly placed cast-in-place concrete according to the curing methods and curing periods in Table 1.

1. Determine the concrete compressive strength using field cured cylinders cured the same as the concrete member when compressive strength is used to determine the curing period. The curing period is the specified number of consecutive days when compressive strength is not used to determine the curing period.
Table 1

<table>
<thead>
<tr>
<th>Element</th>
<th>Curing Methods for Exposed Surfaces</th>
<th>Curing Period</th>
<th>Curing Compound Type</th>
<th>Application Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge Decks and Approach Slabs</td>
<td>LMCCM and WM</td>
<td>14 days</td>
<td>ASTM C309, Type I D, Class A</td>
<td>Manufacturer's recommended rate</td>
</tr>
<tr>
<td>Closure Pours in Bridge Decks and Approach Slabs</td>
<td>LMCCM and WM</td>
<td>7 days and $f'_c$</td>
<td>ASTM C309, Type I D, Class A</td>
<td>Manufacturer's recommended rate</td>
</tr>
<tr>
<td>Other Bridge Elements (superstructure, substructure, and foundation elements)</td>
<td>LMCCM or WM or WCM</td>
<td>0.70 $f'_c$ or 7 days</td>
<td>ASTM C309, Type I D, Class A</td>
<td>100 ft²/gal</td>
</tr>
<tr>
<td>Box Culverts (including wingwalls, and aprons), Headwalls, Retaining Walls, Concrete Drainage Structures, Sign Structure Foundations</td>
<td>LMCCM or WM or WCM</td>
<td>0.70 $f'_c$ or 7 days</td>
<td>ASTM C309, Type I D, Class A</td>
<td>100 ft²/gal</td>
</tr>
<tr>
<td>Concrete barrier</td>
<td>LMCCM or WM or WCM</td>
<td>0.70 $f'_c$ or 7 days</td>
<td>ASTM C309, Type I D, Class A or ASTM C1315, Type 1, Class A</td>
<td>100 ft²/gal</td>
</tr>
<tr>
<td>Curbs, gutters, flatwork, sidewalks, driveways, concrete slope protection, and other concrete items not specified</td>
<td>LMCCM</td>
<td>7 days</td>
<td>ASTM C309, Type I D, Class A</td>
<td>100 ft²/gal</td>
</tr>
</tbody>
</table>

Notes:

1. Use FIPM for all formed surfaces. Specified curing methods apply to exposed concrete surfaces and any formed surfaces where the forms are removed before the curing period ends.
2. $f'_c$ = specified 28 day minimum compressive strength.
3. The curing period for bridge elements that use high early strength concrete may be reduced to the greater of 3 days and the time required to achieve the specified 28 day minimum compressive strength. (Refer to Section 03310 for when the use of high early strength concrete is permitted.)
4. Use a curing compound meeting ASTM C309 when removal is required.
C. Bridge Decks and Approach Slabs
   1. Cure the exposed surfaces of newly placed concrete bridge decks and approach slabs for the specified curing period by a combination of the liquid membrane-curing compound method and the water method.
   2. Apply membrane-curing compound so that no portion of the deck or approach slab is exposed to the atmosphere for more than 20 minutes after the tining or finishing operation.
      a. Use a work bridge that follows immediately after the finishing machine to allow application of the curing compound while the concrete is still plastic.
   3. Cover the entire exposed surface of bridge decks, approach slabs, curbs, and sidewalks as soon as the concrete is sufficiently set to support the materials. Refer to this Section, Article 3.1 for water method requirements.

D. Concrete Barrier
   1. Broom clean the formed surfaces of the barrier after removing forms.
   2. Apply curing compound to exposed concrete surfaces immediately after finishing operations are completed.

3.4 CURE PRECAST CONCRETE

A. Cure all formed surfaces using the FIPM.

B. Cure exposed surfaces of newly placed precast concrete according to the curing methods and curing periods in Table 2.
   1. Determine the concrete compressive strength using field cured cylinders cured the same as the concrete member when compressive strength is used to determine the curing period. The curing period is the specified number of consecutive days when compressive strength is not used to determine the curing period.
<table>
<thead>
<tr>
<th>Element</th>
<th>Curing Methods for Exposed Surfaces</th>
<th>Curing Period</th>
<th>Curing Compound Type</th>
<th>Application Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precast Concrete Deck Panels (full depth), Precast Approach Slabs, (includes parapets when cast concurrent with precast deck and approach slab panels)</td>
<td>• LMCCM and WM</td>
<td>14 days</td>
<td>ASTM C309, Type I D, Class A</td>
<td>Manufacturer's recommended rate</td>
</tr>
<tr>
<td>Precast Substructure Elements, Partial Depth Precast Deck Panels (non-prestressed)</td>
<td>• WM or SRHM</td>
<td>0.7 f’c or 7 days</td>
<td>Not used</td>
<td>Not used</td>
</tr>
<tr>
<td>Prestressed Concrete Members (includes all pretensioned concrete members where pretensioning is required in the plans)</td>
<td>• SRHM or WM or WCM</td>
<td>Specified release strength (f’ci)</td>
<td>Not used</td>
<td>Not used</td>
</tr>
<tr>
<td>Precast Noise Walls, Precast Retaining/Noise Walls, MSE Retaining Wall Panels</td>
<td>• SRHM or WM or WCM</td>
<td>0.70 f’c or 7 days</td>
<td>Not used</td>
<td>Not used</td>
</tr>
<tr>
<td>Precast Box Culvert Structures and Precast Three-Sided Culvert Structures (wet cast and dry cast)</td>
<td>• SRHM or WM or WCM or LMCCM</td>
<td>0.70 f’c or 7 days</td>
<td>ASTM C309, Type I D, Class A</td>
<td>100 ft²/gal</td>
</tr>
<tr>
<td>Wet Cast Concrete Drainage Structures (such as manholes, grade rings, catch basin grade sections, pipe end sections, precast inlets and boxes)</td>
<td>• SRHM or WM or WCM or LMCCM</td>
<td>0.50 f’c or 7 days</td>
<td>ASTM C309, Type I D, Class A</td>
<td>100 ft²/gal</td>
</tr>
<tr>
<td>Modular Block (wet cast)</td>
<td>• WM or WCM or LMCCM</td>
<td>0.70 f’c or 7 days</td>
<td>ASTM C309, Type I D, Class A</td>
<td>100 ft²/gal</td>
</tr>
</tbody>
</table>
### Table 2 (Continued)

<table>
<thead>
<tr>
<th>Element</th>
<th>Curing Methods for Exposed Surfaces</th>
<th>Curing Period</th>
<th>Curing Compound</th>
<th>Application Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Barrier</td>
<td>• LMCCM</td>
<td>7 days and until certified according to QMP</td>
<td>ASTM C1315, Type 1, Class A</td>
<td>100 ft²/gal</td>
</tr>
<tr>
<td>PCC Pavement Panels</td>
<td>• LMCCM and WM</td>
<td>14 days</td>
<td>ASTM C309, Type 1 D, Class A</td>
<td>Manufacturer's recommended rate</td>
</tr>
</tbody>
</table>

**Table 2 Notes:**

1. Use FIPM for all formed surfaces. Specified curing methods apply to exposed concrete surfaces and any formed surfaces where the forms are removed before the curing period ends.
2. f’c = specified 28 day minimum compressive strength.

C. Precast Concrete Deck Panels (full depth), and Precast Approach Slabs
   1. Refer to this Section, Article 3.3, paragraph C.

D. Precast Concrete Barrier
   1. Broom clean the formed surfaces of the barrier after removing forms.
   2. Apply curing compound to exposed concrete surfaces immediately after finishing operations are completed.

END OF SECTION
SECTION 03924
STRUCTURAL CONCRETE REPAIR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Repair of delamination and cracks in structural concrete elements such as columns, pedestals, bent caps, diaphragms, wingwalls, abutment backwalls, girders, parapets, and deck edges.

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

1.3 REFERENCES

A. AASHTO M 235: Epoxy Resin Adhesives
B. AASHTO T 106: Compressive Strength of Hydraulic Cement Mortar (Using 50-mm or 2-in. Cube Specimens)
C. AASHTO T 161: Resistance of Concrete to Rapid Freezing and Thawing
D. ASTM A 780: Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
E. ASTM C 928: Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
F. ASTM D 3963: Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars
G. ASTM D 4285: Indicating Oil or Water in Compressed Air

1.4 DEFINITIONS

Not Used
1.5 SUBMITTALS

A. Manufacturer’s product data sheets and recommended installation instructions for all materials.

B. Evidence that epoxy injection equipment operators have at least two years of experience in the methods and materials of the selected epoxy injection system for information.

C. Working Drawings for review.
   1. Girder jacking drawings
      a. Submit when girder jacking is shown.
      b. Provide the seal of a Professional Engineer or Professional Structural Engineer licensed in the State of Utah.
      c. Include supporting engineering calculations.
   2. Drawings for Temporary Works as shown.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver the materials in unopened packages with labels clearly indicating the following:
   1. Name of Manufacturer
   2. Manufacturer’s product name or product number
   3. Manufacturer’s lot number
   4. Mix ratio
   5. Hazardous material rating and appropriate warnings for handling.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete
   1. Class AA (AE). Refer to Section 03055.

B. Concrete Repair Mortar
   1. Use only products recommended for vertical or overhead application by the manufacturer.
2. Use a product that meets AASHTO T 106 and ASTM C 928 as defined in Table 1.

<table>
<thead>
<tr>
<th>Repair Mortar Type</th>
<th>Element</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Parapets, Diaphragms, and Wingwalls</td>
<td>R1</td>
</tr>
<tr>
<td></td>
<td>Deck Edges, Pedestals, Abutments, and Backwalls</td>
<td>R2</td>
</tr>
<tr>
<td></td>
<td>Girders, Bent Caps, Columns, and other items</td>
<td>R3</td>
</tr>
</tbody>
</table>

3. R3 concrete repair mortar may be substituted for R1 and R2 at the Contractor’s discretion.

4. Use a product that meets AASHTO T 161 Durability Factor of 95 at 28 days.

5. Use a product that dries gray in color.

C. Substrate Coating
   1. Use a bonding agent or primer recommended by the concrete repair mortar manufacturer.

D. Epoxy Resin Adhesive
   1. Use an appropriate Epoxy Resin Adhesive meeting AASHTO M 235.
      a. Provide Type V for all applications.
      b. Provide Grade 3 for all applications.

E. Injection Adhesive
   1. Use an injection adhesive meeting AASHTO M 235.
      a. Use Type IV for all applications.
      b. Meet the requirements for Grade 1 for cracks that can be surface sealed on all faces.
      c. Meet the requirements for Grades 1, 2 or 3 for cracks that cannot be surface sealed on all faces.

F. Surface Seal
   1. Use a surface seal recommended by the injection adhesive manufacturer.
   2. Capable of containing injection adhesive in cracks during pressure injection and until the injection adhesive has cured.

G. Reinforcing Steel
   1. Coated reinforcing steel according to Section 03211.
2.2 EQUIPMENT REQUIREMENTS

A. Concrete Repair Mortar Mixer
   1. Use a small mixer to batch out the concrete repair mortar.

B. Epoxy Injection system
   1. Use at least two pumps having the following characteristics:
      a. Electric-powered and portable
      b. Positive displacement
      c. Positive-ratio control of exact proportions of the two components at the nozzle
      d. In-line metering and mixing
   2. Automatic pressure control capable of discharging the mixed adhesive at any preset pressure up to 200 psi ± 0.5 psi and equipped with a manual pressure control override.
   3. Capable of maintaining the volume ratio of the injection adhesive prescribed by the manufacturer within a tolerance of ± 5 percent by volume at any discharge pressure up to 200 psi.
   4. Sensors on both the component reservoirs that automatically stop the machine when only one component is being pumped to the mixing head.

C. Sandblaster
   1. Use a sandblaster that meets the requirements in ASTM D 4285.

D. Jackhammer
   1. 30 lb class
   2. 15 lb class

PART 3 EXECUTION

3.1 PREPARATION FOR DELAMINATION REPAIR

A. Locate the repair areas.
   1. Sound the items requiring this work and mark the limits of delaminated areas for repair work in the presence of the Engineer.

B. Concrete removal
   1. Make ½ inch deep saw cuts in the sound concrete along the perimeter of the repair area
2. Remove damaged, shattered, and delaminated concrete.
   a. Use 30 lb class jackhammer when allowed.
      1) Do not use pneumatic hammers heavier than 15 lb class for removals in areas directly below the top reinforcing steel.
      2) Use 15 lb class jackhammer or lighter for deck edge repair.
   b. Operate jackhammer at an angle greater than 45 degrees as measured from the element surface.
   c. Protect existing reinforcing steel encountered.
   d. Replace or repair damaged reinforcing steel.
3. Remove loose materials by dry sweeping or clean and dry compressed air with at least 90 psi pressure. Refer to ASTM D 4285.
4. Sandblast clean exposed reinforcing steel and concrete surfaces before placing new concrete.
   a. Protect in place sound rebar.
   b. Prevent sandblasting material and debris from falling into waterways, pedestrian areas, traffic areas, or onto railroad tracks.
5. Clean the repair area by blowing with clean and dry compressed air at 90 psi. Refer to ASTM D 4285.
6. Replace existing reinforcing steel bars with 25 percent or greater section loss.
   a. Cut and remove deteriorated existing reinforcing steel bars.
   b. Match the size of the new reinforcing steel bar to the existing bar.
   c. Provide lap lengths as shown.

3.2 EPOXY INJECTION

A. General
   1. Pressure inject cracks 1/64 to 1/4 inch in width.
   2. Mark cracks to be pressure injected in the presence of the Engineer.

B. Preparation
   1. Sandblast the concrete surfaces clean.
   2. Clean cracks of contaminants using oil-free compressed air according to ASTM D 4285.
      a. Remove remaining material by flushing with water under pressure.
3. Space ports at a distance not more than the thickness of the concrete being injected.  
   a. Limit port spacing at ends of cracks to not more than half the concrete thickness.  
   b. Adjust port spacing based on manufacturer’s recommendations and to ensure injection adhesive fills the cracks.  
4. Apply a surface seal over all exterior faces of the crack that can be reached to contain the injection adhesive in the crack.  

C. Epoxy Injection  
1. Inject the crack when it is at its widest if the crack width changes because of daily temperature cycles or other structural loading of the structure,  
2. Proceed from lower to higher ports.  
3. Plug the port being injected and move to a higher port when injection adhesive appears at the next higher port.  

D. Final Surface Seal  
1. Grind flush all ports extending above the concrete surfaces.  
2. Mask the member in parallel straight line segments between the ends of the crack so the surface seal has a clean and neat appearance when applied.  
3. Apply the surface seal at the application rate of at least 0.09 gal/ym².  
   a. Cover the entire length of the crack for at least 6 inches on both sides of the crack.  
4. Apply a second coat at the same application rate as soon as the first coat is dry to the touch.  
   a. Do not exceed the following times between coats:  

<table>
<thead>
<tr>
<th>Temperature (Degrees F)</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>66</td>
<td>72</td>
</tr>
<tr>
<td>77</td>
<td>36</td>
</tr>
<tr>
<td>90</td>
<td>24</td>
</tr>
</tbody>
</table>
3.3 DELAMINATION REPAIR

A. Form Work
   1. Use forms and braces to place new concrete to the original dimensions.
      a. Rebuild the areas to original shape, ± ¼ inch.
   2. Vibration is required in the forms when the area between forms and existing concrete surface will allow use of vibrators.

B. Repairs with a thickness less than or equal to three inches:
   1. Use concrete repair mortar.
   2. Coat the cleaned concrete using the substrate coating.
   3. Place concrete repair mortar in layers not exceeding the manufacturer’s recommended application thickness per layer.
      a. Rebuild the areas to original shape, ± ¼ inch.
   4. Follow the manufacturer’s recommendations for finishing and curing.

C. Repairs with a thickness greater than three inches.
   1. Use concrete.
   2. Apply an epoxy resin adhesive to the cleaned concrete surface of the repair area before placing the new concrete.
   3. Place, form, and finish concrete and construct falsework according to Section 03310.
   4. Cure concrete according to Section 03390.

D. Finished Surfaces – Provide the look of one color.

3.4 STRUCTURAL CONCRETE REPAIR

A. Perform work according to Table 3.
TABLE 3
Structural Concrete Repair Items

<table>
<thead>
<tr>
<th>Item</th>
<th>Work Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column Repair</td>
<td>Preparation for delamination repair</td>
</tr>
<tr>
<td></td>
<td>Epoxy injection</td>
</tr>
<tr>
<td></td>
<td>Delamination repair</td>
</tr>
<tr>
<td>Pedestal Repair</td>
<td>Jack girders (when shown)</td>
</tr>
<tr>
<td></td>
<td>Preparation for delamination repair</td>
</tr>
<tr>
<td></td>
<td>Delamination repair</td>
</tr>
<tr>
<td>Bent Cap Repair</td>
<td>Jack girders (when shown)</td>
</tr>
<tr>
<td></td>
<td>Preparation for delamination repair</td>
</tr>
<tr>
<td></td>
<td>Epoxy injection</td>
</tr>
<tr>
<td></td>
<td>Delamination repair</td>
</tr>
<tr>
<td>Diaphragm Repair</td>
<td>Preparation for delamination repair</td>
</tr>
<tr>
<td></td>
<td>Epoxy injection</td>
</tr>
<tr>
<td></td>
<td>Delamination repair</td>
</tr>
<tr>
<td>Wingwall Repair</td>
<td>Preparation for delamination repair</td>
</tr>
<tr>
<td></td>
<td>Delamination repair</td>
</tr>
<tr>
<td>Abutment Backwall Repair</td>
<td>Preparation for delamination repair</td>
</tr>
<tr>
<td></td>
<td>Delamination repair</td>
</tr>
<tr>
<td>Girder Repair</td>
<td>Preparation for delamination repair</td>
</tr>
<tr>
<td></td>
<td>Epoxy injection</td>
</tr>
<tr>
<td></td>
<td>Delamination repair</td>
</tr>
<tr>
<td>Girder End Repair</td>
<td>Jack girders (when shown)</td>
</tr>
<tr>
<td></td>
<td>Preparation for delamination repair</td>
</tr>
<tr>
<td></td>
<td>Epoxy injection</td>
</tr>
<tr>
<td></td>
<td>Delamination repair</td>
</tr>
<tr>
<td>Parapet Repair</td>
<td>Preparation for delamination repair</td>
</tr>
<tr>
<td></td>
<td>Delamination repair</td>
</tr>
<tr>
<td>Deck Edge Repair</td>
<td>Preparation for delamination repair</td>
</tr>
<tr>
<td></td>
<td>Delamination repair</td>
</tr>
<tr>
<td>Structural Concrete Repair</td>
<td>Preparation for delamination repair</td>
</tr>
<tr>
<td></td>
<td>Epoxy injection (when shown)</td>
</tr>
<tr>
<td></td>
<td>Delamination repair</td>
</tr>
<tr>
<td>Crack Repair</td>
<td>Epoxy injection</td>
</tr>
</tbody>
</table>

B. Remove sandblasting materials and debris from adjacent surfaces after the work is complete.

END OF SECTION
SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.1 SECTION INCLUDES
   A. Structural steel for bridges and structures.

1.2 RELATED SECTIONS
   A. Section 05822: Bearings
   B. Section 09972: Painting for Structural Steel

1.3 REFERENCES
   A. AASHTO M 111: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products
   B. AASHTO M 270: Structural Steel for Bridges
   C. AASHTO LRFD Bridge Construction Specifications
   D. AASHTO LRFD Bridge Design Specifications
   E. AASHTO/AWS D1.5 Bridge Welding Code
   F. ASTM A 194: Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
   G. ASTM A 370: Mechanical Testing of Steel Products
   H. ASTM A 563: Carbon and Alloy Steel Nuts
   I. ASTM F 436: Hardened Steel Washers
   J. ASTM F 606: Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets
   K. ASTM F 959: Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
1.4 DEFINITIONS

A. Main Members – Members on a critical load path that carry bridge dead and live loads. The loss of capacity of main members would have serious consequences on the structural integrity.

B. Secondary Members – Members other than main members, not designed to carry primary load.

1.5 SUBMITTALS

A. Working Drawings
   1. Detailed shop drawings of all fabricated materials for review.
      a. The seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) is not required.
   2. Erection Drawings for all structural steel members for review.
      a. Fully illustrate the proposed method of erection. Provide complete details of the process including, but not limited to:
         1) Temporary supports, bracing, guys, dead-men, lifting devices, connection details and attachments to bridge members.
         2) The schedule and sequence of erection, location of cranes, crane capacities, location of lifting points on the bridge members, member weights, and any other assumed loads.
         3) Complete details for all anticipated phases and conditions during erection.
         4) Minimum number of items such as main members, secondary members, and connections that must be installed and properly connected to provide structural integrity and stability.
5) Supporting calculations according to the current edition of the AASHTO LRFD Bridge Design Specifications to demonstrate that factored member capacities are not exceeded and final geometry will be correct.

6) Incorporate into the erection drawings the requirements from this Section, article 3.5.

7) Bolting Procedure for field splices and diaphragms that meets the RCSC Specifications for Structural Joints Using High-Strength Bolts including at least the following:
   a) Handling, storage and identification of fasteners.
   b) Preparation of bolted parts.
   c) Pre-installation verification.
   d) Installation.
   e) Inspection.
   f) Personnel or positions responsible for each activity.
   
   b. Include supporting engineering calculations.
   c. Provide the seal of a PE or SE licensed in the State of Utah on the drawings and calculations.

3. Drawings for temporary works.

B. Material Submittals
1. Manufacturer’s certificate of compliance for bolts, nuts, and washers.
   a. Refer to ASTM F 606 and ASTM F 3125.
   b. Include corresponding lot numbers appearing on the shipping package, certification, test location, time and date, and results of the testing.
   c. Include rotational capacity and proof load test results.

2. Three complete fastener assemblies of each combination of diameter, length, grade and lot for verification testing.

3. Certified mill test reports (MTR) for all fabricated structure materials, seven calendar days before fabrication, including materials manufactured outside of the United States. Clearly indicate country of origin on MTR.


C. Welding Submittals
1. Weld Procedure Specifications and Procedure Qualification Records as required by the specified AWS Code.
2. Welder test reports for each operator, process, and position as required by the specified AWS Code.
   a. A letter from the Fabricator that states the certified welders have been using the process without an interruption of more than six months since being certified.

D. Documentation of AISC Certification for information.
   1. Fabrication certification according to this Section, Article 2.6.

E. Bolted Field Splice Certification and Bolted Diaphragm Certification forms.

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

A. Follow AASHTO LRFD Bridge Construction Specifications, Article 11.3, unless otherwise indicated.

B. Do not use stock steel purchased from a warehouse for use in a main member without conducting mill inspection, unless authorization is given.

2.2 HIGH STRENGTH FASTENERS

A. Use bolts, nuts, and washers displaying the manufacturer’s markings.

B. Bolts
   1. Refer to ASTM F 3125. Use Grade A325, Heavy Hex Head.

C. Nuts
   1. Refer to ASTM A 194 or ASTM A 563. Use heat-treated Grades DH and 2H, except use Type DH3 nuts when Type 3 bolts are shown.

D. Washers
   1. Refer to ASTM F 436.

E. Direct Tension Indicator (DTI) Washers
   1. Refer to ASTM F 959.

F. Certification of Bolts and Nuts (Black, Weathering and Galvanized)
   1. Subject to applicable tests from ASTM F 3125 Table 3, with the following clarifications:
      a. Wedge test bolts and nuts according to ASTM F 3125 Section 10.1.
b. Proof load test bolts and nuts according to ASTM F 606 Method 1.
c. Tests for rotational capacity of bolts and nuts according to ASTM F 3125 Supplemental S4 and Annex A2.

2.3 ELASTOMERIC BEARINGS AND ANCHORAGES

A. Refer to Section 05822.

2.4 APPROACH SLAB DRAIN ANGLES AND GRATES

A. Refer to AASHTO M 270, Grade 36, or as shown.

B. Hot-dip galvanize after fabrication. Refer to AASHTO M 111.

2.5 SHOP INSPECTION

A. Notify Engineer immediately upon placing the fabrication order to allow time for shop inspection.
   1. In-state work requires 7 days advanced notice; out-of-state work requires 30 days advanced notice.
   2. Schedule shop inspection before beginning fabrication.
   3. Facilitate inspection procedures on site and supply adequate personnel to perform quality control.

2.6 FABRICATION

A. Fabricate according to AASHTO LRFD Bridge Construction Specifications Section 11, UDOT Steel and Concrete Construction Manual, and AASHTO/AWS D 1.5.

B. The fabricator must have AISC Certified Bridge Fabricator – Advanced Certification (ABR) if fabricated structural steel will be part of a bridge structure except as follows:
   1. Railings, grates, grate frames, and drain pipes may be fabricated with AISC Bridge Component Certification (CPT).

C. Surface preparation of steel
   1. Painted Steel
      a. Refer to Section 09972.
   2. Unpainted Weathering Steel
      a. Meet sandblaster qualifications and surface preparation requirements for painted steel according to Section 09972.
      b. Construct so that erection marks on the steel are not visible after the structure is completed.
c. Commercially blast the following surfaces according to SSPC-SP 10:

1) I-girders
   a) Underside of the exterior portion of the top flange of fascia girders and underside of bottom flange of all girders.
   b) Exterior portion of web of fascia girders.
   c) Top side and outside edge of the exterior portion of the bottom flange of fascia girders.
   d) All welded surfaces.

2) Trusses
   a) Top chord, diagonals, and top bracing.
   b) Exposed surfaces of bottom chord, floor beams, and bottom bracing.
   c) All welded surfaces.

d. Commercially blast all other surfaces according to at least SSPC-SP 6.

e. Develop even patina at completion of welding repair and after surface has been verified by the Engineer.

PART 3 EXECUTION

3.1 INSTALL HIGH STRENGTH FASTENERS

A. Store the bolts and nuts in the original containers until used.
   1. Protect from dirt and moisture.
   2. Remove only as many fasteners from protected storage as can be tightened during a work shift.
      a. Return unused fasteners to protected storage at the end of each work shift.
   3. Clean and re-lubricate fasteners that accumulate rust or dirt resulting from site conditions.
      a. Use manufacturer’s recommended lubricant.

B. Testing
   1. Test the installed bolt, nut, and washer assembly before beginning erection and periodically to verify compliance.
   2. Provide a Skidmore-Wilhelm Calibrator or other acceptable bolt tension indicating device for bolt testing at the job site.
   3. Check the DTI washers in a Skidmore-Wilhelm Calibrator using bolts of sufficient length.
      a. Use DTI washers with solid plates when the fastener-grip length is too short to be tested in a Skidmore-Wilhelm Calibrator.
C. Install fasteners according to AASHTO LRFD Bridge Construction Specifications, Section 11.5.6.4, the bolting procedure in the authorized erection drawings, and the following:

1. Complete the Bolted Field Splice Certification form at the end of this Section as fastener tightening progresses for all girder field splices.
2. Complete the Bolted Diaphragm and Cross Frame Member Certification form at the end of this Section.
3. Use DTI washers to indicate bolt tension.
   a. Follow the manufacturer’s methods and procedures as modified by the Engineer.
   b. Place DTI washer on the side of the connection that will not be embedded in concrete.
      1) A DTI washer is still required if the entire fastener will be embedded in concrete.
      2) Do not place concrete until the inspector has certified that all fasteners are properly tightened.
4. Use drift pins to align bolt holes and maintain dimensions and camber of the member.
5. Insert bolts in open holes with washers and hand tighten.
6. Tighten at least 50 percent of the fasteners as required to approximately one-half final tension to draw all plies of the connection into firm contact.
   a. Do not tighten any fasteners to indicated full tension at this time.
7. Remove drift pins and replace with bolts.
8. Tighten fasteners progressively from fixed or rigid points to the free edges.
9. Fully tighten 50 percent of the fasteners for field splices and diaphragms. Verify remaining fasteners are snug tight before release of crane or removal of shoring.
   a. Reduce the DTI washer gap to 0.005 inch regardless of which element is turned for tightening.
10. Tighten all fasteners to full tension.
11. Review the DTI washer compression for each fastener after the first connection.
   a. Re-evaluate tightening procedure and make corrections as required if over 50 percent of DTI washers tested are fully compressed.

3.2 FIELD WELDING

A. Weld according to AASHTO/AWS D1.5.

B. Meet the same requirements as shop welds.
C. Comply with welding procedures and inspection requirements.
   1. Refer to UDOT Steel and Concrete Construction Manual.

D. Welding operators must be certified according to the specified AWS Code.
   1. Refer to UDOT Steel and Concrete Construction Manual.

3.3 PAINTED STRUCTURAL STEEL

A. Paint all structural steel not designated as unpainted weathering steel.
   1. Refer to Section 09972.

3.4 UNPAINTED WEATHERING STEEL

A. Clean girders of debris after deck concrete is placed.
   1. Redevelop patina as needed.

3.5 ERECTION

A. Erector Qualifications
   1. An AISC certified erector with one of the following certifications is preferred when erecting, bolting, and welding bridge framing members:
      a. Certified Steel Erector with Bridge Erection Endorsement (requirements criteria),
      b. Advanced Certified Steel Erector (checklist criteria).

B. Maintain responsibility for girder erection during each stage of construction including the protection of structural steel members, the workers, and the traveling public.

C. Erect structural steel members according to the authorized erection drawings and in a manner that prevents damage to elements of the structure.
   1. Follow match-marks.

D. Temporarily support, anchor, and brace main members such as girders during erection to produce the proper alignment and camber in the completed structure.
   1. Install cross frames and diagonal bracing as necessary to provide stability and correct geometry.
   2. Provide temporary bracing or stiffening devices if necessary during each erection stage.
   3. Support, anchor, and brace erected superstructure members as detailed in the authorized erection drawings before allowing traffic under the bridge.
E. Design temporary supports and falsework according to the current edition of the AASHTO LRFD Bridge Construction Specifications, Section 3, Temporary Works.

F. Provide additional materials that are required to keep both the temporary and final stresses within the allowable limits used in design.

G. Handle materials so that no parts will be bent, broken, or otherwise damaged.
   1. Do not injure or distort the members when hammering.

H. Remove dirt and debris from bearing surfaces and surfaces that will be in permanent contact before the members are assembled.

I. Do not open traffic under a partially erected bridge superstructure unless allowed in the authorized erection drawings.

END OF SECTION

Bolted Field Splice Certification and Bolted Diaphragm Connection Certification forms follow.
Bolted Field Splice Certification

Consecutively number splices looking stations ahead and increasing from left to right. Number across the beam lines before moving down station to the next line of splices. Copy this page as required. Initial the appropriate box to certify that the fastener tightening has been completed according to the specifications.

Do not perform final tightening until the inspector certifies that plates are drawn into full contact. Do not place concrete deck until the inspector has certified that all fasteners are properly tightened.

Send a completed copy of this form to the Engineer before the final inspection.

<table>
<thead>
<tr>
<th>Splice No.</th>
<th>Top Flange</th>
<th>Web</th>
<th>Bottom Flange</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plates were drawn into contact with each other before final tightening of fasteners.</td>
<td>Contr. Initials</td>
<td>Inspect. Initials</td>
<td>Contr. Initials</td>
</tr>
</tbody>
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<th>Bottom Flange</th>
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<tr>
<td>Fasteners are tightened to spec. Gap under direct tension indicator is less than or equal to 0.005 inch.</td>
<td>Contr. Initials</td>
<td>Inspect. Initials</td>
<td>Contr. Initials</td>
</tr>
</tbody>
</table>

Project Number: Structure Number:

Implementation 01-09-2017
Bolted Diaphragm and Cross Frame Member Connection Certification

Consecutively number diaphragm connections looking stations ahead and increasing from left to right. Number across the beam lines before moving down station to the next line of connections. Copy this page as required. Initial the appropriate box to certify that the fastener tightening has been completed according to the specifications.

Do not perform final tightening until the inspector certifies that connection plates are drawn into full contact. Do not place concrete deck until the inspector has certified that all fasteners are properly tightened.

Send a completed copy of this form to the Engineer before the final inspection.

Project Number:
Structure Number:

<table>
<thead>
<tr>
<th>Connection No.</th>
<th>Contractor Initials</th>
<th>Inspector Initials</th>
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</table>
SECTION 05832

STRIP SEAL EXPANSION JOINT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Strip seal expansion joint for bridge decks and approach slabs.

B. Removal of existing expansion joint system.

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 05120: Structural Steel

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

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

C. AASHTO M 235: Epoxy Resin Adhesives

D. AASHTO M 270: Structural Steel for Bridges

E. AASHTO/AWS D1.5: Bridge Welding Code

F. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation

G. ASTM D 395: Rubber Property – Compression Set

H. ASTM D 412: Vulcanized Rubber and Thermoplastic Elastomers – Tension
I. ASTM D 471: Rubber Property – Effect of Liquids

J. ASTM D 573: Rubber – Deterioration in an Air Oven

K. ASTM D 1149: Rubber Deterioration – Cracking in an Ozone Controlled Environment

L. ASTM D 2240: Rubber Property – Durometer Hardness

M. ASTM D 4070: Adhesive Lubricant for Installation of Preformed Elastomeric Bridge Compression Seals in Concrete Structures

N. ASTM D 5973: Elastomeric Strip Seals with Steel Locking Edge Rails Used in Expansion Joint Sealing

O. American Institute of Steel Construction (AISC)

1.4 DEFINITIONS

A. Expansion Joint System – Extruded elastometric seal element inserted into and bonded to a steel extrusion.

1.5 SUBMITTALS

A. Working Drawings
   1. Detailed shop drawings of all fabricated materials for review.
      a. Include the following:
         1) Joint seal assembly, anchorage components, and method of installation.
         2) Concrete recess details and any required revisions or additions to concrete, reinforcement, structural steel, and other components.
      b. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah.

B. Materials
   1. Mill Test Report (MTR) for all structural steel for information.
      a. Provide item number and name on all material submittals.
      b. Refer to Section 05120.
   3. Welding procedure specifications meeting AASHTO/AWS D 1.5. for information.
C. Manufacturer’s product data sheet and installation instructions.

D. Manufacturer’s SBR certification for information.

E. Repair procedures for review.
   1. Required when watertight integrity test fails.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete
   1. Class AA(AE) refer to Section 03055.

B. Structural Steel
   1. Steel Extrusions – AASHTO M 270, Grade 36
   2. Plates – AASHTO M 270, Grade 36
   3. Round Bars – AASHTO M 270, Grade 36
   4. Studs – AASHTO M 169
   5. Galvanize all structural steel according to AASHTO M 111.

C. Lubricating Adhesive
   1. Follow manufacturer’s recommendation and ASTM D 4070.

D. Epoxy Resin Adhesive
   1. AASHTO M 235, Type II.
   2. Choose class rating consistent with the application temperature.

E. Reinforcing Steel
   1. Use coated reinforcing steel according to Section 03211.

F. Rigid Plastic Foam
   1. Type 9. Refer to ASTM C 578.

G. Elastomeric Seal
   1. Single layer strip type.
   2. Continuous with no splices unless approved by the Engineer.
3. Conforming to the properties listed in Table 1.

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>2000 psi</td>
<td>ASTM D 412</td>
</tr>
<tr>
<td>Elongation at Break</td>
<td>250%</td>
<td>ASTM D 412</td>
</tr>
<tr>
<td>Hardness, Type A Durometer</td>
<td>60 ± 5%</td>
<td>ASTM D 2240*</td>
</tr>
<tr>
<td>Oven Aging 70 hrs at 212°F</td>
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<td></td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>20% loss max</td>
<td>ASTM D 573</td>
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<tr>
<td>Elongation</td>
<td>20% loss max</td>
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</tr>
<tr>
<td>Hardness</td>
<td>0 to +10 points</td>
<td></td>
</tr>
<tr>
<td>Oil Swell, 70 hrs at 212°F</td>
<td>45%</td>
<td>ASTM D 471</td>
</tr>
<tr>
<td>Ozone Resistance, 70 hrs at 104°F</td>
<td>No Cracks</td>
<td>ASTM D 1149</td>
</tr>
<tr>
<td>Low Temperature Stiffening</td>
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<td></td>
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<tr>
<td>7 days at 14°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardness (Type A durometer)</td>
<td>0 to +15 points</td>
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</tr>
<tr>
<td>Compression Set, 70 hrs at 212°F</td>
<td>35%</td>
<td>ASTM D 395</td>
</tr>
</tbody>
</table>

*As modified by ASTM D 5973.

2.2 FABRICATION

A. Refer to Section 05120, except AISC Bridge Component QMS (CPT) Certification is required.

B. Check the elastomeric seal and top of the extruded steel shape of each section for straightness after expansion joint and anchorage system fabrication.
   1. Use a string line stretched taut from curb angle point to curb angle point or necessary construction joint end.

C. Shop Tolerances
   1. Do not deviate in straightness by more than ½ inch for steel surfaces.
   2. Do not deviate more than \( \frac{3}{32} \) inch for surfaces when string line is stretched between ends and the point of maximum departure from true.
PART 3 EXECUTION

3.1 EXPANSION JOINT MODIFICATION PREPARATION

A. Asphalt Removal
   1. Make saw cuts parallel to existing joints to define the removal area.
   2. Remove asphalt surfacing in such a manner that the concrete deck is not damaged.

B. Concrete Saw Cuts
   1. Locate the saw cuts at the offset as shown and saw 1 inch deep in the concrete deck parallel to existing joints to define work area.

C. Prevent debris from falling into streams, pedestrian areas, traffic areas, and on railroad tracks.

3.2 CONCRETE REMOVAL FOR EXPANSION JOINT MODIFICATION

A. Use jackhammer method to remove existing concrete.
   1. Partial Depth Removal – Use 45-pound class hand operated jackhammers or smaller.
   2. Full Depth Removal – Use 90-pound class hand operated jackhammers or smaller.
      a. Use 45 pound class hand-operated jack hammer or smaller when removing concrete within 6 inches of girders, diaphragms, deck that are to remain.
   3. Operate jackhammers at an angle greater than 45 degrees as measured from the deck surface.

B. Parapet
   1. Remove parapet concrete as shown.
   2. Protect existing electrical conduit from damage.

3.3 REINFORCING STEEL FOR EXPANSION JOINT MODIFICATION

A. Protect and clean existing reinforcing steel to remain as shown.
   1. Clean corrosion and adhering materials by sandblasting.

B. Place new reinforcing steel after sandblasting operations are complete.

3.4 EXPANSION JOINT SYSTEM INSTALLATION

A. Install expansion joint system according to the authorized shop drawings.

B. Prevent twists, bends, and warping when handling strip seal.
C. Provide a factory-trained representative during system setting, concrete placement, elastomeric seal element installation, and during the watertight integrity test.
   1. The Engineer may waive the requirement for the manufacturer’s representative to be onsite if the Installer can demonstrate that the Installer’s superintendent for the work has performed at least two satisfactory applications of the modular expansion joint in the last five years.
      a. The manufacturer’s technical representative must be available for consultation throughout the duration of the application.
   2. The Department reserves the right to require the manufacturer’s technical representative to be onsite if at any time the Engineer is concerned with the product installation quality.

3.5 JOINT WIDTH

A. Form the joint width using rigid plastic foam as shown.
   1. Anchor securely.

B. Maintain separation of sections by placing rigid plastic foam between sections of the concrete parapet.

C. Form parapet joint width with rigid plastic foam as shown.

3.6 CONCRETE

A. Clean concrete and steel surfaces before coating with an epoxy resin adhesive.
   1. Follow epoxy resin adhesive manufacturer’s installation instructions.

B. Place and finish concrete according Section 03310.

C. Place concrete not to impede free movement of expansion joint.

3.7 ELASTOMERIC SEAL

A. Install elastomeric seals before shipping unless field splices of expansion joint are required.

B. Install elastomeric seals in the field after construction is complete if field splices are necessary.

C. Lubricate the steel extrusion cavity before installing the elastomeric seal.
D. Remove the rigid plastic foam used to form the joint opening and any other objects that may interfere with the installation and operation of the elastomeric seal so the seal convolution hangs freely after installation.

3.8 FIELD QUALITY CONTROL AND WATERTIGHT INTEGRITY TEST

A. Field Tolerances for Expansion Joint
   1. Re-examine steel surfaces for straightness and shop tolerance requirements after installing joint system in its final position and before placing concrete.

B. Final In-place Tolerances for Expansion Joint
   1. Re-examine the extrusion gland face after concrete placement.
      a. Deviations from the string line of more than ¼ inch are not allowed.
      b. Do not deviate parallel extrusion faces from each other by more than ⅛ inch at any location.

C. Test expansion system in the presence of the Engineer to verify that joint areas can hold a minimum depth of 3 inches of water for one hour without leakage.

D. Provide recommended repair for failed watertight integrity test.
   1. If joint fails the watertight integrity test after the repair, remove leaking seals, clean steel extrusion grooves, and install new seals if leaking occurs during testing.

END OF SECTION