[[When using this document set the following Styles:

Normal: font size 10 pt.; Paragraph: left, line spacing single, spacing 0 before & 0 after

Heading 1: font size - 11pt ; Underline; Bold, ALL CAPS, Paragraph: Indent 0: hanging 1" flush left, keep with next; no tab at 0.5"

Heading 2: font size - 11pt ; bold, flush left, line spacing single, Widow/orphan control, Level 2, Tabs: 1"

USE AS REQUIRED

Fill-in-the-blanks are _____

INDEX SB2014 Book

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DIVISION SB Special Provisions starts here

SB2014-1 **INDEX TO DIVISION SB**

Use on all Bridge jobs let combined.

CREATED 10/30/1992

REVISED 5/16/2013

INDEX TO DIVISION SB

DIVISION SB

Section No. Item Page No.

HERE

BRIDGE PLANS

The plans for this project, consisting of the sheets tabulated below, were approved by the State Bridge Engineer.

BRIDGE NO.	TOTAL SHEETS	SHEET NO.	DATE OF APPROVAL

New or revised sheets were approved as listed below:

BRIDGE NO.	SHEET NO.	DATE OF APPROVAL

I hereby certify that the Special Provisions for bridge construction (Division SB) contained in this Proposal were prepared by me or under my direct supervision, and that I am a duly licensed Professional Engineer under the laws of the State of Minnesota.

_____

( )

Date:_____ Lic. No._____

DIVISION SB

SB-1 _____ -SB

SB-2 _____ -SB

SB-3 _____ -SB

SB-4 _____ -SB

SB-5 _____ -SB

SB-6 _____ -SB

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SB-15 _____ -SB

SB-16 _____ -SB

SB-17 _____ -SB

SB-18 _____ -SB

SB-19 _____ -SB

SB-20 _____ -SB

SB2014-1

Use as required for projects needing plans of existing structures.

CREATED 8/3/1994

REVISED 5/16/2013 (4)

SB- BRIDGE PLANS

Plans of existing structures are available at the Minnesota Department of Transportation, Bridge Office, 3485 Hadley Ave N, Oakdale, MN, 55128, for review and inspection by bidders; electronic copies are also available for viewing, printing and downloading on the MnDOT Consumer Access EDMS (Electronic Document Management System) at http://dotapp7.dot.state.mn.us/cyberdocs_guest/. However, the state neither warrants nor represents that existing structures conform exactly to the details shown in those plans.

SB2014-1508
Use with deck repair jobs which include wearing courses.
CREATED 8/3/1994
REVISED 5/16/2013 (2)

SB- (1508) CONSTRUCTION STAKES, LINES AND GRADES

The provisions of 1508, "Construction Stakes, Lines and Grades," are supplemented as follows:

UAR

The Engineer may take profiles before any concrete removal operations begin and as s/he deems necessary after concrete removal. The Engineer will then establish a smooth profile grade across (the) (each) bridge and its approaches that will provide the minimum wearing course thickness and a smooth transition to the inplace roadway.

SB2014-1513

Use this special provision if the loads on a bridge need to be restricted more than those weights designated in the spec book. Designer will consider construction loading (including snoopers etc.) if rating is HS20 or less.

CREATED 5/16/2013

REVISED 5/16/2013

SB- (1513) RESTRICTIONS ON MOVEMENT AND STORAGE OF HEAVY LOADS AND EQUIPMENT

The Contractor shall haul Materials and move and store equipment in accordance with the Highway Traffic Regulation Act and applicable provisions of Minnesota Rules when using public Roads or completed Structures, base courses, and pavements within the Project that are open to traffic and becoming a part of the permanent improvement.

The Contractor shall comply with legal load restrictions and with special restrictions required by the Contract when hauling or storing Materials and moving or storing equipment on Structures, completed Subgrades, base courses, and pavements within the Project, under construction or completed but not yet open to traffic.

The Contractor shall complete and place a cab card in each vehicle used for hauling bituminous mixture, aggregate, batch concrete, and grading material (including borrow and excess) before starting work. This cab card shall identify the truck or tractor and trailer by Minnesota or prorated license number and shall contain the tare, maximum allowable legal gross mass, supporting information, and the signature of the owner. The Contractor shall make the card available to the Engineer upon request. The Contract Unit Prices include Contractor-related costs in providing, verifying, and spot checking the cab card information, including weighing empty and loaded trucks on certified commercial scales.

The Contractor shall not operate equipment mounted on crawler tracks or steel tired wheels on or across concrete or bituminous surfaces unless otherwise approved by the Engineer. The Contract requirements may impose special restrictions on speed, load distribution, surface protection, and other precautions.

When construction operations require crossing an existing pavement, Bridges, or completed portions of the Pavement Structure with otherwise prohibited equipment or loads, the Contractor shall use Department-approved methods of load distribution or bridging at no additional cost to the Department.

The Contractor will not be relieved of liability for damages resulting from the operation and movement of construction equipment because of the issuance of a special permit, or by adherence to any other restrictions imposed.

Unless otherwise required by the Contract or approved by the Engineer, the Contractor shall temporarily store or park construction Materials and equipment on a Bridge deck during Bridge construction in accordance with the limits of this section, established to reflect typical design live loads. The Contractor shall store Materials and equipment limited as follows:

(1) No stockpiles weighing greater than _____ lb per 1,000 ft² [_____ kg per 100 m²],
(2) No individual stockpiles of Materials (including pallets of products, reinforcing bar bundles, and aggregate piles) weighing greater than _____ lb per 100 ft² [_____ kg per 10 m²],
(3) No single vehicle or equipment exceeding _____ lb [_____ kg], and
(4) No combination of more than _____ lb [_____ kg] of vehicles, Materials, and other equipment per span with lengths greater than _____ ft [_____ m].

If loading exceeds the above defined limits, the Contractor shall submit the proposed loads and structural analysis of the deck and beams certified by a Professional Engineer to the Bridge Engineer for the Bridge Engineer's review within a minimum of 7 calendar days before placement of loads.

SB2014-1706
Use on ALL BRIDGES.
CREATED 12/4/1994
REVISED 5/16/2013 (1)

SB- (1706) EMPLOYEE HEALTH AND WELFARE

The provisions of 1706, "Employee Health and Welfare," are supplemented as follows:

The Contractor shall submit a plan at the preconstruction conference providing all OSHA required safety equipment (safety nets, static lines, false decks, etc.) for all work areas whose working surface is 6 feet [1.8 meters] or more above the ground, water, or other surface. Submittal of this plan will in no way relieve the Contractor of his/her responsibility for providing a safe working area.

All safety equipment, in accordance with the Contractor's plan, must be inplace and operable in adequate time to allow Department personnel to perform their required inspection duties at the appropriate time. Don't place concrete in any areas affected by such required inspection until the inspection has been completed.

The installation of safety lines, safety nets, or other systems whose purpose is to reduce the hazards of bridge work may require the attachment of anchorage devices to beams, girders, diaphragms, bracing or other components of the structure. Clamp type anchorage systems which do not require modification of structural members may be used, provided they do not interfere with proper execution of the work; if using an anchorage system which requires modification of structural members, request approval, in writing, for plan modifications as provided in MnDOT specifications. Requests to install systems which require field welding or drilling of primary stress carrying members of a bridge will not be approved. The Contractor shall indicate any portions of anchorage devices which will remain permanently in the structure.

On both ends of each pier cap extending 6 feet [1.8 meters] or more above the ground, the Contractor shall install an insert or other suitable anchorage to which safety lines can be attached. Remove any portion of said device extending outside the finished lines of the pier cap unless otherwise approved by the Engineer. The Contractor shall repair or seal any void or cavity resulting from the installation or removal of this device to prevent the ponding or entry of water as directed by the Engineer.

The Contractor shall furnish, install and remove approved anchorage systems at no increased cost to the state for materials, fabrication, erection, or removal of the bridge component or anchorage system.

Use the next paragraph when lead paint is present.

Paint systems on Bridge No. _____ contain lead. Protect worker health and safety if operations result in removal or detachment of paint from metal surfaces.

SB2014-1707

Use as required for projects adjacent to roadways which are open to traffic during construction operations.

CREATED 8/3/1994

REVISED 5/16/2013 (1)

SB- (1707) CONSTRUCTION OPERATIONS ADJACENT TO ROADWAYS

The Contractor shall perform in accordance with 1404, “Maintenance of Traffic,” 1502, “Plans and Working Drawings,” and 1707, “Public Convenience and Safety,” provisions except as modified below:

When necessary to adequately prevent undermining of the existing roadbed and protect traffic, sheet and shore the roadway side and end of each footing excavation having a traveled roadway adjacent thereto. The Contractor shall leave sheeting and shoring in place until the excavated area has been properly backfilled.

Use the next paragraph when required.

The Contractor shall construct protective installations so as to just clear the neat lines of the footings along the roadway sides of those footings, having a traveled roadway adjacent thereto.

The Contractor shall at least six weeks before starting construction of the _____, supply the Engineer with five copies of the detailed plans and specifications and two copies of the associated calculations of the proposed system for constructing an installation adjacent to traveled roadways. Design the protective installations in accordance with AASHTO "Guide Design Specifications for Bridge Temporary Works". The plans and specifications shall be prepared by an engineer, thoroughly checked by a second engineer for completeness and accuracy, and certified by one of the aforementioned professional engineers licensed in the state of Minnesota. Include in the documents sufficient details so that construction of the proposed system – whether staged or not staged – can be completed solely by reference to the plans and specifications. No work will be permitted adjacent to traveled roadways until these plans have been approved by the Engineer.

SB2014-1709

Used ONLY for a bridge that is considered to be over "Navigable" waters.

CREATED 8/3/1994

REVISED 5/16/2013 (3)

SB- (1709) NAVIGABLE WATERWAYS

Perform all work on navigable waterways in accordance with 1709, "Navigable Waterways," and the following:

All work on or in navigable waters is subject to regulations formulated by the United States Coast Guard, Department of Transportation.

Prepare plans showing the location and dimensions of proposed cofferdams and other temporary construction which may directly or indirectly affect navigation clearances or impede or divert stream flow, as well as proposed method of furnishing, installing, operating and maintaining temporary navigation lights.

Use the next paragraph when located in the 8th District below 46°-20' North Latitude approximately south of a line through Breckenridge and the north end of Mille Lacs Lake.

Forward 8 sets of prints to the Commander (DWB), Eighth Coast Guard District, 1222 Spruce Street, St. Louis, Missouri 63103 for approval. When approval has been obtained from the Coast Guard, furnish two sets of prints with such approval noted thereon to the Project Engineer.

Use the next paragraph when located in the 9th District above 46°-20' North Latitude approximately north of a line through Breckenridge and the north end of Mille Lacs Lake.

Forward 8 sets of prints to the Commander (DPW3), Ninth Coast Guard District, 1240 East 9th Street, Cleveland, Ohio 44199 for approval. When approval has been obtained from the Coast Guard, furnish two sets of prints with such approval noted thereon to the Project Engineer.

Don't start construction that requires approval of the above noted governmental agency until notice of approval has been furnished to the Project Engineer.

Coast Guard approval of the location and dimensions of cofferdams and other temporary construction does not in any way relieve the Contractor of his/her responsibility for providing adequate and safe construction; nor does it in any way alter requirements for forwarding plans of cofferdams and other temporary construction to the Project Engineer for approval as to type of construction.

All costs incurred by compliance with the above requirements are considered incidental expense for which no direct compensation will be made.

SB2014-1717
Use ON ALL BRIDGES.
CREATED 8/3/1994
REVISED 5/16/2013 (4)

SB- **(1717) AIR, LAND, AND WATER POLLUTION**

The provisions of 1717, "Air, Land, and Water Pollution," are supplemented as follows:

The Contractor's attention is hereby directed to MPCA Rule 7011.0150 (http://www.pca.state.mn.us) as it relates to sandblasting and/or concrete removal operations.

Use the next eight paragraphs for ALL paint projects.

The Contractor shall contain waste materials on the project site and provide for their handling, storage, transportation and disposal in accordance with Minnesota Pollution Control laws and regulations. The Contractor shall document the storage, transfer and disposal of waste materials in accordance with the MnDOT Environmental Stewardship publication titled "MnDOT Steel Structure Paint Removal Program for Contractors", a current copy of which is available at http://www.dot.state.mn.us/environment/regulatedmaterials/paintremoval.html. Waste materials are defined as paint overspray and drippings, used paint pails, rags, spent solvents, cleaning solutions, and other related debris from cleaning operations including spent abrasive materials or paint chips. Painting, and all work associated therewith, shall be so conducted as to preclude waste materials from falling upon public waters.

It is the responsibility of the Contractor to provide the following safeguards at all times during cleaning and painting operations. All safeguards shall be in place and operable before cleaning and painting operations begin.

A. Primary safeguards such as containment (curtains and floor coverings), together with adequate structural support such as scaffolding or rope nets, shall be utilized to contain waste materials in the work area. Catchment systems shall be emptied as often as necessary to maintain their structural integrity.

B. Safeguards such as floating booms, mats of absorbent material, skimmers, or similar systems shall be placed in streams to avoid nuisance conditions in the stream caused by cleaning or painting operations.

C. Locked storage of cleaning and painting materials to prevent access by vandals.

Cleaning and painting operations shall be suspended during periods when unfavorable weather conditions may reduce the effectiveness of the above noted safeguards. In situations where use of some of the safeguards listed are not feasible, other innovative safeguards shall be employed. Emphasis shall be placed on containment of waste materials rather than placing reliance on safeguards such as booms, straw dams, skimmers, or absorbent mats. These shall be considered backup systems to guard against water pollution which may result from the failure of primary safeguards.

Materials such as paint chips and sand which are readily recoverable from bridge decks or stream banks, empty paint pails, and rags and debris from cleaning operations shall be disposed of in a proper manner. Paint chips and spent sand shall be removed from the bridge deck on a daily basis and in an approved manner. Recoverable sand and paint chips from blasting operations may be recycled, but the ultimate disposal shall be to an appropriate waste facility. Spent aqueous cleaning solutions shall be discharged to a recognized sewage collection and treatment system. Spent solvents and cans or pails containing waste paint shall be taken to an incinerator approved by the MPCA for disposal, or to an MPCA approved hazardous waste storage area.

In the event of an accidental loss of painting or cleaning materials or debris into public waters, the Contractor shall take immediate action to recover the lost materials, and the incident shall be promptly reported by telephone to the State Duty Officer at 1 800 422 0798 followed by a written report addressed to MPCA, Water Quality Division, Compliance and Enforcement Section, 520 Lafayette Road, St. Paul, Minnesota, 55155.

Use the next paragraph only when required by pollution control or fish and wildlife agencies.

Unless otherwise provided in these special provisions, construction, demolition and/or removal operations conducted over or in the vicinity of public waters shall be so controlled as to prevent materials from falling into the water. Any materials which do fall into the water, or onto areas where there is a likelihood that they will be picked up by rising water levels, shall be retrieved and stored in areas where such likelihood does not exist.

SB2014-1803

Use on all repair and widening jobs where stage construction is required.

CREATED 8/3/1994

REVISED 5/16/2013 (1)

SB- (1803) PROGRESS SCHEDULES

The provisions of 1803, "Progress Schedules," are supplemented as follows:

The Contractor's attention is hereby called to the requirements for stage construction as indicated in the Plans and/or Special Provisions. The Contractor shall submit plans and schedules to the Engineer for approval detailing his/her proposed scheme and sequence of operations, including traffic channelization, flagging, protective installations, and other pertinent procedures to be employed both on and off of the structure.

No compensation, other than for plan pay items, will be made for complying with the above requirements.

SB2014-1807.1
Use when SB2014-2476.1 is used.
CREATED 12/12/2001
REVISED 5/16/2013 (2)

SB- (1807) FAILURE TO COMPLETE WORK ON TIME

The provisions of 1807.1, "Assessment of Liquidated Damages," are supplemented as follows:

See requirements for *Methods for Paint Removal and Waste Disposal* as indicated in these special provisions SB. _____.

The Contractor is subject to a daily charge for failure to submit documentation of the testing and disposal of hazardous and non-hazardous waste as required under these special provisions. A $150.00 monetary deduction per calendar day, per shipment will be assessed and the amount deducted from any monies due the Contractor, until all work is complete to the satisfaction of the Engineer.

The monetary deduction as set forth above may apply equally, separately and may be assessed concurrently with other damages as described in these special provisions and the Standard Specifications for Construction.

SB2014-1807.2
Use when SB2014-2476.2 is used.
CREATED 12/12/2001
REVISED 5/16/2013 (2)

SB- (1807) FAILURE TO COMPLETE WORK ON TIME

The provisions of 1807.1, "Assessment of Liquidated Damages," are supplemented as follows:

See requirements for *Containment and Disposal of Waste Materials* as indicated in these special provisions SB. _____.

The Contractor is subject to a daily charge for failure to submit documentation of the testing and disposal of hazardous and non-hazardous waste as required under these special provisions. A $150.00 monetary deduction per calendar day, per shipment will be assessed and the amount deducted from any monies due the Contractor, until all work is complete to the satisfaction of the Engineer.

The monetary deduction as set forth above may apply equally, separately and may be assessed concurrently with other damages as described in these special provisions and the Standard Specifications for Construction.

SB2014-2104

Use for full deck removal or full bridge removal or when an Asbestos and Regulated Waste Inspection Report has been completed.

CREATED 12/1/2004

REVISED 3/4/2015 (7)

SB- (2104) REMOVAL OF ASBESTOS AND REGULATED WASTE (BRIDGE)

Remove and dispose of any regulated waste found on existing bridges or from the utilities located on the bridge in accordance with the applicable MnDOT Standard Specifications and the following:

SB- If, during the course of removal or renovation of utility or bridge, additional asbestos materials or regulated wastes other than that noted in the Assessment Summary are encountered, notify the MnDOT Project Engineer to suspend work and furnish a documented inspection and evaluation by a MnDOT approved certified MDH contractor prior to resuming work. The work, as outlined in this paragraph, will be paid for as Extra Work.

SB- Dispose of all asbestos and/or regulated waste in accordance with MnDOT's manual. Only those listed in this manual as pre-approved for asbestos and/or regulated waste will be allowed to work on this project. Use MnDOT approved companies for testing, waste transport and disposal as provided and described in MnDOT's manual "*Asbestos and Regulated Waste Manual For Structure Demolition Or Relocations for Construction Projects*" available on the following website: http://www.dot.state.mn.us/environment/buildingbridge/index.html. Contact MnDOT Office of Environmental Stewardship at 651-366-3630 with any questions regarding the manual.

SB- All material shall be removed, identified, and disposed of in accordance with Section S-1701 (LAWS TO BE OBSERVED (BRIDGE)) of these Special Provisions. Permission to begin the regulated waste removals, with the exception of material needed for hazardous and regulated waste assessment or testing, will not be granted until the Engineer has copies of all required notices.

SB- Permission to proceed with the demolition or renovation of bridges will not be granted until the Engineer has received copies of all required notifications as indicated in Section S-1701 (LAWS TO BE OBSERVED (BRIDGE)) of these Special Provisions.

Notify any utility owners at least three (3) days prior to the removal of any regulated waste which may affect the utility, allowing the utility owner time to have a representative on site.

SB- See the attached "Asbestos and Regulated Waste Inspection Report" for information on whether or not asbestos or regulated waste was detected in the bridge(s) to be removed or renovated.

The assessment summary along with the plan or Special Provisions is intended for informational purposes. Quantity, type and analysis of any asbestos or regulated waste containing material are estimates intended as a general guide.

Use the next paragraph when the assessment report identifies non-utility related ACM's or regulated waste.

SB- No measurement will be made of any portion of the asbestos or regulated waste material removal, but the complete removal thereof as specified shall be construed to be included in the single lump sum for which payment is made under Item 2104.601 (Remove Regulated Waste Material (Bridge)).

Use the next paragraph when the assessment report identifies utility related (i.e. piping insulation, piping materials, etc.) ACM's or regulated waste

SB- Remove items _____, _____ & _____ identified in the attached assessment. No measurement will be made of any portion of the asbestos or regulated waste material removal from any utility, but the complete removal thereof as specified shall be construed to be included in the single lump sum for which payment is made under Item 2104.601 (Remove Regulated Waste Material (Utility)).

SB2014-2105
See designer notes below.
CREATED 11/2/1994
REVISED 5/16/2013 (2)

SB- BRIDGE ABUTMENT CONSTRUCTION

Use the following paragraph where Foundations & Other Recommendations require a time delay.

Do not start construction of each abutment until (at least 72 hours after) (_____ months after) the approach fill at that abutment has been constructed to the full height and cross section. Extend the approach fill construction a distance of at least 50 feet [15 m] behind the abutment as measured along the centerline of the roadway.

Consult w/ Regional Bridge Construction Engineer, use when abutment is supported on spread footing and settlement may be an issue. Also, consult w/ grading designer to modify std. plan sht. 5-297.233 to show limits of surcharge.

SB- Construct the approach surcharge to the full height and cross section starting from the _____ (e.g., front edge of the footing) and extending back a distance of at least 50 feet [15 m] as measured along the centerline of the roadway of bridges supported on spread footings. See Standard Plan Sheet 5-297.233 and .234 in the roadway plans for additional information.

Consult w/ Regional Bridge Construction Engineer, use when there is insufficient room to place 1:1.5 slope at front edge of surcharge.

SB- Construct abutment approach fill to the dimensions shown in the plans using temporary shoring or sheeting. The relevant contract unit price for Structure Excavation includes the cost of providing, installing, and removing temporary shoring or sheeting as included in the cost of structure excavation.

SB2014-2360

Use on repair and widening jobs where bituminous wearing course is required.

CREATED 8/3/1994

REVISED 5/16/2013 (3)

SB- **PLANT MIXED ASPHALT PAVEMENT**

This work consists of _____(describe work) _____.

The designer is required to attach a note to his/her specs notifying the Special Provisions Engineer of the need for MnDOT 2360 special provision to be placed in the Division "S" section of the Proposal.

The designer is also required to contact the Bituminous Office (John Garrity 651/366-5577) for the mix number(s) and the pay item(s).

SB2014-2401
Use on all projects.
CREATED 8/3/1994
REVISED 5/12/2015 (6)

SB- **(2401) CONCRETE BRIDGE CONSTRUCTION**

The provisions of 2401, "Concrete Bridge Construction," are supplemented as follows:

Designer is directed to evaluate all potential prematurely applied load scenarios (i.e. pier caps, concrete hinges, falsework, etc.) and if a strength greater than what is defined in Table 2401-1, "Curing Requirements for Concrete Bridge Elements," is required write a SP for it here. Reminder: all barrier rails are 100%.

SB- Add the following to 2401.3.G:

The curing requirement for concrete bridge element _____ is _____ percent of the compressive strength prior to applying load to the element from _____.

SB2014-2401.1

Use on projects requiring High Performance Concrete (3YHPC) when required by the Regional Construction Eng.

CREATED 2/11/2015

REVISED 4/22/2015 (1)

SB- **Structural Concrete – High Performance Concrete Bridge Decks (Contractor Concrete Mix Design)**

Delete the contents of 2401.2.A, "Concrete," and replace with the following:

For Bridge No. _____, design a **3YHPC-M** or **3YHPC-S** concrete mixture that will minimize cracking. Perform the work in accordance with the applicable requirements of MnDOT 2401, "Concrete Bridge Construction," 2461, "Structural Concrete," and the following:

2.A.1 Fine Aggregate Requirements

Provide fine aggregates complying with quality requirements of 3126.2.D, "Deleterious Material," 3126.2.E, "Organic Impurities," and 3126.2.F, "Structural Strength."

2.A.1.a Fine Aggregate Alkali Silica Reactivity (ASR) Requirements

The Department will routinely test fine aggregate sources for alkali silica reactivity (ASR) in accordance with the following:

(1) Multiple sources of certified portland cement in accordance with ASTM C 1260 MnDOT Modified; and

(2) Multiple combinations of certified portland cement and supplementary cementitious materials in accordance with ASTM C 1567 MnDOT Modified.

The Concrete Engineer, in conjunction with the Engineer, will review the 14-day fine aggregate expansion test results to determine the acceptability of the proposed fine aggregate and cement combination in accordance with the following:

(1) For fine aggregate and cement combinations previously tested by the Department, the Concrete Engineer will use the average of all 14-day unmitigated test results for an individual source to determine necessary mitigation in accordance with Table HPC-1.

(2) If the previously tested proposed fine aggregate and cement combination requires less mitigation than the average 14-day unmitigated test result, the Concrete Engineer will allow mitigation at the lesser rate in accordance with Table HPC-1.

(3) Alkali silica reactivity (ASR) ASTM C1260 and ASTM C1567 test results are available on the MnDOT Concrete Engineering Unit website.

Table HPC-1
Fine Aggregate ASR Mitigation Requirements

14-day Fine Aggregate Unmitigated Expansion Limits	Class F Fly Ash	Class C Fly Ash	Slag	Slag/Class F Fly Ash	Slag/Class C Fly Ash	IS(20)/Class F Fly Ash	IS(20)/Class C Fly Ash
≤ 0.150	No mitigation required						
>0.150 - 0.200	Minimum 20%	Minimum 20%	35%	20% Slag with a minimum of 15% Class F fly ash	20% Slag and 20% Class C fly ash	Type IS(20) with a minimum of 15% Class F	Type IS(20) with a minimum of 15% Class C
> 0.200 – 0.300	Minimum 20%	Minimum 30%	35%				
> 0.300	The Department will reject the fine aggregate						

The Contractor may use 100% Portland cement for High Early Concrete, provided no mitigation is required for the fine aggregate in accordance with Table HPC-1. If mitigation is required, the Contractor is required to use a minimum of 15% of any supplementary cementitious material when designing High Early Concrete.

The Concrete Engineer may reject the fine aggregate if mortar bar specimens exhibit an indication of external or internal distress not represented by the expansion results. The Concrete Engineer will make the final acceptance of the aggregate.

2.A.2 Intermediate Aggregate Requirements

Provide intermediate aggregates complying with the quality requirements of 3137.2.D.2, "Coarse Aggregate for Bridge Superstructure," except as modified in Table HPC-2. If the intermediate aggregate is from the same source as the ¾ in- fraction, the aggregate quality is determined based upon the composite of the ¾ in- and intermediate aggregate.

The Concrete Engineer classifies intermediate aggregate in accordance with Table HPC-2.

Table HPC-2
Intermediate Aggregate for Use in Concrete

If the gradation meets the following:	Classify material type as:	Gradation Test Procedures	Quality Test Requirements
100% passing the 1/2" and ≤90% passing #4	Intermediate Aggregate	Coarse Aggregate (+4 Portion)	Spec. 3137.2.D.2 except 3137.2.D.2(i) modified to maximum 40% carbonate
		Fine Aggregate (-4 Portion)	Shale in Sand (-4 Portion)
100% passing the 1/2" and >90% passing #4	Intermediate Aggregate	Fine Aggregate (Minimum 1000 g sample)	Shale Content Test by AASHTO T113 MnDOT Modified (+4 Portion)
			Shale in Sand (-4 Portion)
100% passing the 3/8" and ≤90% passing #4	Coarse Sand	Fine Aggregate	Shale Content Test by AASHTO T113 MnDOT Modified (+4 Portion)
			Shale in Sand (-4 Portion)

For any intermediate aggregate size not previously tested by the Department, the Concrete Engineer reserves the right to test for alkali silica reactivity, in accordance with ASTM C1260, prior to allowing incorporation into the concrete mix design.

2.A.3 Coarse Aggregate Requirements

Provide Class A, B or C coarse aggregate meeting the quality requirements in accordance with 3137.2.D.2, "Coarse Aggregate for Bridge Superstructure."

When providing Class B aggregate, the maximum absorption percent by weight is 1.10%.

2.A.3.a Coarse Aggregate Alkali Silica Reactivity (ASR) Requirements

When using coarse aggregate identified as quartzite or gneiss, the Concrete Engineer will review ASTM C1293 testing to determine the necessary ASR mitigation requirements in accordance with Table HPC-3.

ASR ASTM C1293 test results are available on the MnDOT Concrete Engineering Unit website.

Table HPC-3
Coarse Aggregate ASR Mitigation Requirements*

ASTM C1293 Expansion Results	Class F Fly Ash	Class C Fly Ash	Slag	Slag/Class F Fly Ash	Slag/Class C Fly Ash	IS(20)/Class F Fly Ash	IS(20)/Class C Fly Ash
≤ 0.040	No mitigation required						
>0.040	Minimum 30%	Not Allowed	35%	20% Slag with a minimum of 15% Class F fly ash	20% Slag and 20% Class C fly ash	Type IS(20) with a minimum of 15% Class F	Type IS(20) with a minimum of 15% Class C

* The Engineer will allow the Contractor to substitute a portion of the minimum required supplementary cementitious material with up to 5% silica fume by weight for mitigation purposes.

2.A.4 Cementitious Materials

Provide only cementitious materials from the Approved/Qualified Products List.

2.A.4.a Cement

Use Type I or Type I/II cement complying with Specification 3101, "Portland Cement," or blended cement in accordance with Specification 3103, "Blended Hydraulic Cement."

(1) Total alkalis (Na_2Oe) no greater than 0.60 percent in the portland cement, and
(2) Total alkalis (Na_2Oe) no greater than 3.0 lb per yd^3 of concrete resulting from the portland cement.

2.A.4.b Fly Ash

Use fly ash conforming with Specification 3115, "Fly Ash for use in Portland Cement." The Concrete Engineer defines Class F fly ash for the purposes of ASR mitigation as having a maximum CaO content of 18.0%.

2.A.4.c Ground Granulated Blast Furnace Slag

Use ground granulated blast furnace slag conforming to Specification 3102, "Ground Granulated Blast-Furnace Slag."

2.A.4.d Silica Fume

Use silica fume conforming to ASTM C 1240.

2.A.4.e Ternary Mixes

Ternary mixes are defined as portland cement and two other supplementary cementitious materials, or blended cement and one other supplementary cementitious material with a maximum replacement of 40% by weight.

2.A.5 Allowable Admixtures

Use any of the following admixtures on the MnDOT Approved/Qualified Products as listed under "Concrete Admixtures A-S":

(A) Type A, Water Reducing Admixture,
(B) Type B, Retarding Admixture,
(C) Type C, Accelerating Admixture,
(D) Type D, Water Reducing and Retarding Admixture,
(E) Type F, High Range Water Reducing Admixture, and
(F) Type S, Specific Performance Based Admixture

Obtain a written statement from the manufacturer of the admixtures verifying:
(1) Compatibility of the combination of materials, and
(2) Manufacturer recommended sequence of incorporating the admixtures into the concrete.

The manufacturer will further designate a technical representative to dispense the admixture products.

Utilize the technical representative in an advisory capacity and have them report to the Contractor any operations or procedures which are considered as detrimental to the integrity of the placement. Verify with the Engineer whether the Manufacturer's technical representative's presence is required during the concrete placement.

2.A.6 Concrete Mix Design Requirements

Submit the concrete mixes using the appropriate MnDOT Contractor Mix Design Submittal Workbook available on the Department's website at least 21 calendar days before the initial concrete placement. For mix design calculations, the Engineer, in conjunction with the Concrete Engineer, will provide specific gravity and absorption data.

The Concrete Engineer, in conjunction with the Engineer, will review the mix design submittal for compliance with the contract.

2.A.6.a Concrete Mix Design Requirements

Design and produce 3YHPC-M or 3YPHC-S concrete mixes based on an absolute volume of 27.0 ft^3 [1.0 m^3] in accordance with the Table HPC-4 and the following requirements:

Table HPC-4
High Performance Bridge Deck Concrete Mix Design Requirements

Concrete Grade	Mix Number *	Intended Use	w/c ratio	Target Air Content	Maximum %SCM (Fly Ash/Slag/ Silica Fume/ Ternary) ‖	Slump Range †, *inches*	Minimum Compressive Strength, f'c (28-day)	3137 Spec.
HPC	3YHPC-M	Bridge Deck – Monolithic	0.35-0.45	6.5%	30/35/5/40	1 - 4	4000 psi	2.D.2
	3YHPC-S	Bridge – Structural Slab						

* Provide a Job Mix Formula in accordance with 2401.2.A.7. Use any good standard practice to develop a job mix formula and gradation working range by using procedures such as but not limited to 8-18, 8-20 gradation control, Shilstone process, FHWA 0.45 power chart or any other performance related gradation control to produce a workable and pumpable concrete mixture meeting all the requirements of this contract.
‖ The individual limits of each SCM shall apply to ternary mixtures.
† Keep the consistency of the concrete uniform during entire placement.

2.A.6.b Required Preliminary Testing

Prior to placement of any 3YHPC-M or 3YHPC-S Concrete, the Engineer will require preliminary batching and testing of the concrete mix design.

Submit the concrete mixes using the appropriate MnDOT Contractor Mix Design Submittal Workbook available on the Department's website at least 14 calendar days prior to the beginning of preliminary laboratory mixing and testing of the proposed mix designs. Any changes or adjustments to the material or mix design require a new Contractor mix design submittal. For mix design calculations, the Engineer, in conjunction with the Concrete Engineer, will provide specific gravity and absorption data.

The Concrete Engineer, in conjunction with the Engineer, will review the mix design submittal for compliance with the contract.

Test the concrete for the following hardened concrete properties in accordance with Table HPC-5:

Table HPC-5 Required Hardened Concrete Properties for Mixes 3YHPC-M and 3YHPC-S		
Test	Requirement	Test Method
Required Strength (Average of 3 cylinders)	4000 psi at 28 days	ASTM C31
Rapid Chloride Permeability	≤ 2500 coulombs at 28 days (For Preliminary Approval) ≤ 1500 coulombs at 56 days	ASTM C1202
Freeze-Thaw Durability	Greater than 90% at 300 cycles	ASTM C666 Procedure A
Shrinkage	No greater than 0.040 percent at 28 days	ASTM C157
Scaling	Visual rating not greater than 1 at 50 cycles	ASTM C672

The Engineer will allow the maturity method for subsequent strength determination. Perform all maturity testing in accordance with ASTM C1074 and the MnDOT Concrete Manual.

If a mix is approved, the Concrete Engineer will consider the mix design and testing as acceptable for a period of 5 years provided the actual concrete mixed and placed in the field meets the Contract Requirements. The Concrete Engineer will not require new testing within that 5-year period as long as all the constituents (including the aggregates) of the proposed mix design are the same as the original mix design.

The Engineer determines final acceptance of concrete for payment based on satisfactory field placement and performance.

2.A.7 Job Mix Formula

A Job Mix Formula (JMF) contains the following:

(a) Proportions for each aggregate fraction,
(b) Individual gradations for each aggregate fraction, and
(c) Composite gradation of the combined aggregates including working ranges on each sieve in accordance with Table HPC-6.

Table HPC-6 Job Mix Formula Working Range	
Sieve Sizes	**Working Range, %***
1 in [25 mm] and larger	±5
¾ in [19 mm]	±5
½ in [12.5 mm]	±5
⅜ in [9.5 mm]	±5
No.4 [4.75 mm]	±5
No.8 [2.36 mm]	±4
No.16 [1.18 mm]	±4
No.30 [600 µm]	±4
No.50 [300 µm]	±3
No.100 [150 µm]	±2
No.200 [75 µm]	≤ 1.6
* Working range limits of the composite gradation based on a moving average of 4 tests (N=4).	

2.A.7.a Verification of JMF

Prior to beginning placements of bridge deck concrete, perform gradation testing to ensure current materials comply with the approved JMF. Perform gradation testing in accordance with the Schedule of Materials Control.

(1) Take samples at the belt leading to the weigh hopper or other locations close to the incorporation of the work as approved by the Engineer.
(2) Add fill-in sieves as needed during the testing process to prevent overloading.

The Producer and Engineer will test and record the individual gradation results using the Concrete Aggregate Worksheet.

(1) Using the JMF Moving Average Summary Worksheet, calculate the moving average of Producer aggregate gradation test results during production.
(2) The Engineer will randomly verify Producer combined aggregate gradation results as defined in the Schedule of Materials Control.

If, during production, the approved JMF falls outside of the allowable working range immediately sample and test additional gradation and continue production.

2.A.7.b JMF Adjustment

If it is determined that the current aggregates do not meet the approved JMF, submit a new mix design including JMF to the Concrete Engineer in accordance with 2401.2.A.7.

2.A.7.c JMF Acceptance

The Engineer will make monetary adjustments for the quantity of bridge deck concrete represented by the JMF Working Range failure, from the failing test to the next passing test, at a minimum rate of $500.00 or $5.00 per cubic yard, whichever is greater.

2.A.8 Laboratory batching, testing requirements and submittals:

To determine the characteristics of the Contractor proposed mix design, the Concrete Engineer will require the Contractor to prepare test batches and do laboratory testing. Conduct all batching and testing of concrete at a **single** AMRL certified laboratory using the exact materials proposed in the mix design.

Lab testing requirements:

(a) Slump and air content at <5 minutes, 15 minutes, and 30 minutes after the completion of mixing,
(b) Compressive strength (Make cylinders in accordance with AASHTO T126 and tested in accordance with AASHTO T22) at 1, 3, 7, 28, 56 days (sets of 3),
(c) Hardened air content (ASTM C457) at a minimum of 7 days,
(d) Rapid chloride permeability (ASTM C1202) at 28 days and 56 days (2 specimens for 28 day test and 2 test specimens for 56 day test (Take 2 specimens from each batch of a 2 batch mix)),
(e) Concrete Durability (ASTM C666, Procedure A) at 300 cycles, and
(f) Concrete Shrinkage (ASTM C157) at 28 days.

The Contractor is required to contact the MnDOT Concrete Engineering Unit a minimum of 2-days prior to any mixing so that a MnDOT representative can observe the process. This same 2-day notification is required prior to any physical testing on hardened concrete samples. Additionally, retain any hardened concrete test specimens for a minimum of 90 days and make available for MnDOT to examine.

Perform all testing for plastic concrete after all admixtures additions to the concrete mixture.

After completion of the laboratory testing specified herein and, at least, 15 working days prior to the trial placement, submit the laboratory test data to the MnDOT for review and acceptance.

Include the following information in the laboratory reports of the design mixes:

(a) Exact batch weights and properties of all ingredients used and all aggregate gradations
(b) Slump and air content

(c) Cylinder identification, including mix designation
(d) Date and time of cylinder preparation
(e) Date and time cylinder specimen was tested
(f) Compressive strength of each cylinder specimen at 1, 3, 7, 28, and 56 day (sets of 3)
(g) A graphic plot of age, from 0 to 56 days, vs. strength for each mix design
(h) Hardened air content at a minimum of 7 days
(i) Rapid chloride permeability at 28 days and 56 days
(j) Concrete Durability at 300 cycles and
(k) Concrete Shrinkage at 28 days.

2.A.9 Prior to Actual Bridge Deck Placement

2.A.9.a Trial Placement

A minimum of 14 calendar days prior to the actual placement of the bridge deck slab concrete, successfully complete a separate trial placement utilizing a minimum of two (2) - 10 yd^3 loads.

The Engineer may allow the incorporation of the concrete for trial batches into the bridge footings, abutments or end diaphragms. The Contractor may also choose to incorporate the trial batches into residential /commercial construction in the immediate vicinity of the project. In any case, the Engineer will require mixing, transporting, and placing the concrete using the same methods as the actual placement of the bridge deck.

If the concrete is incorporated into the permanent work, the Engineer will test the plastic concrete in accordance with the Schedule of Materials Control. The Engineer may require additional trial batches if the concrete delivered to the project does not comply with the plastic concrete requirements of the Contract.

The Engineer will waive a trial placement, at the contractor's request, provided the contractor submits a history of at least three successful bridge deck placements in the last 5 years using the same mix design and similar pumping or placement configuration.

The concrete mix design, laboratory batching and mixing, and the trial placement is incidental to the concrete furnished and placed.

Use the same materials, same supplier, and same supplier's manufacturing plant, and proportions in the permanent work as in the trial placement. Strength requirements specified for each mix are applicable to the cylinder tests taken during the production work.

2.A.9.b Slab Placement and Curing Plan

At least 14 calendar days prior to slab placement, provide a slab placement and curing plan for each bridge to the Engineer for approval. Include the following information in the placement and curing plan:

(1) Anticipated concrete delivery rates
(2) Estimated start and finish time
(3) Material, labor and equipment proposed for placing, finishing, and curing including placement of wet burlap, soaker hose, or other system to maintain the deck in a moist condition during the curing period
(4) Number of work bridges proposed for use
(5) Number of people responsible for the various tasks and
(6) Bulkheading methods and materials proposed for use if the Contractor cannot maintain the proposed concrete placement rates.

A 10 ft [3 m] float is required for full-depth decks prior to carpet dragging regardless of whether texture planing is specified for the final ride surface. Float slab in accordance with MnDOT Construction Manual 5-393.358 to ensure the final surface does not vary by greater than ⅛ in [3 mm] within a 10 ft [3 m] straightedge laid longitudinally on the final surface. This surface tolerance includes areas near expansion devices and other breaks in the continuity of the bridge slab.

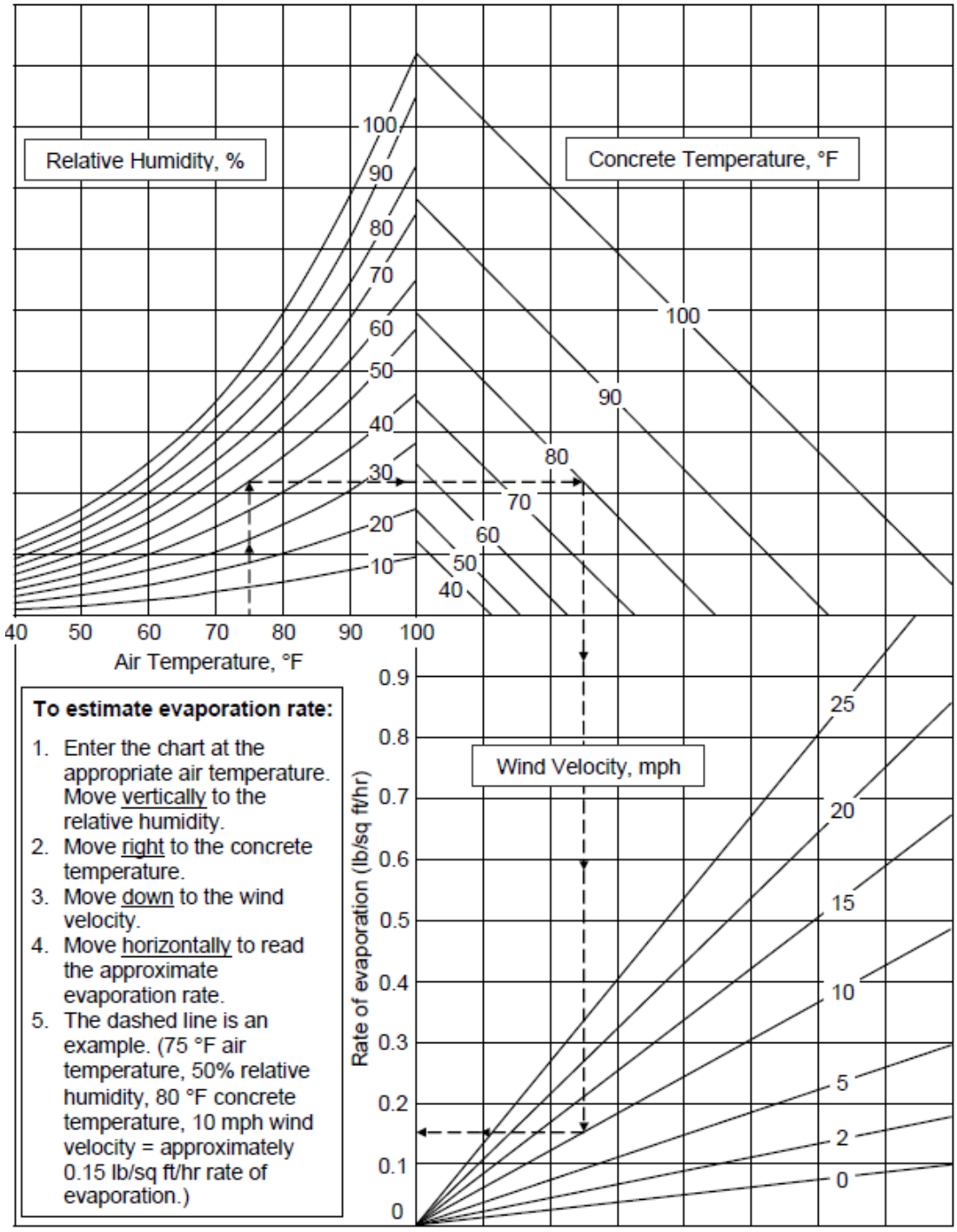
Attend a pre-placement meeting 2 days to 4 days before the slab placement to review the information and details provided in the placement and curing plan. The following project personnel are required to attend the pre-placement meeting:

(1) Contractor
(2) Engineer
(3) Concrete supplier and
(4) If required by the Engineer, the concrete pump supplier.

2.A.9.c Three (3) Hours Prior to Beginning Bridge Deck Concrete Placement

The Engineer requires the Contractor to comply with all of the following conditions prior to allowing the Contractor to begin the bridge deck concrete placement:

(1) Provide a forecast to the Engineer three (3) hours before placement. The Engineer will review the forecast for the following:
   (a) No forecasted precipitation two (2) hours prior to the scheduled placement duration, nor up to two (2) hours after the anticipated completion of the placement, and
   (b) Less than 30% chance of precipitation for the entire placement window and
(2) Only if the combination of air temperature, relative humidity, concrete temperature and wind velocity produces an evaporation rate of less than 0.20 pounds per square foot of surface area per hour, according Figure HPC-1:



[1] Based on ACI 305 R, "Hot Weathering Concreting"

FIGURE HPC-1

SB- Delete the 16th paragraph through 18th paragraphs of 2401.3.G, "Concrete Curing and Protection," and replace with the following:

2.A.9.d Actual Bridge Deck Placement and Curing Requirements

In addition to the requirements set forth in 2461.3.G.4, "Field Adjustments," if any adjustments are necessary on site, comply with the following:

(1) The Engineer will only allow the addition of admixtures originally incorporated into the mix, except Viscosity Modifying Admixture (VMA) is allowed to adjust slump even if they were not used in the original testing

(2) The Engineer will allow a maximum of 1 gal of water additions per yd^3 of concrete on site provided additional water is available to add per the Certificate of Compliance, including any water necessary to dilute admixtures and

(3) Mix the load a minimum of 5 minutes or 50 revolutions after any additions.

The Engineer will not allow finishing aids or evaporation retarders for use in finishing of the concrete.

The Contractor is fully responsible for curing methods. Comply with the following curing methods unless other methods are approved by the Engineer in writing.

Table HPC-7
Required Curing Method Based on Final Bridge Deck Surface

Bridge Deck Type	Final Bridge Deck Surface	Required Curing Method ‖
Bridge structural slab curing (3YHPC-S)	Low Slump Wearing Course	Conventional wet curing after carpet drag
Bridge deck slab curing for full-depth decks (3YHPC-M)	Epoxy Chip Seal Wearing Course or Premixed Polymer Wearing Course	Conventional wet curing after carpet drag
	Bridge Deck Planing	Conventional wet curing after carpet drag.
	Tined Texturing*	Conventional wet curing after tine texturing AMS curing Compound after wet cure period
	Finished Sidewalk or Trail Portion of Deck (without separate pour above)*	Conventional wet curing after applying transverse broom finish AMS curing Compound after wet cure period

‖ Apply conventional wet curing to bridge slabs following the finishing machine or air screed.
* Prevent marring of broomed finish or tined textured surface by careful placement of wet curing.

Use conventional wet curing consisting of pre-wetted burlap covered with white plastic sheeting in accordance with the following:

(1) Place the burlap to cover 100 percent of the deck area without visible openings

(2) Place the wet curing within 30 min after the finishing machine completes the final strike-off of the concrete surface

(3) If the Contractor fails to place the wet curing within 30 min, the Department will monetarily deduct $500 for every 5 min period, or any portion thereof, after the initial time period until the Contractor places the wet curing as approved by the Engineer, the Department may assess the deduction more than once

(4) Keep the slab surface continuously wet for an initial curing period of at least 7 calendar days

(5) Use a work bridge to follow the finish machine and

(6) Provide an additional center rail on wide bridges, if necessary.

Where marring of the broomed finish or tined texturing surface finish is a concern, the Engineer may authorize curing as follows:

(1) Apply a membrane curing compound meeting the requirements of 3754, "Poly-Alpha Methylsytrene (AMS) Membrane Curing Compound"
(2) Apply curing compound using approved power-operated spray equipment
(3) Provide a uniform, solid white, opaque coverage of membrane cure material on exposed concrete surfaces (equal to a white sheet of paper)
(4) Place the membrane cure within 30 min of concrete placement unless otherwise directed by the Engineer
(5) Provide curing compound for moisture retention until the placement of a conventional wet curing
(6) Apply conventional wet curing when walking on the concrete will not produce imprints deeper than $^{1}/_{16}$ in [1.6 mm]
(7) Keep the deck slab surface continuously wet for an initial curing period of at least 7 calendar days including weekends, holidays, or both if these fall within the 7-calendar-day curing period
(8) The Engineer will not allow placement of membrane curing compound on any concrete surface that expects future placement of additional concrete on that surface and
(9) If the Contractor fails to meet these requirements, the Department may reduce the contract unit price for the concrete item in accordance with 1512, "Conformity with Contract Documents."

SB- Delete 2401.3.I.2, "Crack Sealing," and replace with the following:

The Contractor is fully responsible for crack sealing all cracks identified by the Engineer in accordance with Table HPC-8.

Table HPC-8
Required Crack Sealing Requirements Based on Final Bridge Deck Surface

Bridge Deck Type	Final Bridge Deck Surface	Crack Sealing Requirements
Bridge structural slab (3YHPC-S) *	Low Slump Wearing Course	Seal cracks in accordance with 2401.3.I.2
Bridge deck slab for full-depth decks (3YHPC-M)	Epoxy Chip Seal Wearing Course or Premixed Polymer Wearing Course	See wearing course special provision
	Bridge Deck Texture Planing	Seal cracks in accordance with 2401.3.I.2 after texture planing
	Tined Texturing	Seal cracks in accordance with 2401.3.I.2
	Finished Sidewalk or Trail Portion of Deck (without separate pour above)	Seal cracks in accordance with 2401.3.I.2

* Shotblast the surface in preparation for low slump wearing course. Prior to placing the low slump wearing course, the Engineer will visually inspect the bridge structural slab, and will mark cracks that require sealing appearing on the top surface. Control the application of the crack sealer such that the maximum width of crack sealant does not exceed 1 in [25 mm]. If exceeding the permitted width of 1 in [25 mm], remove excess by means of surface grinding to prevent debonding of concrete wearing course. The Engineer requires the sealer to cure completely prior to pre-wetting of the deck, as required for placement of a low slump concrete wearing course.

Designer note: select the method that is required and remove the other.

SB- Method of Measurement

If measuring bridge slab concrete by area, the Engineer will base the measurement on end-of-slab stationing and out-to-out transverse dimensions of the slab.

If measuring bridge slab concrete by cubic yard, the Engineer will base the measurement on the basis of the dimensions of the structure shown in the plans of the slab.

Designer note: select the payment that is required and remove the others.

SB- Basis of Payment

Payment for Item No. 2401.618 "BRIDGE SLAB CONCRETE (3YHPC-M)" will be made at the Contract price per square foot and shall be compensation in full for all costs of forming, placing, finishing, curing, crack sealing, and all associated incidentals necessary to construct the bridge deck and diaphragms as detailed in the Plans in accordance with these specifications.

Payment for Item No. 2401.618 "BRIDGE SLAB CONCRETE (3YHPC-S)" will be made at the Contract price per square foot and shall be compensation in full for all costs of forming, placing, finishing, curing, crack sealing, and all associated incidentals necessary to construct the bridge deck and diaphragms as detailed in the Plans in accordance with these specifications.

Payment for Item No. 2401.607 "BRIDGE SLAB CONCRETE (3YHPC-M)" will be made at the Contract price per cubic yard and shall be compensation in full for all costs of forming, placing, finishing, curing, crack sealing, and all associated incidentals necessary to construct the bridge deck and diaphragms as detailed in the Plans in accordance with these specifications.

Payment for Item No. 2401.607 "BRIDGE SLAB CONCRETE (3YHPC-S)" will be made at the Contract price per cubic yard and shall be compensation in full for all costs of forming, placing, finishing, curing, crack sealing, and all associated incidentals necessary to construct the bridge deck and diaphragms as detailed in the Plans in accordance with these specifications.

SB- Control Strength Cylinders

Delete 2461.3.G.5.b, "Control Strength Cylinders," and replace with the following:

3.G.5.b Curing and Transporting Standard (28-day) Strength Cylinders

Provide moist curing environments of adequate size and number for initial and final curing in accordance with ASTM C31 and in accordance with 2031.3.C, "Special Requirements."

The Concrete Engineer defines the **initial curing period** as immediately after molding and finishing for a period of up to 48 hours in a temperature range from 60° F to 80° F [16° C and 27° C].

After the initial curing period, the Engineer will both transport and further cure the test specimens in the provided curing tanks. The Engineer will deliver the test specimens to the laboratory for compressive strength testing.

Provide curing tanks of adequate size and number for curing all of the concrete test specimens in accordance with 2031.3.C, "Special Requirements." Maintain the water in the curing tanks to a water temperature of 60° F to 80° F [16° C and 27° C]. When cured in the testing laboratory, maintain the cylinders at a temperature of 73.5° F ± 3.5° F [23.0° C ± 2.0° C].

The Engineer will allow the Contractor to submit a strength-maturity relationship curve for use in lieu of control cylinders. Perform all maturity testing and validation of the strength-maturity relationship curve in accordance with ASTM C1074 and the MnDOT Concrete Manual.

3.G.5.b (1) Acceptance of Concrete Compressive Strength

The Concrete Engineer defines a **strength test** as the average (28-day) strength of three (3) cylinders fabricated from a single sample of concrete and cured in accordance with the MnDOT Concrete Manual.

The Engineer will consider concrete acceptable in accordance with Table HPC-9 provided **both** conditions are met for a required f'c.

Table HPC-9 Acceptance Criteria for Standard 28-day Cylinders Concrete Grades F, G, M, P, and S		
	All strength tests	**Moving average of 3 consecutive strength tests ***
f'c ≤ 5000 psi	> (f'c – 500 psi)	≥ f'c
f'c > 5000 psi	> 0.90 * f'c	≥ f'c
* If a project does not establish a moving average of 3 consecutive strength tests, use either the single strength test or the average of 2 strength tests to determine acceptance.		

3.G.5.b (2) Strength Test Below Acceptance Criteria

If any single strength test (3 cylinders) falls below the criteria established in Table HPC-9, the Engineer, in conjunction with the Concrete Engineer, will determine the following:

(A) If the concrete has attained critical load-carrying capacity;
(B) If investigation is required; The investigation may consist of, but is not limited to reviewing the following:
  (B.1) Sampling and testing plastic concrete,
  (B.2) Handling of cylinders,
  (B.3) Cylinder curing procedures,
  (B.4) Compressive strength testing procedures,
  (B.5) Certificate of Compliances
(C) If dispute resolution coring is required in accordance with 2461.3.G.5.b(4).

3.G.5.b (3) Moving Average Below Acceptance Criteria

If the moving average of three (3) consecutive strength tests falls below f'c, the Concrete Engineer will require a new mix design in accordance with Table HPC-4.

3.G.5.b (4) Dispute Resolution Coring

The Engineer and Contractor will mutually agree on an Independent Third Party to core and test the concrete in accordance with ASTM C42.

(A) The Engineer will identify a minimum of three (3) locations for the Independent Third Party to core,
(B) The Independent Third Party will take one (1) core at each location,
(C) The Contractor will complete all coring within 14 days of notification of the low strength concrete, and
(D) The Contractor is responsible for ensuring the core holes are repaired.

The Engineer, in conjunction with the Concrete Engineer, will review the core test results and evaluate in accordance with Table HPC -10, providing all other concrete tests meet requirements.

Table HPC-10
Evaluation of Core Test Results

Core (average of 3 cores) Test Results:	Engineer considers concrete:	Cost of Coring and Testing:	Resolution:
≥ 85% of f'c	Acceptable to remain in place	Engineer Responsibility	No monetary adjustment for single strength test failure.
< 85% of f'c	Unacceptable	Contractor Responsibility	Remove and replace concrete in accordance with 1503, "Conformity with Contract Documents," and 1512, "Unacceptable and Unauthorized Work," as directed by the Engineer. If the Engineer, in conjunction with the Concrete Engineer, determines the concrete can remain in place, the Engineer may not pay for the concrete or will pay at an adjusted Contract Unit Price and consider any additional actions in accordance with Table HPC-11.

3.G.5.b (5) Non-Conforming Material

If the Contractor inadvertently places concrete not meeting the strength requirements in accordance with Table HPC-10 into the work, the Engineer will not accept nonconforming concrete at the contract unit price.

For concrete not meeting the moving average of three (3) consecutive strength tests, the Engineer will make determinations regarding the disposition, payment, or removal. The Department will adjust the contract unit price for the contract item of the concrete in accordance with Tables HPC-11 based upon cylinder strength test results.

Table HPC-11
3YHPC-M and 3YHPC-S

Moving average of 3 consecutive strength tests	Adjusted Contract Unit Price
< 100.00% of f'c	Remove and replace concrete in accordance with 1512, "Unacceptable and Unauthorized Work," as directed by the Engineer. If the Engineer, in conjunction with the Concrete Engineer, determines the concrete can remain in place, the Engineer may apply a monetary adjustment to the Contract unit price or not pay for the concrete.*

* When there is not a separate contract unit price for *Structural Concrete* for an item of work or the concrete is a minor component of the contract unit price, the Department will reduce payment based on a concrete price of $100.00 per yd^3 [$130.00 per cu. m] or the Contractor-provided invoice amount for the concrete in question, whichever is less.

SB2014-2401.2

Use when falsework design may be critical, such as with slab spans, box girders, rigid frames, and concrete arches or when recommended by the Region Const. Engineer.

CREATED 4/25/1997

REVISED 5/16/2013 (4)

SB- Falsework and Forms and Bridge Slab Placement

Delete 2401.3.B.2, "Design of Falsework and Forms," and replace with the following:

At least six weeks before starting construction of the (_____ and) superstructure falsework, supply the Engineer with three copies of the detailed plans and Specifications and two copies of the associated calculations of the proposed system for constructing the (_____ and) superstructure falsework and forms. Design the falsework and forms in accordance with the current AASHTO "Guide Design Specifications for Bridge Temporary Works". Ensure the plans and specifications are prepared by an engineer, thoroughly checked by a second engineer for completeness and accuracy, and certified by one of the aforementioned professional engineers licensed in the State of Minnesota. Include sufficient details so that construction of the proposed system can be completed solely by reference to the plans and Specifications. Show the design criteria on the first sheet of the plans.

As a minimum, falsework plans must contain the following:

(1) Indicate the size of all load-supporting members and all transverse and longitudinal bracing. Include connection details for load-supporting members. For box girder structures, the drawings must show the falsework members supporting sloping exterior girders, deck overhangs and any attached construction walkways.
(2) Show all design-controlling dimensions, including beam length and spacing; post location and spacing; overall height of falsework bents; vertical distance between connectors in diagonal bracing; and similar dimensions that are critical to the design.
(3) Show the location and method by which the falsework will be adjusted to final grade.
(4) Unless a concrete placing schedule is specified in the contract, the falsework plans must include a superstructure placing diagram showing the proposed concrete placing sequence and/or the direction of pour, whichever one is applicable, and the location of all construction joints. (For relatively simple structures, this requirement may be satisfied by a note on the plans.)

Add the following to 2401.3.B.4:

It is not permitted to place the concrete for the (_____ and) superstructure until (1) plans and Specifications meeting the above requirements have been provided to the Engineer; (2) the engineer who has certified plans and specifications for the falsework and forms has inspected the falsework after erection; and (3) the engineer inspecting the as-constructed falsework certifies in writing that all details are approved.

Use the next 2 paragraphs when applicable.

Add the following to 2401.3.F.3.b(1), "General":

At least two weeks in advance of casting Bridge Slab concrete, provide the Engineer with detailed plans for placing the concrete, including the scheme for supporting screed rails for the Bridge Slab and schedules setting forth the rate of concrete delivery. Place the concrete at a rate of _____ cubic yards [cubic meters] per hour.

If concrete is cast by means of a pumping operation, maintain a standby pump or crane capable of delivering an uninterrupted flow of concrete in case of a pump breakdown.

SB2014-2401.3

Use only when end span lengths are less than 80% of the adjacent span lengths.

CREATED 8/3/1994

REVISED 5/16/2013 (1)

SB- Beam Tie Downs for Slab Construction

The plans indicate that the bridge slab for Bridge No. ____ be placed in one continuous pour. In order to prevent uplift of the beams (during the placement of the concrete in the slab) at the abutment where the slab pour terminates, either counterweight or rigidly tie down the beams at that abutment before the placement of the concrete in the slab is started.

UAR

Use a minimum counter weight of 3000 lb or higher if calculated.

Counterweights or tie downs must resist an uplift of at least (3000) (____) lbs. [(1360) (____) kg] for each line of beams. Furnish to the Engineer for approval complete details of the proposed methods to use to hold down the beams at the location mentioned above. Do not remove counterweights or release tie downs until at least seventy-five (75) percent of the slab in the span where the devices are used is in place.

SB2014-2401.4

Use with bridges having skews 20 degrees or greater, when there is a vertical curve, but only when recommended by the Regional Bridge Engineer.

CREATED 8/3/1994

REVISED 12/25/2013 (2)

SB- **Bridge Slab**

Operate the finishing machine for Bridge No. _____ so that the longitudinal axis of the machine is generally parallel to the centerline of bearings of the substructure units.

SB2014-2401.5

Use with high abutments that have vertical construction joints detailed in the plan.

CREATED 8/3/1994

REVISED 5/16/2013 (1)

SB- Placement of Concrete in High Abutments

Delay adjacent concrete pours of abutments with vertical construction joints by 72 hours to reduce the effects of shrinkage.

SB2014-2401.6

Use with high abutments that have vertical construction joints detailed in the plan. Use only if recommended by the Regional Bridge Engineer.

CREATED 8/3/1994

REVISED 5/16/2013 (1)

SB- Placement of Concrete in High Abutments

Delay adjacent concrete pours of abutments with vertical construction joints by 72 hours to reduce the effects of shrinkage. When necessary to advance the project schedule, the 72 hour delay may be reduced to a minimum of 24 hours for abutments that are continuously formed. The forms will remain in place on adjacent pours for the full curing period.

SB2014-2401.7
Use when slipforming is prohibited.
CREATED 11/25/1997
REVISED 12/25/2013 (2)

UAR

SB- **Slipforming of Bridge Barrier Prohibited**

Slipforming of _____ barrier is not permitted (on this project) (on Bridge No. _____).

SB2014-2401.8

DO NOT USE for Metro District Bridges.

DO USE for bridge slabs having more than 200 yd^3 [150 m^3] of concrete.

CREATED 5/3/1996

REVISED 5/16/2013 (1)

UAR

UAR

SB- **Bridge Slabs**

The plans indicate that (the bridge slab) (each half of the bridge slab) for Bridge No. ____ be placed in one continuous pour. Place not more than (one) (two) transverse construction joint(s) (in the bridge slab) (each half of the bridge slab) to facilitate the placing of the concrete. The location of such transverse construction joints, the sequence of pours, and the direction in which the pours will be placed are subject to the Engineer's approval.

Replace 2401.3.E.1, "Transverse Construction Joints," provisions with the following:

Immediately prior to placing concrete against a construction joint in the bridge slab, coat the surface of the inplace concrete with an approved bonding agent or grout.

SB2014-2401.9
Use on all projects (except repainting projects).
CREATED 2/23/1996
REVISED 5/16/2013 (4)

SB- Joint Filler and Sealing

The provisions of 2401.3.I.1, "Joint Sealing," are supplemented as follows:

Complete concrete curing prior to installation of sealing materials. A minimum of 14 days drying is required prior to application of sealers. Sawcut joints, sandblast, blow clean, and ensure the concrete surfaces are dry at the time the sealer is installed. Perform work as per manufacturer's recommendations.

Construct preformed joint(s) as detailed in the plans and in conformance with the following requirements.

1. Use bituminous felt that complies with AASHTO M33, modified to the extent that the load required to compress the test specimen to 50 percent of its thickness before test be not more than 1200 psi (8274 kPa).

2. Supply cork complying with 3702, "Preformed Joint Fillers".

3. Supply polystyrene complying with the following:

Compressive Strength for Polystyrene Elements		
Type	**Compressive Strength (min.) [5% deflection]**	**Characteristics**
A (High Density)	30 psi [207 kPa]	Closed Cell Expanded Polystyrene
B (Low Density)	10 psi [69 kPa]	Molded Polystyrene
Test for compressive strength of polystyrene in accordance with ASTM D 1621. Furnish evidence that the material meets these requirements, if requested by the Engineer.		

SB2014-2401.10

Use where Site and Development Unit recommends an Architectural surface finish to the concrete.

CREATED 3/9/2000

REVISED 5/16/2013 (6)

SB- Architectural Concrete Texture

Until further notice, the Bridge Office Architectural Specialist (Melissa Schultz, 651-366-4465, melissa.schultz@state.mn.us) will provide all "ARCHITECTURAL SURFACE FINISH" special provision boilerplates.

SB2014-2401.11
Use when a surface finish is required.
CREATED 3/1/2000
REVISED 12/25/2013 (10)

SB- Finish of Concrete Surfaces

For the following paragraph, modify minimum curing days when needed for short working day contracts.

Cure concrete for a minimum of 28 days or as recommended by the manufacturer prior to applying special surface finish (SSF) or acrylic paint. Thoroughly flush all surfaces that are to receive SSF with clean water not more than 24 hours before commencing with the SSF finishing.

A. Special Surface Finish

The provisions of 2401.3.F.2.C, "Special Surface Finish," are supplemented as follows:

Apply SSF on the exposed concrete surfaces as designated below for Bridge No.(s). _____.

Refer to attached "Designer Guide for Surface Finish Requirements," then create a list of surfaces to be coated.

UAR

1. Railposts
. Barrier or Parapet (other than Type F)
. Outside surfaces of barrier
. Edges of slabs
. Edges of stairway treads
. Stairway risers
. Wingwalls
. Copings
. Bottom of overhangs
. Abutments
. Piers/pier cap
. Crash struts

Select a color and color # specified by the department Architectural Specialist (Melissa Schultz, 651/366-4465).

Provide a finish color for all SSF matching [MnDOT standard color "Gray-Modified" on file in the MnDOT Chemical Laboratory (651-366-5548)] [Federal Standard 595 C No. (26622 pearl gray), or (_____)]. Provide paint free of toxic metals and toxic pigments.

Use top coat sentence, if department Architectural Specialist specifies it.

Apply a top coat of 100% acrylic paint 3584, "Exterior Masonry Acrylic Emulsion Paint," in the color specified.

Provide a test area, 3 foot x 3 foot [1 meter x 1 meter], for final color selection and have the Engineer approve the test area after the color has been added to it.

B. Finishing Roadway Faces and Tops of Barrier

UAR

1. Finish conventionally formed roadway faces, tops of barriers (and medians), as per 2401.3.F.2.d, "Curb, Sidewalk, and Median Finish," and the following:

a) Plan and execute concrete placement, form removal, and finishing operations so that the surface finishing can be started immediately after forms are removed. Remove the roadway face forms as soon as the concrete can retain its molded shape. In no case shall the elapsed time between concrete placement and initial surface finishing exceed 24 hours.

For the next paragraph, use an acrylic paint for the finish on rdwy face & top of barriers unless otherwise indicated by the District.

For the next paragraph, select a color and color # to be specified by the department Architectural Specialist (Melissa Schultz, 651/366-4465). An acrylic paint finish is the standard.

b) After completion of the curing period, paint the roadway faces and tops of the barriers (and median) with an approved acrylic paint conforming to 3584, "Exterior Masonry Acrylic Emulsion Paint". The color of the acrylic paint shall conform to [MnDOT standard color "Gray-Modified" on file in the MnDOT Chemical Laboratory (651-366-5548)] [Federal Std. No. 595 C, No. 26622 pearl gray, or (_____)]. Apply the paint at a rate of 300 ft^2 per gallon [7.4 m^2 per L]. Commence or suspend the painting operation when the air and surface temperature meet or exceed the manufacturer's recommendations.

UAR

2. Finish slipformed roadway faces and tops of barriers (and median), in accordance with the following:

a) Lightly broom the barrier surface immediately after passage of the slipformer.

b) Coat the roadway face and top of the barrier as described above for the conventionally formed barrier.

For the following section, use when PCB are included in the plan.

C. Finishing Precast Concrete Girders

Apply two coats of 100% acrylic paint 3584, "Exterior Masonry Acrylic Emulsion Paint," on the exposed concrete surfaces as designated below for Bridge No.(s). _____.

Refer to attached "Designer Guide for Surface Finish Requirements," then create a list of the surfaces to be coated.

1. Outside face of fascia girder
_. Bottom of bottom flange of fascia girder
_. All faces of all girders
_. Bottom of bottom flange of all girders

UAR

Provide a finish color for acrylic paint matching [MnDOT standard color "Gray-Modified" on file in the MnDOT Chemical Laboratory (651-366-5548)] [Federal Standard 595 C No. (26622 pearl gray), or (_____)].

Apply the paint at a rate of 300 ft^2 per gallon [7.4 m^2 per L]. Commence or suspend the painting operation when the air and surface temperature meet or exceed the manufacturer's recommendations.

D. Basis of Payment

Finishing of concrete surfaces, except as otherwise provided in these special provisions, special surface finish, application of topcoat, and painting are considered an incidental expense to the respective concrete mixes for this construction, and no additional compensation will be made for this work.

DESIGNER GUIDE FOR SURFACE FINISH REQUIREMENTS

BRIDGES OVER		FOR ALL TYPES OF BRIDGES									FOR CONCRETE GIRDERS, BOXES, ETC.	
		BARRIER & POSTS (EXCEPT "F")	COPINGS	EDGE OF SLAB	PIERS	ABUTMENTS	MEDIAN "F" BARRIER	INSIDE FACE "F" BARRIER	OUTSIDE FACE "F" BARRIER	WINGWALLS	OUTSIDE FACE & BOTTOM OF BOTTOM FLANGE	BOX GIRDERS
INTERSTATE	URBAN	X	X	X	X	X	2	2	X	X	2	X
	RURAL	X	X	X	X	X	2	2	X	X	2	X
TRUNK HIGHWAYS	URBAN	X	X	X	X	X	2	2	X	X	2	X
	RURAL	X	X	X	X	X	2	2	X	X	2	X
SECONDARY ROADS	URBAN	X	X	X	X	X	2	2	X	X	2	X
	RURAL	X					2*	2*				
CITY STREETS		X	X	X	X	X	2	2	X	X	2	X
STREAMS		X	1	1	1	1	2*	2*	1	1	1 & 2	1
SWAMPS AND MARSHES		X					2*	2*				
RAILROADS		X					2*	2*				
RAILROADS OVER TH		X	X	X	X	X	X	X		X	X	X

X = USE SPECIAL SURFACE FINISH ON THESE FACES.

1= ONLY IN SPECIAL CASES, SUCH AS IN RESIDENTIAL AREAS, CAMPING GROUNDS, ETC.

2 = USE APPROVED ACRYLIC PAINT. *USE SB2014-2401.12 WHEN BARRIERS ARE THE ONLY SURFACES TO RECEIVE SPECIAL SURFACE FINISH.

CHECK WITH BRIDGE CONSTRUCTION UNIT
IN THE EVENT OF QUESTIONABLE CONDITIONS OR AREAS.

SB2014-2401.12

Use when the roadway faces & tops of barrier railings are the ONLY surfaces to receive special surface finish.

CREATED 5/1/1998

REVISED 10/3/2013 (3)

SB- Finish of Concrete

A. Finishing Roadway Faces and Tops of Barrier

UAR

1. Finish the roadway faces and tops of barriers (and medians), if conventionally formed, in accordance with 2401.3.F.2.d, "Curb, Sidewalk, and Median Finish," except as follows:

a) Plan and execute concrete placement, form removal, and finishing operations so that the surface finishing can be started immediately after forms are removed. The roadway face forms may be removed as soon as the concrete can retain its molded shape. However, in no case shall the elapsed time between concrete placement and initial surface finishing exceed 24 hours.

For the following paragraph, modify minimum curing days when needed for short working day contracts.

UAR

b) After completion of the 28 day curing period, paint the roadway faces and tops of the barriers (and median) with an approved acrylic paint conforming to 3584, "Exterior Masonry Acrylic Emulsion Paint". Provide an acrylic paint matching Federal Std. No. 595 C No. 26622 (pearl gray). Apply the paint at an approximate rate of 300 ft^2 per gallon [7.4 m^2 per L]. Commence painting operation when the air and surface temperature is at least 50°F [10°C] with temperature rising, and suspend when the air and surface temperature is falling and reaches 55°F [13°C].

UAR

2. Finish the roadway faces and tops of barriers (and median), if slipformed, in accordance with the following:

a) Lightly broom the barrier immediately after passage of the slipformer creating a uniform texture appearance.

For the following paragraph, modify minimum curing days when needed for short working day contracts.

b) After completion of the 28 day curing period, paint the roadway face and top of the barriers with an approved acrylic paint as described above for the conventionally formed railing.

B. Basis of Payment

Everything described above is considered an incidental expense to the concrete mix for this construction.

SB2014-2401.13

Use where special surface finish is required on inplace concrete.

CREATED 10/30/1997

REVISED 5/16/2013 (2)

SB- Finish of Inplace Concrete

Provide and apply a Special Surface Finish as described in 2401.3.F.2.c, "Special Surface Finish," on the following exposed concrete surfaces:

1. _____
2. _____
3. _____
4. _____
5. _____

Etch concrete surfaces by sandblasting before applying the special surface finish to them.

Select ONE of the two following paragraphs.

Payment for Item No. 2401.618 "SPECIAL SURFACE FINISH (INPLACE)", at the Contract price per square foot shall be compensation in full for performing all work described above complete in place.

Payment for Item No. 2401.604 "SPECIAL SURFACE FINISH (INPLACE)", at the Contract price per square meter shall be compensation in full for performing all work described above complete in place.

SB2014-2401.14

Use when texture planing is required on monolithic bridge deck slab.

Use in the Metro District unless otherwise recommended by the Metro Region Construction Engineer.

CREATED 6/5/1996

REVISED 4/21/2015 (11)

SB- Texture Planing of Bridge Deck Slab Surface

Delete the 3rd paragraph of 2401.3.F.3.b(3), "Final Finish Texture," and substitute the following:

Take special care in finishing roadway surfaces in the vicinity of expansion devices and other locations where breaks in continuity occur to ensure a smooth riding surface.

After the concrete has been consolidated, screeded, floated, and carpet dragged, apply curing as soon as required in this contract.

Upon completion of curing, check surface smoothness on the roadway surface. The final surface must meet the tolerance requirements of 2401.3.F.3.b(3), "Final Finish Texture". Correct surface areas not meeting the specified tolerances by removal and replacement or by grinding using a surface diamond grinding device consisting of multiple diamond blades on the high spots to the extent directed by the Engineer prior to beginning surface texturing operations. Nonconforming areas that are not satisfactorily corrected are subject to 1503 and 1512.

Notify the Engineer at least 24 hours before beginning corrective work. Do not begin corrective work before the Engineer approves the methods and procedures in writing.

After completion of work required to meet surface tolerance, texture the roadway surface in a longitudinal direction by planing the hardened concrete by diamond saw-blade grinding. Plane the entire surface area of the roadway, except the area within 20 inches [500 mm] of the curb, or gutter to a uniform texture. The surface must have a finished texture with the width of the grooves between 1/10 inch [2.5 mm] and 1/8 inch [3.3 mm] at a distance of between 5/64 inch [2.0 mm] and 1/8 inch [3.0 mm] apart. The grooves must not be less than 1/32 inch [0.8 mm] or more than 1/8 inch [3.0 mm] in depth. The actual textured surface in any selected 1.5 feet [0.5 meter] by 100 foot [30 meter] longitudinal strip must not be less than 98% of the surface area.

Prior to planing operations, submit a procedure to the Engineer indicating how the expansion joint devices and plow finger straps will be protected from any damage during the planing operations. Do not begin planing before the Engineer approves the methods and procedures in writing. The Engineer will observe the planing and damage to the expansion joint devices and plow finger straps will be corrected or will be removed and replaced as unacceptable work, as directed by the Engineer. If the Engineer does not direct either repair or replace of the unacceptable work, the Contractor may leave the work in-place and the Engineer will adjust the contract unit price of the affected items by 80 percent.

Perform planing in a manner that will provide a smooth riding surface at expansion joints and at the ends of the concrete wearing course. After completion of the planing, the permissible surface deviation will be 1/8 inch [3 mm] in 10 feet [3 meters] measured with a straightedge laid longitudinally and 1/8 inch [3 mm] in 3 feet [1 meter] measured transversely at right angles to the centerline of roadway. **In all areas of the exposed deck the Contractor will be required to provide positive drainage (including the 20 inches [500 mm] of unplanned gutter).**

All slurry material shall become property of the Contractor and must be disposed of as per MnDOT 2104.3.C.3, "Concrete and Masonry Structures," as approved by the Engineer, and as described in this special provision.

Continuously vacuum from the surface all concrete residue and water (slurry) resulting from concrete texture planing, and capture and contain for further handling or processing. The slurry must not be permitted to flow across lanes occupied by traffic, flow into drainage facilities or discharge anywhere within the highway Right of Way. Submit a slurry disposal or reuse plan at the preconstruction conference for written approval of the means and methods by the Engineer.

The method to manage the slurry may require separation of the solids from the liquids. This separation may be achieved mechanically by centrifuging or passively by allowing settlement of the fines to occur in a temporary impermeable lined containment area. If a temporary containment area is used within the highway Right of Way, a Site Plan as per 1717, "Air, Land, and Water Pollution," will be required for the Engineer's written approval. Include at minimum in the Site Plan methods for storm water protection at the temporary containment area, a description of the proposed separation method, and the process for final removal and restoration of the disturbed containment area. For any method used to separate the liquid from the solids, identify the name and location of the Publically Owned Treatment Works facility (POTW) that the liquids will be deposited in, or how the processed water will be reused.

As part of the slurry disposal or reuse plan, provide documentation that identifies the name and location of the Minnesota Pollution Control Agency (MPCA) permitted lined Mixed Municipal Solid Waste (MMSW) or industrial landfill that the solids will be deposited in, or identify any alternative methods of disposal or reuse that meet environmental requirements of regulated industrial waste.

Hold the Department harmless for any fines or sanctions caused by actions or inactions regarding compliance with concrete slurry management and disposal. All materials and labor for installation of storm water protection practices, maintenance, control, removal and disposal for the management of concrete slurry is incidental to the bridge deck texture planing operation.

The Engineer will measure the surface of the finished concrete and all planed areas not meeting the requirements may, at the Engineer’s option, be re-planed, be replaced as unacceptable work, or left as is and accepted for payment subject to a price reduction of 50 cents per sq ft [$5.40 per sq m] but, in all cases, provide positive surface drainage.

Select ONE of the two following paragraphs.

Measurement will be made to the nearest square foot of concrete area planed and textured based on surface area. Payment will be made under Item 2401.618 "BRIDGE DECK PLANING" at the Contract bid price per square foot, which shall be compensation in full for all costs relative to the specified texture planing.

Measurement will be made to the nearest square meter of concrete area planed and textured based on surface area. Payment will be made under Item 2401.604 "BRIDGE DECK PLANING" at the Contract bid price per square meter, which shall be compensation in full for all costs relative to the specified texture planing.

SB2014-2401.14A

Use with monolithic bridge deck when the Regional Engineer recommends 10 degree diagonal tining.

CREATED 7/1/2014

REVISED 7/1/2014

SB- Modified Transverse Texturing (Tining) on Bridge Slab

The 3rd paragraph of 2401.3.F.b(3) is supplemented with the following:

Immediately after carpet dragging, texture the bridge deck slab surface with a metal-tine pattern. Install the transverse texturing (tining) on a slight diagonal, at an angle of approximately 10 degrees to a line perpendicular to the roadway centerline, produced by using a device meeting the following characteristics and requirements:

1) Equipped with steel tines from 4 in to 6 in [100 mm to 150 mm] long and from 1/12 in to 1/8 in [2 mm to 3 mm] thick,

2) Steel tines arranged to obtain randomized grooves from 1/8 in to 5/16 in [3 mm to 8 mm] deep, and

3) Grooves variably spaced from 5/8 in to 1 in [16 mm to 25 mm].

Do not texture or tine within 1 ft [300 mm] of gutterline.

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Primary use is CIP Boxes.
CREATED 6/15/1998
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SB- POST TENSIONING SYSTEM

A. Description of Work

Prestress the concrete using post-tensioning method. Perform work in accordance with the plans, the applicable provisions of 2401, "Concrete Bridge Construction," and 2405, "Prestressed Concrete Beams," and the following:

This work includes:

1. Design calculations and working drawings.

2. Furnishing and installing the ducts and prestressing strands, including strand positioning devices for the tendons and appurtenant items necessary for the particular system to be used.

3. Furnishing and installing the anchorage system.

4. In-place friction testing.

5. Post-tensioning the system.

6. Grouting the ducts and anchorage blockouts upon completion of the stressing operations.

7. Protection of anchorages, clean-up, and other work necessary for installation of the system.

SB- Working Drawings

A. General:

Submit working drawings of the proposed prestressed concrete members in accordance with the requirements of 1502, "Plans and Working Drawings," and these special provisions.

Prepare composite drawings in plan, elevation and section which show to scale the relative positions of all items that are to be embedded in the concrete, the concrete cover, and the embedment depth for the portions of the structure that are to be temporarily or permanently prestressed. Such embedded items include the prestressing ducts, vents, anchorage reinforcement and hardware, and reinforcing steel strand. Ensure such drawings are adequate so that there will be no conflict between the planned positions of any embedded items, and that concrete cover will be adequate. If conflicts are discovered during the preparation of such drawings, revise the working drawings for one or more of the embedded items, or propose changes in the dimensions of the work as necessary to eliminate the conflicts or provide proper cover. Any such revisions must be approved by the Engineer before work on an affected item is started.

On the drawings, show the method and procedure of jacking and the type, size, and properties of the strands or bars and the anchorage assemblies. Show the number of strands per tendon. Include details in addition to those shown on the contract plans for any additional reinforcing steel required to resist the concrete bursting stresses in the vicinity of the anchorage assemblies. Show the force or stress diagram on the drawings. Show the sizes, shapes, and dimensions for the ducts. Show lay-out dimensions for locating the ducts along the tendon path at intervals not exceeding one-tenth the span length of the member being prestressed, and at anchorages, low points, high points, and points of inflection. Include vent locations and details of the vents on the drawings.

On the drawings, include complete details of the method, materials, and equipment proposed for use in the prestressing operations. With such details, outline the method and sequence of jacking, show complete details of the prestressing steel, anchoring devices, type of enclosures, block-outs, and show all other data pertaining to the post-tensioning system or operations.

Submit calculations showing, at each stage of erection, the elongation of the strands at the time of jacking, the initial forces in the strands, prestress losses, parameters, and the final working forces. Include the stresses in the anchorages and distribution plates in the calculations.

Final prestress losses and final working forces are not required when the post-tensioning system is fully designed and detailed in the Plans and the Contractor does not propose to change the system.

Submit complete details for grouting prestressing tendons including the materials and proportions for grout, details of equipment for mixing and placing grout and methods of mixing and placing grout.

The Contractor is not required to duplicate in the working drawings any aspect of the system that is fully detailed in the plans unless a change is proposed.

B. Contractor Proposed Options:

The Contractor may propose for consideration by the Engineer certain variations from the prestressing systems shown in the contract document.

C. Restrictions to Contractor Proposed Options:

1. Conform materials and devices used in the prestress system to the requirements in the following Materials Section of this Special Provision.

2. The net compressive stress in the concrete after all losses shall be at least as large as that provided by the system shown on the Plans.

3. Generally conform the distribution of individual tendons at each section to the distribution shown on the Plans.

4. Conform the ultimate strength of the structure with the proposed prestressing system, stresses in the concrete and prestressing steel at all sections and at all stages of construction and all work and materials to meet the requirements of the AASHTO Standard Specifications for Highway Bridges, 16th Edition (referred to hereafter as AASHTO) including all Interim Specifications, the requirements of the Design Criteria noted on the Plans, and the AASHTO Guide Specifications for Design and Construction of Segmental Concrete Bridges as applicable.

5. Fully redesign and detail, as required, the elements where an alternate prestressing system is proposed to be used. When the system is fully designed and detailed in the Plans, the cost for the original designer to review the proposed change will be at the expense of the Contractor.

6. Submit 5 sets of complete shop drawings including the prestressing scheme and system, reinforcing steel, and concrete cover; and design calculations (including short and long term prestress losses) for the Engineer’s approval.

7. Any Contractor proposed option to the prestressing system approved by the Engineer, which results in a change in other quantities from that shown on the plans, shall be paid based on the quantity actually used and accepted or the plan quantity, whichever is less, and at the unit bid price.

SB- Materials

A. Prestress Anchorages

Secure all prestressing steel at the ends by means of permanent type anchoring device. Develop in prestress anchorages at least 95 percent of the guaranteed ultimate tensile strength of the prestressing steel.

Testing of anchorage devices shall be performed by an independent testing agency in accordance with the procedures described in Division II Article 10.3.2 of AASHTO. The anchorage device shall meet the acceptance criteria specified in Division II Article 10.3.2.3.10 for a moderately aggressive environment using samples representing the type of prestressing steel and concrete strength to be used on the project. Assemble the test specimen in an unbonded state and, in testing, do not exceed the anticipated anchor set. Supply certified copies of test results for the anchorage system to the Engineer. Arrange the anchorage system so that the prestressing force in the tendon may be verified prior to the removal of the stressing equipment.

The Contractor is responsible for tendon anchorages, the design and furnishing of local zone reinforcement in accordance with AASHTO Division I, Section 9.21 (in addition to the reinforcement shown on the plans).

Ensure prestress anchorage devices effectively distribute prestressing loads to the concrete and conform to the following requirements.

a. The bearing stress in the concrete created by the anchorage plates shall not exceed the values per Division I, Section 9.21.

b. Bending stresses in the plates or assemblies induced by the pull of the prestressing steel shall not exceed the yield point of the material in the anchorage plate when 95 percent of the ultimate strength of the tendon is applied. Nor shall it cause visual distortion of the anchor plate as determined by the Engineer.

B. Ducts

1. General

Ensure all duct material is sufficiently rigid to withstand loads imposed during placing of concrete and internal pressure during grouting while maintaining its shape, remaining in proper alignment and remaining watertight.

Ensure the duct system, including splices and joints, effectively prevents entrance of cement paste or water into the system and effectively contains pressurized grout during grouting of the tendon. Also ensure the duct system is capable of withstanding water pressure during flushing of a duct in the event the grouting operation is aborted.

Ensure the interior diameter of ducts for single strand, bar or wire tendons are at least ½ inch [6 mm] greater than the nominal diameter of the tendon. Ensure the interior diameter of ducts for tendons consisting of more than one strand, bar or wire are such that the interior area is not less than 2.5 times the net area of the prestressing steel.

2. Duct Type Designation

Key to Duct Material:
A - Galvanized Rigid Steel Pipe
B - Corrugated Metal
C - Corrugated Plastic

Except as otherwise designated in the plans, use the type of duct material in specific applications as follows:

Number of Strands in Tendon		Tendon Radius (R) ft [m]	Duct Type Material
0.5"[13 mm]	0.6" [15 mm]		
1 to 13	1 to 8	30 [9] or more 10 [3]* to 30 [9] 2 [.61] to 10 [3]	A, B, C A, B A
14 to 18	9 to 13	30 [9] or more 12 [3.8]* to 30 [9] 2 [.76] to 12 [3.8]	A, B, C A, B A
19 to 32	14 to 20	50 [15] or more 25 [7.6]* to 50 [15] 3 [.9] to 25 [7.6]	A, B, C A, B A

* This radius is the minimum allowed for a tendon unless otherwise approved by the Engineer based on test data.

C. Specific Material Properties

1. Type A - Galvanized Rigid Steel Pipe

Steel pipe duct shall be galvanized steel pipe conforming to the requirements of 3362, "Structural Steel Pipe," Schedule 40. Bend the pipe so as to accurately conform to the alignment of the tendon, taking into consideration the minimum bending radius shown in the working drawings.

2. Type B - Corrugated Metal

Fabricate corrugated metal duct with either welded or interlocked seams and bend without crimping or flattening. Connect sections of duct with heat shrink sleeves having uni-directional circumferential shrinkage manufactured specifically for the size of the duct being coupled, consisting of an irradiated and cross linked high density polyethylene backing for external applications and linear-density polyethylene for internal applications. Adhesive must bond to steel and polyolefin plastic materials.

Ensure the heat shrink sleeves have an adhesive layer that will withstand 150° F [65° C] operating temperature and meet the requirements of the following table:

Property	Test Method	Minimum Requirements	
		Internal Application	External Application
Minimum Fully Recovered Thickness		92 mils	111 mils
Peel Strength	ASTM D 1000	29 pli	46 pli
Softening Point	ASTM E 28	162°F [72°C]	216°F [102°C]
Lap Shear	DIN 30 672M	87 psi	58 psi
Tensile Strength	ASTM D 638	2,900 psi	3,480 psi
Hardness	ASTM D 2240	46 Shore D	52 Shore D
Water Absorption	ASTM D 570	Less than 0.05%	Less than 0.05%
Color		Yellow	Black
Shrinkage		33%	23%

Install heat shrink sleeves using procedures and methods in accordance with the manufacturer's recommendations.

Fabricate duct and metal connectors from galvanized sheet steel meeting the requirements of ASTM 525, Coating Designation G90. Repair areas of zinc coating damaged by welding or in fabricating interlocked seams by painting with a zinc dust-zinc oxide paint conforming to Federal Specifications TT-P-640 or MIL-P-21035.

Joints between sections of duct shall have no sharp edges within contact of the prestressing steel.

The minimum duct thickness for strand and wire tendons is 26 gauge up to 2.6" [67 mm] diameter. Ducts larger than 2.6" [67 mm] diameter shall be 24 gauge minimum thickness.

3. Type C - Corrugated Plastic Duct

Do not use ducts manufactured from recycled material. Use seamless fabrication methods to manufacture ducts.

Use corrugated duct manufactured from unfilled polypropylene or polyethylene. The polypropylene duct shall meet the requirements of ASTM D4101 "Standard Specification for Polypropylene Plastic Injection and Extrusion Materials" with a cell classification range of PP0340B14542 to PP0340B67884.

The polyethylene duct shall be corrugated high-density material conforming to the requirements of ASTM D 3350 "Standard Specification for Polyethylene Plastics Pipe and Fittings" Type III, Class C, Category 5, Grade P33.

Testing Requirements for Corrugated Plastic Duct:

Ensure that the duct system components and accessories meet the requirements of Chapter 4, Articles 4.1 through 4.1.8 of International Federation of Structural Concrete (FIB) Technical Report, Bulletin 7, titled "Corrugated Plastic Duct for Internal Bonded Post-Tensioning" as modified herein.

The requirements in FIB Technical Report, Bulletin 7, are modified as follows: Conduct the lateral load resistance test (FIB 4.1.4), without the use of a duct stiffener plate, using a load of 150 lbs. [68 kg] for all sizes; Wear resistance of duct (FIB 4.1.7) must not be less than 0.06 in. [1.5 mm] for duct up to 3.35 inches [85 mm] in diameter and not less than 0.08 inch [2 mm] for duct greater than 3.35 inches [85 mm] in diameter; Bond length test (FIB 4.1.8) must achieve 40 % GUTS in a maximum length of 16 duct diameters.

D. Minimum Radius of Curvature

Tendons ducts shall be installed with a radius of curvature shown in the Plans.

E. Grout and Grout Storage

a. Use only pre-packaged grouts that meet the specifications of the table below. Select the post-tensioning grout for use by the proper application either repair or horizontal. Mix pre-packaged grout with potable water. Maintain grout fluidity in strict compliance with the grout manufacturer's recommendations and test with a flow cone.

b. Store grout in a location that is both dry and convenient to the work. Storage in the open must be on a raised platform and with adequate waterproof covering to protect the material. On site storage of grout is limited to a maximum period of one month.

c. All grouting operations shall comply with the requirements of SB-18.3.10.

Grout Properties

Meet or exceed the specified physical properties for the grout stated herein as determined by the following standard and modified ASTM test methods conducted at normal laboratory temperature 65-78˚F [18-25˚C] and conditions. Conduct all grout tests with grout mixed to produce the minimum time of efflux. Establish the water content to produce the minimum and maximum time of efflux.

Property	Test Value	Test Method
Total Chloride Ions	Max. 0.08% by weight of cementitious material	ASTM C 1152
Fine Aggregate (if utilized)	99% passing the No. 50 Sieve (300 micron)	ASTM C 136*
Hardened Height Change @ 24 hours and 28 days	0.0% to + 0.2%	ASTM C 1090**
Expansion	$\leq$ 2.0% for up to 3 hours	ASTM C 940
Wet Density – Laboratory	Report maximum and minimum obtained test value lb/ft^3 [kg/l]	ASTM C 185
Wet Density – Field	Report maximum and minimum obtained test value lb/ft^3 [kg/l]	ASTM C 138
Compressive Strength 28 day (Average of 3 cubes)	$\geq$ 7,000 psi [48.3 MPa]	ASTM C 942
Initial Set of Grout	Min. 3 hours Max. 12 hours	ASTM C 953
Time of Efflux***		
(a) Immediately after mixing	Min. 20 Sec. Max. 30 Sec.	ASTM C 939
	Or Min. 9 Sec. Max. 20 Sec.	ASTM C 939***
(b) 30 minutes after mixing with remixing for 30 sec	Max. 30 Sec.	ASTM C 939
	Or Max. 30 Sec.	ASTM C 939****
Bleeding @ 3 hours	Max. 0.0 percent	ASTM C 940*****
Permeability @ 28 days	Max. 2500 coulombs At 30 V for 6 hours	ASTM C 1202

*Use ASTM C117 procedure modified to use a #50 sieve. Determine the percent passing the #50 sieve after washing the sieve.

**Modify ASTM C1090 to include verification at both 24 hours and 28 days.

***Adjustments to flow rates will be achieved by strict compliance with the manufacturer's recommendations. The time of efflux is the time to fill a one liter container placed directly under the flow cone.

****Modify the ASTM C939 test by filling the cone to the top instead of to the standard level.

*****Modify ASTM C940 to conform with the wick induced bleed test as follows:

(a) Use a wick made of a 20 inch [0.5 m] length of ASTM A416 seven wire 0.5 inch [12.7 mm] diameter strand. Wrap the strand with 2 inch [50 mm] wide duct or electrical tape at each end prior to cuffing to avoid splaying of the wires when it is cut. Degrease (with acetone or hexane solvent) and wire brush to remove any surface rust on the strand before temperature conditioning.

(b) Condition the dry ingredients, mixing water, prestressing strand and test apparatus overnight at 65 to 75˚F [18 to 24˚C].

(c) Mix the conditioned dry ingredients with the conditioned mixing water and place 27 oz. [800 ml] of the resulting grout into the 1 quart [1,000 ml] graduate cylinder. Measure and record the level of the top of the grout.

(d) Completely insert the strand into the graduated cylinder. Center and fasten the strand so it remains essentially parallel to the vertical axis of the cylinder. Measure and record the level of the top of the grout.

(e) Store the mixed grout at the temperature range listed above in (b).

(f) Measure the level of the bleed water every 15 minutes for the first hour and hourly for two successive readings thereafter.

(g) Calculate the bleed water, if any, at the end of the three hour test period and the resulting expansion per the procedures outlined in ASTM C940, with the quantity of bleed water expressed as a percent of the initial grout volume. Note if the bleed water remains above or below the top of the original grout height. Note if any bleed water is absorbed into the specimen during the test.

Simulated Field High Temperature Fluidity Test

Perform a conditioned laboratory high temperature grout fluidity test as described below using production grouting equipment utilizing both mixing and storage tanks. Grouts must conform to the requirements of _____ including initial fluidity test. For the test to be successful, the grout must have an efflux time of not greater than 30 seconds at the end of the one hour test period. Efflux time may be determined by either ASTM C939 or the modified ASTM C939 described herein.

(a) Perform the test in a temperature conditioned laboratory. Condition the room, grout, water, duct, pump, mixer and all other equipment to be used to a temperature of 90˚F [32.5˚C] for a minimum of 12 hours prior to the test.

(b) Use 400 ft ± 10 ft [122 m ± 3 m] of duct (tube) for the test. Use a duct with a nominal inside diameter of 1 in [25 mm].

(c) Mix the grout to the specified water content. Pump the grout through the duct until the grout discharges from the outlet end of the duct and is returned to the pump.

(d) Start the one hour test period after the duct is completely filled with grout. Record the time to circulate the grout through the duct. Constantly pump and recirculate the grout into the commercial grout mixer storage tank.

(e) Pump and recirculate the grout for a minimum of one hour.

(f) Record at 15 minute intervals throughout the test period, the pumping pressure at the inlet, grout temperature, and fluidity at the discharge outlet.

F. Prestressing Steel

1. Strand: Unless otherwise noted on the plans, use uncoated strand meeting requirements of AASHTO M203, ASTM A416, (Grade 270), low relaxation 7-wire strand meeting the requirements of ASTM A 416).

2. Bar: Unless otherwise noted on the plans, uncoated Grade 150, high strength, threaded bar meeting the requirements of ASTM A 722, Type II.

G. Inlets, Outlets, Valves and Plugs

1. Provide permanent grout inlets, outlets, and threaded plugs made of ASTM A 240 Type 316 stainless steel, nylon or polyolefin materials. For products made from nylon, the cell class of the nylon according to ASTM D5989 shall be of S-PA0141 (weather resistant), S-PA0231 or S-PA0401 (ultimate strength not less than 10,000 psi with UV stabilizer added). Products made from polyolefin shall contain antioxidant(s) with a minimum Oxidation Induction Time (OIT) according to ASTM D 3895 of not less than 20 minutes. Test the remolded finished polyolefin material for stress crack resistance using ASTM F 2136 at an applied stress of 348 psi. resulting in a minimum failure time of 3 hours.

2. All inlets and outlets will be equipped with pressure rated mechanical shut-off valves or plugs. Inlets, outlets, valves and plugs will be rated for a minimum pressure rating of 150 psi. Use inlets and outlets with a minimum inside diameter of 3/4 in [19 mm] for strand and 3/8 in [9.5 mm] for single bar tendons and four-strand duct.

3. Provide dual mechanical shutoff valves when performing vertical grouting.

4. Temporary items, not part of the permanent structure, shall be specifically designated on the PT System drawings and may be made of any suitable material.

H. Permanent Grout caps

1. Use permanent grout caps made from fiber reinforced polymer or ASTM A 240 Type 316L stainless steel. The resins used in the fiber reinforced polymer shall be either nylon, Acrylonitrite Butadiene Styrene (ABS) or polyester. For products made from nylon, the cell class of the nylon according to ASTM D5989 shall be S-PA0141 (weather resistant), S-PA0231 or S-PA0401 (ultimate strength not less than 10,000 psi with UV stabilizer added). For products made from nylon a cell class of S-PA0141 (weathering resistant) is required.

2. Seal the cap with "O" ring seals or precision fitted flat gaskets placed against the bearing plate. Place a grout vent on the top of the cap. Grout caps must be rated for a minimum pressure rating of 150 psi. Use ASTM A 240 Type 316L stainless steel bolts to attach the cap to the anchorage. When stainless steel grout caps are supplied, provide certified test reports documenting the chemical analysis of the steel.

SB- Construction Requirements

A. Protection of Prestressing Steel

Protect prestressing steel against physical damage at all times from manufacture to grouting or encasing in concrete. Prestressing steel that has sustained physical damage at any time will be rejected. Any reel that is found to contain broken wires will be rejected and the reel shall be replaced.

Package prestressing steel in containers or shipping forms for protection against physical damage and corrosion during shipping and storage. Place a corrosion inhibitor, which prevents rust or other results or corrosion, in the package or form, incorporated in a corrosion inhibitor carrier type packaging material, or, when permitted by the engineer, applied directly to the steel. The corrosion inhibitor shall have no deleterious effect on the steel or concrete or bond strength of steel to concrete. Inhibitor carrier type packaging material shall conform to the provisions of Federal Specifications MIL-P-3420. Immediately replace or restore to original condition packaging or forms damaged from any cause.

Clearly mark the shipping package or form with the heat number and with a statement that the package contains high-strength prestressing steel; use care in handling. Also mark the type and amount of corrosion inhibitor used, the date when placed, safety orders and instructions for use on the package or form.

Store the prestressing steel in a manner which will prevent the packing material from becoming saturated with water and allow a free flow of air around the packages. Immediately rejuvenate or replace the corrosion inhibitor if the useful life of the corrosion inhibitor in the package expires.

Free the prestressing steel from loose rust, loose mill scale, dirt, paint, oil, grease or other deleterious material at the time the prestressing steel is installed in the tendons. Removal of tightly adhering rust or mill scale is not required. Do not use prestressing steel which has experienced rusting to the extent that it exhibits pits visible to the naked eye.

Protect the prestressing steel from corrosion the entire period it is in place but ungrouted as provided below, if the period of time between installation of prestressing steel and grouting of the tendon will exceed 10 calendar days.

When the plans provide for prestressing steel to be installed in one unit with a length of prestressing steel left projecting to be threaded into another unit during erection, protect all of the prestressing from corrosion from immediately after it is installed in the first unit until the tendon is grouted in the second unit as provided below.

When corrosion protection of in-place prestressing steel is required, apply a corrosion inhibitor which prevents rust or other results of corrosion directly to the prestressing steel. Use a water soluble corrosion inhibitor with no deleterious effects on the prestressing steel or grout or bonding of the prestressing steel to the grout. The corrosion inhibitor, the amount and time of initial application, and the frequency of reapplication are subject to the Engineer's approval.

B. Installation of Ducts

Securely tie ducts in position, and carefully inspect and repair before placing the concrete. Exercise care during placement of the concrete to avoid displacing or damaging the ducts. Support internal ducts at intervals of not more than 4 feet [1.2 meters]. Any additional mild reinforcing required to support post-tensioning ducts shall be supplied by the contractor with no additional compensation. The tolerance on the location of the tendons shall be plus or minus ¼ in [6 mm] at any point. After installation in the forms, keep the ends of the ducts sealed at all times to prevent entry of water and debris.

All ducts or anchorage assemblies for permanent post-tensioning shall be provided with vent pipes or other suitable connections at each end and at each side of couplers for the injection of grout after post-tensioning. Ducts, except vertical ducts, shall be vented at the high points of the post-tensioning steel profile when there is more than a 6 in [150 mm] variation in the vertical position of the duct. All low points shall be vented if freezing weather conditions are anticipated prior to grouting. Use ½ in [13 mm] minimum diameter standard pipe or suitable plastic pipe for vents. Make all connections to ducts with metallic or plastic structural fasteners. Use waterproof tape at all connections including vent and grouting pipes. Plastic components, if selected and approved, shall not react with the concrete or enhance corrosion of the post-tensioning steel, and shall be free of water soluble chlorides. The vents shall be mortar tight, taped as necessary, and shall provide means for injection of grout through the vents and for sealing the vents. Remove ends of steel vents at least 1 inch [25 mm] below the concrete surface after the grout has set. Properly grout over the vents with an epoxy grout. After the grout has set, remove the ends of plastic vents to the surface of the concrete.

Fit all grout injection and vent pipes with positive mechanical shut-off valves. Fill vents and injection pipes with valves, caps or other devices capable of withstanding the pumping pressures.

C. Testing of Prestressing Tendons by the Contractor

1. Testing by Contractor

In-Place Friction Test: For the purpose of accurately determining the friction loss in the tendons, test, in place, the first tendon installed or one selected by the Engineer. Use the same equipment to perform the tests as for the tensioning operations.

For the test procedure, stress the tendon at an anchorage assembly with the dead end consisting of a load cell.

Tension the test specimen to 80% of ultimate in 10 increments and then de-tension from 80% of ultimate to 0% in 10 increments. Record the gauge pressure, elongation and load cell force for each increment. Furnish this data to the Engineer. Re-evaluate as necessary the theoretical elongations shown on the post-tensioning working drawings using the results of the tests and correct as necessary. Submit revisions to the theoretical elongations to the Engineer for approval. Propose apparatus and methods used to perform the tests, subject to the review of the Engineer. After the initial testing, two more tests may be requested if difficulty in tensioning operations becomes apparent. Submit the results of the friction tests to the Engineer.

2. Test Data

Provide, in graph form, load extension test data for strand samples taken from each coil to be used in the work. Submit this data to the Engineer at least one week prior to the use in the work of any of the strand from the coil.

Identify all strand coils shipped to the Project by the use of metallic tags or other equally durable means, indicating the heat number and physical properties of the material. The marking system shall remain inplace until the entire coil has been used up. All strand received at the Project that does not have the required identification, as described above, will be rejected.

D. Post-Tensioning Operations

1. Stress in Tendons

The post-tensioning forces shown are theoretical and do not include losses in the system or thermal affects.

Tension all post-tensioning by means of hydraulic jacks so that the force of the prestressing steel shall not be less than the value shown on the approved working drawings. The maximum temporary tensile stress (jacking stress) in prestressing steel shall not exceed 81 percent of the guaranteed ultimate tensile strength (GUTS) of the prestressing steel. Anchor the prestressing steel in a way that will result in the ultimate retention of forces not less than those shown on the approved working drawings, but in no case shall the stress, after anchor set, exceed 70 percent of the guaranteed ultimate tensile strength of the prestressing steel at the anchorage nor 75% at the end of the anchorage seating zone.

When friction must be reduced, water soluble oil or graphite with no corrosive agents may be used as a lubricant subject to the approval of the Engineer. Flush lubricants from the duct as soon as possible after stressing is completed by use of water pressure. Flush these ducts again just prior to the grouting operations. Each time the ducts are flushed, immediately blow dry with oil-free air.

2. Stressing Jacks

Equip each jack used to stress tendons with a pressure gauge that has an accurate reading dial at least 6 inch [150 mm] in diameter for determining the jack pressure. The display indicator on the gauge shall be readable by normal vision at a distance of 10 ft [3.05 meters]. Prior to use for stressing on the project, calibrate each jack and its gauge as a unit by a testing laboratory approved by the Engineer.

Perform calibration with the cylinder extension approximately in the position that it will be when applying the final jacking force and with the jacking assembly in an identical configuration to that which will be used at the job site (i.e. same length hydraulic lines). Furnish certified calibration calculations and a calibration chart, both in Metric units of measure, to the Engineer for each jack.

Perform recalibration of each jack at six month intervals and at other times when requested by the Engineer. Calibrations subsequent to the initial laboratory calibration may be accomplished by the use of a master gauge. Calibrate the master gauge at the same time as the initial calibration of the jacks, as part of the unit for each jack. Furnish the data recorded during the initial calibrations to the Engineer for use in the field. Supply the master gauge in a protective waterproof container capable of protecting the calibration of the master gauge during shipment. Provide a quick-attach coupler next to the permanent gauge in the hydraulic lines which enables the quick and easy installation of the master gauge to verify the permanent gauge readings. The Engineer shall possess the master gauge for the duration of the project. If a jack is repaired or modified, including replacing the seals or changing the length of the hydraulic lines, recalibrate the jack by the approved testing laboratory. No extra compensation will be allowed for the initial or subsequent jack calibrations or for the use and required calibration of a master gauge.

3. Stressing of Tendons

Do not apply post-tensioning forces until the concrete has attained the specified compressive strength as evidenced by tests on representative samples of the concrete. Store these samples under the same conditions as the concrete in order to accurately represent the curing condition of the concrete in place.

Conduct the tensioning process so that tension being applied and the elongation of the post-tensioning steel may be measured at all times. Keep a permanent record of gauge pressures and elongations at all times and submit to the Engineer. The post-tensioning force may be verified as deemed necessary by the Engineer.

For all tendons the elongation coinciding with the tendon force measured by gauge pressure shall agree within five percent of the theoretical calculated elongation for the entire operation. When provisional (unused) ducts are installed to accommodate future additional post-tensioning, the tolerance will be 7%. Check any deviation and determine and remedy the source of error to the satisfaction of the Engineer before proceeding with the work. Measure elongations to the nearest millimeter. In determining why the measured tendon force and the theoretical elongation do not agree within five percent, the Contractor may elect to establish that the apparent modulus of elasticity of the post-tensioning steel varies from the value shown in the general notes to the plans by conducting a bench test on a full size tendon in accordance with a procedure furnished by the Engineer. This test may be performed at a site remote from the project provided that the Contractor pays the cost to the Engineer of sending a representative to witness the test. The manufacturer of the system must furnish equipment for tensioning the tendons. Should agreement between pressure gauge readings and measured elongations fall outside the acceptable tolerances, the Engineer may require without additional compensation to the Contractor, additional in-place friction tests in accordance with these Special Provisions.

In the event that more than two percent of the individual strand wires in a tendon break during the tensioning operation, remove and replace the tendon. Do not allow previously tensioned strands unless approved by the Engineer.

Cut prestressing steel using an abrasive saw within ¾ in to 1½ in [19 mm to 38 mm] away from the anchoring device. Do not flame cut prestressing steel, except for pretensioned prestressing steel.

E. Grouting Operations

a. Grouting Operations Plan: Submit a grouting operations plan for approval at least six weeks in advance of any scheduled grouting operations. Written approval of the grouting operations plan by the Engineer is required before any grouting of the permanent structure takes place.

At a minimum, the plan will address and provide procedures for the following items:

1. Names and proof of training for the grouting crew and the crew supervisor in conformance with this specification;
2. Type, quantity, and brand of materials used in grouting including all certifications required;
3. Type of equipment furnished, including capacity in relation to demand and working condition, as well as back-up equipment and spare parts;
4. General grouting procedure;
5. Duct pressure test and repair procedures;
6. Method to be used to control the rate of flow within ducts;
7. Theoretical grout volume calculations;
8. Mixing and pumping procedures;
9. Direction of grouting;
10. Sequence of use of the inlets and outlet pipes;

11. Procedures for handling blockages;
12. Procedures for possible post grouting repair.

b. Before grouting operations begin, conduct a pre-grouting conference with the grouting crew and the Engineer. At the meeting discuss the grouting operation plan, required testing, corrective procedures and any other relevant issues.

c. Grout Inlets and Outlets: Ensure the connections from the grout pump hose to inlets are free of dirt and are air- tight. Inspect valves to be sure that they can be opened and closed properly.

d. Supplies: Before grouting operations start, provide an adequate supply of water and compressed air for clearing and testing the ducts, mixing and pumping the grout. Where water is not supplied through the public water supply system, provide a water storage tank of sufficient capacity.

e. Equipment:

General: Provide grouting equipment consisting of measuring devices for water, a high-speed shear colloidal mixer, a storage hopper (holding reservoir) and a pump with all the necessary connecting hoses, valves, and pressure gauge. Provide pumping equipment with sufficient capacity to ensure that the post-tensioning ducts to be grouted can be filled and vented without interruption at the required rate of injection in not more than 30 minutes.

1. Provide an air compressor and hoses with sufficient output to perform the required functions.
2. Provide vacuum grouting equipment (volumetric measuring type) prior to the start of grouting operations and retain the equipment on the job during the duration of tendon grouting operations.

Mixer, Storage Hopper: Provide a high speed shear colloidal mixer capable of continuous mechanical mixing producing a homogeneous and stable grout free of lumps and undispersed cement. The colloidal grout machinery will have a charging tank for blending and a holding tank. The blending tank must be equipped with a high shear colloidal mixer. The holding tank must be kept agitated and at least partially full at all times during the pumping operation to prevent air from being drawn into the post-tensioning duct. Add water during the initial mixing by use of a flow meter or calibrated water reservoir with a measuring accuracy equal to one percent of the total water volume.

Grout Pumping Equipment: Provide pumping equipment capable of continuous operation which includes a system for circulating the grout when actual grouting is not in progress. The equipment will be capable of maintaining pressure on completely grouted ducts and will be fitted with a valve that can be closed off without loss of pressure in the duct. Grout pumps will be positive displacement type, and will provide a continuous flow of grout and will be able to maintain a discharge pressure of at least 145 psi. Pumps will be constructed to have seals adequate to prevent oil, air or other foreign substances entering the grout and to prevent loss of grout or water. The capacity will be such that an optimal rate of grouting can be achieved. Place a pressure gauge having a full scale reading of no more than 300 psi at the duct inlet. If long hoses (in excess of 100 ft [3.5 mm]) are used, place two gauges, one at the pump and one at the inlet. The diameter and rated pressure capacity of the grout hoses must be compatible with the pump output.

Vacuum Grouting Equipment: Provide vacuum grouting equipment at the job site, concurrently with all pressure grouting operations, consisting of the following:

- Volumeter for the measurement of void volume
- Vacuum pump with a minimum capacity of 10 cfm and equipped with flow-meter capable of measuring amount of grout being injected
- Manual colloidal mixers and/or dissolvers (manual high speed shear mixers), for voids less than 20 liters in volume
- Standard colloidal mixers, for voids 20 liters and greater in volume

Stand-by Equipment: During grouting operations, provide a stand-by grout mixer and pump.

F. Grouting:

1. General: Perform test to confirm the accuracy of the volume-measuring component of the vacuum grouting equipment each day before performing any grouting operations. Use either water or grout for testing using standard testing devices with volumes of 0.5 gal [1.9 L] and 6.5 gal [25 L] and an accuracy of equal to or less than 4 oz [119 mL]. Perform one test with each device. The results must verify the accuracy of the void volume-measuring component of the vacuum grouting equipment within 1% of the test devise volume and must verify the accuracy of the grout volume component of the vacuum grouting equipment within 5% of the test devise volume. Ensure the Engineer is present when any tests are performed. Grout tendons in accordance with the procedures set forth in the approved grouting operation plan. Grout all empty ducts.

2. Temperature Considerations: Maximum grout temperature must not exceed 90°F [32°C] at the grout inlet. Use chilled water and/or pre-cooling of the bagged material to maintain mixed grout temperature below the maximum allowed temperature. Grouting operations are prohibited when the ambient temperature is below 40°F [4.5°C] or is 40°F [4.5°C] and falling.

3. Mixing and Pumping: Mix the grout with a metered amount of water. The materials will be mixed to produce a homogeneous grout. Continuously agitate the grout until grouting is complete.

4. Grout Production Test: During grouting operations the fluidity of the grout must be strictly maintained within the limits established by the grout manufacturer. A target fluidity rate will be established by the manufacturer's representative, based on ambient weather conditions. Determine grout fluidity by use of either test method found in SB-18.2.04. Perform fluidity test for each tendon to be grouted and maintain the correct water to cementitious ratio. Do not use grout which tests outside the allowable flow rates.

Prior to grouting empty ducts, condition the grout materials as required to limit the grout temperature at the inlet end of the grout hose to 90°F [32°C]. Prior to performing repair grouting operations, condition the grout materials to limit the grout temperature at the inlet end of the grout hose to 85°F [29°C]. Check the temperature of the grout at the inlet end of the grout hose hourly.

Perform a wick induced bleed test in accordance with SB-18.2.04 at the beginning of each day's grouting operation for the initial two cantilevers and spans being precast or erected. Frequency may be reduced to the first and every third day of consecutive grouting operations should zero bleed be consistently achieved.

If zero bleed is not achieved at the end of the required time period, do not begin grouting of any new or additional tendons until the grouting operations have been adjusted and further testing shows the grout meets the specified requirements.

5. Grout Operations: Open all grout outlets before starting the grouting operation. Grout tendons in accordance with the Grouting Operations Plan.

Unless approved otherwise by the Engineer, pump grout at a rate of 16 ft to 50 ft [5 M to 15 M] of duct per minute. Conduct normal grouting operations at a pressure range of 10 psi to 50 psi measured at the grout inlet. Do not exceed the maximum pumping pressure of 145 psi at the grout inlet.

Use grout pumping methods which will ensure complete filling of the ducts and complete encasement of the steel. Grout must flow from the first and subsequent outlets until any residual water or entrapped air has been removed prior to closing the outlet.

Pump grout through the duct and continuously discharge it at the anchorage and grout cap outlets until all free water and air are discharged and the consistency of the grout is equivalent to that of the grout being pumped into the inlet. Close the anchorage outlet and discharge a minimum of 2 gal [7.6 L] of grout from the grout cap into a clean receptacle. Close the grout cap outlet.

For each tendon, immediately after uncontaminated uniform discharge begins, perform a fluidity test using the flow cone on the grout discharged from the anchorage outlet. The measured grout efflux time will not be less than the efflux time measured at the pump or minimum acceptable efflux time as established in SB-18.2.04. Alternately, check the grout fluidity using the Wet Density method contained in SB-18.2.04. The measured density must fall within the values established in SB-18.2.04. The density at the final outlet must not be less than the grout density at the inlet. If the grout fluidity is not acceptable, discharge additional grout from the anchorage outlet and test the grout fluidity. Continue this cycle until an acceptable grout fluidity is achieved. Discard grout used for testing fluidity. After all outlets have been bled and sealed, elevate the grout pressure to ±75 psi, seal the inlet valve and wait two minutes to determine if any leaks exist. If leaks are present, fix the leaks using methods approved by the Engineer. Repeat the above stated process until no leaks are present. If no leaks are present, bleed the pressure to 5 psi and wait a minimum of ten minutes for any entrapped air to flow to the high points. After the minimum ten minutes period has expired, increase the pressure as needed and discharge grout at each high point outlet to eliminate any entrapped air or water. Complete the process by locking a pressure of 30 psi into the tendon.

If the actual grouting pressure exceeds the maximum allowed, the inlet will be closed and the grout will be pumped at the next outlet, which has just been, or is ready to be closed as long as a one-way flow is maintained. Grout will not be pumped into a succeeding outlet from which grout has not yet flowed. If this procedure is used, the outlet/inlet, which is to be used for pumping, will be fitted with a positive shut-off and pressure gage.

When complete grouting of the tendon cannot be achieved by the steps stated herein, stop the grouting operation. After waiting 48 hours, fill the tendon with grout in accordance with the procedure outlined in SB-18.3.10.F.8.

6. Vertical Grouting: For all vertical tendons, provide a standpipe at the upper end of the tendon to store bleed water and grout, maintain the grout level above the level of the prestressing plate and anchorage. This device will be designed and sized to maintain the level of the grout at an elevation which will assure that bleeding will at no time cause the level of the grout to drop below the highest point of the upper anchorage device. Design the standpipe to allow all bleed water to rise into the standpipe, not into the uppermost part of the tendon and anchorage device.

Discharge grout and check grout fluidity as described above. As grouting is completed, the standpipe will be filled with grout to a level which assures that, as settlement of the grout occurs, the level of the grout will not drop below the highest point in the upper anchorage device. If the level of the grout drops below the highest point in the anchorage device, immediately add grout to the standpipe. After the grout has hardened, the standpipe will be removed. In the presence of the Engineer, visually inspect for voids using an endoscope or probe. Fill all voids found in the duct using volumetric measuring vacuum grouting processes.

If the grouting pressure exceeds the maximum recommended pumping pressure, then grout will be pumped at increasingly higher outlets which have been or are ready to be closed as long as a one-way flow of grout is maintained. Grout will be allowed to flow from each outlet until all air and water have been purged prior to using that outlet for pumping.

7. Construction Traffic and Operations Causing Vibrations: During grouting and for a period of 4 hours upon completion of grouting, eliminate vibrations from sources such as moving vehicles on the partially completed superstructure as well as jackhammers, compressors, generators, pile driving operations and soil compaction operations that are operating within 300 ft [100 M] down-station and 300 ft [100 M] up-station of the ends of the span in which grouting is taking place.

8. Post-Grouting Operations and Inspection: Do not remove or open inlets and outlets until the grout has cured for 24 to 48 hours. Perform inspections within one hour after the removal of the inlet/outlet. After the grout has cured, remove all outlets located at anchorages and high points along the tendon to facilitate inspection. Drill and inspect all high points along the tendon as well as the inlets or outlets located at the anchorages. Depending on the geometry of the grout inlets, drilling may be required to penetrate to the inner surface of the trumpet or duct. Use drilling equipment that will automatically shut-off when steel is encountered. Unless grout caps are determined to have voids by sounding, do not drill into the cap. Perform inspections in the presence of the Engineer using endoscopes or probes. Within four hours of completion of the inspections, fill all duct and anchorage voids using the volumetric measuring vacuum grouting process.

Seal and repair all anchorage and inlet/outlet voids that are produced by drilling for inspection purposes. Remove the inlet/outlet to a minimum depth of 2 in [50 mm]. Use an injection tube to extend to the bottom of the drilled holes for backfilling with epoxy.

Post grouting inspection of tendons having a length of less than 150 ft [46 M] may utilize the following statistical frequency for inspection:

Utilize the following statistical frequency for post grouting inspection of the cantilever tendons, or as directed by the Engineer.

a. Inspect the first 9 cantilever tendons at outlets located at anchors and tendon high points by drilling and probing with the MnDOT owned endoscope or probe. If one or more of the inspection locations are found to contain a defect (void), repeat this step (100% inspection) until no defects are detected.

b. When no defects are detected as defined in No. 1 above, then the frequency of inspection may be reduced to inspect every fourth tendon (25%). If a defect is located, inspect 100% of the last three tendons grouted. Return to step 1 above and renew the cycle of 100% tendon inspection.

Utilize the following statistical frequency for post grouting inspection of the <u>continuity tendons</u> (tendons in the bottom of the segments, between the piers, which extend in the longitudinal direction), or as directed by the Engineer.

a. Inspect the first 9 continuity tendons at outlets located at anchors and tendon high points by drilling and probing with the MnDOT owned endoscope or probe. If one or more of the inspection locations are found to contain a defect (void), repeat this step (100% inspection) until no defects are detected.

b. When no defects are detected as defined in No. 1 above, then the frequency of inspection may be reduced to inspect every other tendon (50%). If a defect is located, inspect 100% of the last three tendons grouted. Return to step 1 above and renew the cycle of 100% tendon inspection.

Utilize the following statistical frequency for post grouting inspection of <u>all other tendons</u>, except as noted otherwise or as directed by the Engineer.

a. Inspect the first 2 tendons at outlets located at anchors and tendon high points by drilling and probing with the MnDOT owned endoscope or probe. If one or more of the inspection locations are found to contain a defect (void), repeat this step (100% inspection) until no defects are detected.

b. When no defects are detected as defined in No. 1 above, then the frequency of inspection may be reduced to inspect every twentieth tendon (5%). If a defect is located, inspect 100% of the last three tendons grouted. Return to step 1 above and renew the cycle of 100% tendon inspection.

If tendon grouting operations were prematurely terminated prior to completely filling the tendon, drill into the duct and explore the voided areas with an endoscope. Probing is not allowed. Determine the location and extent of all voided areas. Install grout inlets as needed and fill the voids using volumetric measuring vacuum grouting equipment.

9. Grouting Report: Provide a grouting report signed by the Contractor and/or the Subcontractor within 72 hours of each grouting operation for review by the Engineer.

Report the theoretical quantity of grout anticipated as compared to the actual quantity of grout used to fill the duct. Notify the Engineer immediately of shortages or overages.

Information to be noted in the records must include but not necessarily be limited to the following:

- Identification of the tendon
- Date grouted
- Number of days from tendon installation to grouting
- Type of grout
- Injection end and applied grouting pressure, ratio of actual to theoretical grout quantity
- Summary of any problems encountered and corrective action taken.

SB- Protection of Prestress Anchorages

As soon as possible but not to exceed 14 days after tensioning and grouting is completed, clean exposed end anchorages, strands, other metal accessories and concrete in and around blockout by sandblasting or equal of rust, misplaced mortar, grout, and other such materials. The surfaces of concrete against which concrete encasement over anchorage assemblies is to be placed shall be abrasive blast cleaned and aggregate exposed. Immediately following the cleaning operations, thoroughly dry the entire surface of the anchorage recess (all metal and concrete) and place permanent grout caps on each anchor head. Apply a heavy unbroken coating of "wet-to-dry" epoxy bonding compound, per AASHTO M235, Class II, to all surfaces against which concrete or grout will be cast.

When blockouts are used, the following shall apply: Place epoxy coated mesh across the anchor head block out and tie to the inplace reinforcement with plastic coated wire ties. Place an approved high strength and low shrinkage grout over the anchor heads. After the grout has cured, place an approved epoxy paint (which does not delaminate) over the concrete block out. Cover the entire block out plus at least 1 ft [300 mm] all around as approved by the Engineer. Apply this epoxy paint in a manner and thickness as recommended by the manufacturer.

SB- Final Clean Up

Before Final Acceptance, clean the interior of the concrete box girders of all rubbish, excess materials, loose concrete, grout, dirt, and debris. Sweep out the interior of the box girders. Perform the final clean up after all work on the interior of the box girders, including grouting of all tendons and electric work, has been completed.

SB- **Basis of Payment**

Payment for Item No. 2405.616 "POST-TENSIONING SYSTEM" will be made at the Contract Price per System and shall be full compensation for furnishing, installing, testing, stressing and grouting all temporary and permanent post-tensioning tendons. Payment includes anchorage assemblies, additional reinforcement for supporting ducts, lubricants, cleaning of ducts, grout and grouting, testing, anchorage protection systems, labor, materials, tools, equipment and incidentals necessary for completing the work in accordance with Contract requirements.

SB2014-2401.16

Use with integral concrete diaphragms, but only if approved by the Regional Bridge Construction Engineer.

CREATED 3/5/2003

REVISED 10/3/2014 (5)

SB- Integral Concrete Diaphragms

Use an approved chemical retarder from the "Approved/Qualified Product List for Concrete Products, Concrete Admixtures A-G" (http://www.dot.state.mn.us/products) in the concrete for the first poured integral concrete diaphragm. Adjust the retarder dosage so the integral diaphragm concrete remains in an unhardened state during placement of the entire bridge slab. Gradually reduce retarder dosage after the first end diaphragm.

SB2014-2401.17

Use when required per "TABLE MC-1"of this special provision.
Direct any questions to the respective Regional Bridge Construction Engineer.

CREATED 4/22/2015
REVISED 4/22/2015

SB- **Mass Concrete**

A. General

Assume the responsibility to produce a structure free of cracks, which result from unnecessary heat of hydration during the curing of the mass concrete.

This effort consists of temperature control of mass concrete for the purpose of minimizing potential cracking as a result of excessive temperature differentials due to the heat of hydration in concrete and for limiting the maximum temperature of concrete during the hydration process.

Unless otherwise noted in the plans, Mass Concrete, Concrete Temperature Control and Form Removal requirements for each concrete element must comply with Table MC-1:

Table MC-1
Mass Concrete, Concrete Temperature Control and Form Removal Requirements

Concrete Element	Least Dimension	Mass Concrete Requirements Apply?	Concrete Temperature Control Requirements		Form Removal Requirements Apply? (Section B.3)
			Maximum Temperature Differential Apply? (Section B.1)	Maximum Temperature Apply? (Section B.2)	
Pier Tremie Seal Concrete	Any Dimension	No	No	No	No
Pre-cast Beams	Any Dimension	No	No	No	No
For all other concrete elements					
Concrete Design Strength ≥ 6,000 psi [41,370 kPa]	≤ 48 in [1225 mm]	No	No	Yes	No
Post-Tensioned Elements		No	No	Yes	No
All Other Concrete Elements		No	No	No	No
All Concrete Elements*	> 48 in [1225 mm]	Yes	Yes	Yes	Yes
Drilled Shafts	> 48 in [1225 mm]	Yes	No	Yes	No
Buried Footings	≥ 60 in [1525 mm]	Yes	Yes	Yes	Yes
*Except as noted otherwise in table					

Provide temperature control of these elements in accordance with ACI 207.1R-05, "Guide to Mass Concrete," ACI 207.2R-07, "Report on Thermal and Volume Change Effects on Cracking of Mass Concrete," and ACI 207.4R-05, "Cooling and Insulating Systems for Mass Concrete."

The Engineer will allow the Contractor to place successive lifts of concrete over other mass concrete elements if the requirements defined in this special provision are met. Do not alter the mass concrete curing and protection on top of the previous mass concrete elements until the concrete has reached the compressive strengths defined in 2401.3.G, "Concrete Curing and Protection."

A.1 Contractor Concrete Mix Designs

Designer Note: For the following paragraph you will reference a separate special provision (it is currently being developed by the Concrete Office…coming soon to a special provision near you!).

Design concrete mix designs for all concrete elements defined in Table MC-1 and in accordance with SB-xxx.

B. Temperature Limitations

Maintain temperature control as specified from the time of concrete placement until all interior concrete temperatures are decreasing and requirements in this special provision are met.

B.1 Maximum Temperature Differential

The temperature differential between the centroid of the placement and a point 2 in [50 mm] inside the surface along the shortest line from the centroid to the nearest surface of the element at any given time shall not exceed the limits of Table MC-:

Table MC-2
Maximum Temperature Differential

Time	Maximum Temperature Differential
First 48 Hours	45º F [7° C]
Next 2 to 7 Calendar Days	50º F [10° C]
Greater than 8 Calendar Days	60º F [15° C]

Instead of the limits of Table MC-2, The Contractor may propose for consideration by the Engineer differential temperature vs. concrete strength curves based upon the following:

(1) A finite element analysis revealing the calculated thermal stresses developed within the concrete will not exceed the tensile strength of the concrete,
(2) Use test data from the actual concrete placed in the element to define any specific input properties of the concrete used in the model,
(3) Apply a safety factor of at least two (2) to all stress calculations,
(4) At least 60 calendar days prior to casting a mass concrete element that utilizes differential temperature vs. concrete strength curves, submit the finite element analysis as part of the Mass Concrete Placement and Temperature Plan,
(5) The Engineer reserves the right to allow and discontinue use of the strength curves based on cracking observed on previous concrete elements, and
(6) On concrete placements where differential temperature vs. concrete strength curves are allowed for use by the Engineer, the allowable differential temperature referenced in Table MC-5 will be determined from the curves.

B.2 Maximum Peak Temperature

Do not exceed a maximum peak concrete temperature of 160º F [71º C] for all mass/non-mass concrete elements, except for those elements excluded in table MC-1.

B.3 Form Removal

The Engineer will allow the Contractor to remove the forms from the mass concrete elements provided the following requirements are met:

(1) Maximum peak temperature is reached and drops by more than 3º F [1.7º C],
(2) Maximum temperature differential is reached and drops by more than 3º F [1.7º C],
(3) The temperature difference between the ambient and the point 2 in [50 mm] from the surface has reached its maximum, drops by more than 3º F [1.7º C], and doesn't exceed 35º F [19º C],
(4) A minimum of 72 hours for bridge substructures and 96 hours for bridge superstructures,
(5) The requirements of 2401.3.G, "Concrete Curing and Protection," or a minimum compressive strength of 2000 psi [13800 kPa], whichever is greater, based on control cylinders. The Contractor is responsible for making and testing control cylinders at a Qualified Laboratory. Produce sets of 3 cylinders to be used as part of the determination of removal of forms, and
(6) Gradually discontinue heating or cooling protection in a manner such that the rate of temperature reduction adjacent to the concrete surface does not exceed 20º F [11º C] during any 12-hour period until the surface temperature reaches that of the ambient temperature outside any cold weather protection.

C. Temperature Control

Monitor and control the maximum interior and exterior temperature differentials as specified in this special provision.

C.1 Mass Concrete Placement and Temperature Plan

A registered Professional Engineer in the state of Minnesota is required to develop and complete the analysis for the mass concrete placement and temperature plan in accordance with the following:

(1) At least 30 calendar days prior to casting a mass concrete element, submit a Preliminary Mass Concrete Placement and Temperature Plan to the Engineer, and
(2) Within 48 hours of actual concrete placement, submit a Final Mass Concrete Placement and Temperature Plan to the Engineer using actual environmental conditions and current construction practices.

Provide the placement and temperature plan for each mass concrete element including, but not limited to the following items:

(1) Specific element information, dimensions, and the location of temperature sensors within the element,
(2) Mass concrete mix design reviewed and accepted by the Engineer,
(3) Expected placement conditions including, but not limited to the following:
    (a) Ambient temperatures,
    (b) Concrete constituent temperatures for mixing,
    (c) Ice or heating requirements,
    (d) Concrete temperature at the point of placement, and
    (e) Options for protection to satisfy temperature control.
(4) Comprehensive heat generation and dissipation analysis in accordance with ACI 207.1R-05 "Guide to Mass Concrete," for each mass concrete element. The analysis determines the following:
    (a) Predicted concrete temperature at the centroid,
    (b) Location and temperature of maximum temperature if not at the centroid,
    (c) Temperatures 2 in [50 mm] inside of the exterior surface exposed to air,
    (d) Complete analyses until all temperatures are decreasing and the mass concrete element reaches maximum temperature differential and begins to decrease, or for the duration of the curing period, whichever is longer, and

(e) Perform analyses for the anticipated mean weekly ambient air (or enclosure) temperatures for the period of the proposed placement and for temperatures plus and minus 20º F [7° C] of the mean weekly ambient air (or enclosure) temperature.

(5) Anticipated concrete placement temperatures measured at discharge into the forms for the mean weekly ambient air temperatures,

(6) The method(s) that are intended for ensuring that required temperature control (maximum temperature differential and maximum peak temperature) for the designated mass concrete elements are not exceeded considering the anticipated mean weekly ambient or enclosure air temperatures in which the element is cast.

(a) If cooling tubes are selected as a means for controlling the heat of hydration, submit the following:

i. Summary of design and details for cooling tube system,

ii. Submit the method of temperature control of cooling water effluent to the Engineer for review and acceptance, and

iii. Submit a heat transfer analysis, for the cooling tube system, prepared by a registered Professional Engineer licensed in Minnesota.

(b) If cooling tubes are used and circulating waterway water through the tube system is proposed for temperature control, monitor the spent cooling water temperature to assure that the temperature is in an appropriate range to be discharged back into the waterway water that it originated from.

(7) Contractor planned field placement and protection methodologies for varying conditions along with planned mitigation measures should temperature control not follow the Mass Concrete Placement and Temperature Plan.

C.2 Temperature Monitoring

Cast temperature sensors 2 in [50 mm] below the concrete surfaces for measuring temperature differentials. The Engineer will not permit surface-mounted temperature sensors.

Provide temperature monitoring devices that meet the following requirements:

(a) Automatic sensing and recording instruments that record information at a maximum interval of one hour,

(b) Operate over a range of 0º F to 200º F [-17º C to 93º C] with an accuracy of plus or minus 2º F [1.1º C],

(c) Use a minimum of two (2) sets of two (2) sensors (or 4 total sensors) for each placement,

Record temperature development at the following locations:

(a) Unless indicated otherwise by the heat generation and dissipation analysis, place the monitoring points at the geometric center (centroid) of the element or placement (interior point) and a point located 2 in [50 mm] inside the exterior surface along the shortest line from the centroid to the nearest surface of the element (exterior point),

(b) Monitor temperature at a minimum of two independent sets of interior and exterior points for each element to provide redundancy in the event of a monitoring device failure, and

(c) Other locations as accepted by the Engineer.

Monitor temperatures in accordance with the following:

(a) Review temperature readings at intervals not greater than 24 hours or as required by the Mass Concrete Placement and Temperature Plan to ensure that the automatic devices are working properly and that the temperatures are within allowable limits,

(b) Ensure devices begin recording data immediately after casting is complete,

(c) Continue monitoring temperatures for a minimum of 96 hours and until 24 hours after all of the form removal requirements from B.3 above are met, and all formwork, insulation, and other temporary items are removed from the mass concrete element and it is exposed to the environment,

(d) Transmit readings to the Engineer immediately after they are recorded and at least every 24 hours or as required by the Mass Concrete Placement and Temperature Plan,

(e) If monitoring indicates that the maximum temperature differential and/or the maximum peak temperature has or appears to have the potential to exceed specified limits, as determined by the Contractor or the Engineer, take immediate action to retard further growth in the differential or maximum peak temperatures to bring control back within specified limits by adjusting the protection plan in accordance with mitigation measures outlined in the Mass Concrete Placement and Temperature Plan,
(f) Make any necessary revisions to the plan to avoid exceeding temperature limits on any remaining placements and submit to the Engineer for review, and
(g) The Engineer must review and accept all revisions to the plan prior to implementation.

D. Crack Repair

The Engineer will make a visual inspection of the mass concrete elements and will identify all crack widths that are greater than 0.01 in [0.25 mm] wide appearing on the concrete surface. Provide lift equipment and other equipment as necessary to allow the Engineer full access to the surfaces of the mass concrete elements for the purpose of inspection.

Seal cracks in mass concrete that exceed 0.01 in [0.25 mm] in width as determined by the Engineer in accordance with Table MC-3. Do not repair cracks until at least 24 hours after all of the form removal requirements from B.3 above are met, and all formwork, insulation, and other temporary items are removed from the mass concrete element and it is exposed to the environment.

Table MC-3
Crack Sealing Requirements for Mass Concrete

Crack Width *in [mm]*	Crack Sealing Method
0.01 [0.25] to ≤ 0.03 [0.80]	Approved Epoxy Crack Sealant
0.03 [0.08] – 0.06 [1.50]	Approved Epoxy Injection Method and Materials #
> 0.06 [1.50]	As determined by the Engineer. The Engineer will evaluate whether these cracks compromise the integrity of the structure or the fitness for use
#Perform epoxy injection operations in accordance with the material and equipment manufacturer's published recommendations, except where otherwise directed by the Engineer. Upon satisfactory completion and repair, remove all injection ports, excess epoxy and sealing epoxy from the concrete surface.	

E. Non-Compliance with Concrete Temperature Limitation

The remedies herein for the Contractor's failure to comply with the requirements of this Special Provision are in addition to, and not in limitation of, those provided elsewhere under the Contract.

The Engineer may deduct the whole, or part, of any payment for concrete identified as Mass Concrete as defined herein or elsewhere in the Contract Documents if, in the Engineer's evaluation and judgment, the Contractor fails to maintain the maximum peak temperature and/or the maximum differential temperature within the limits specified herein.

Tables MC-4 and MC-5 represent the materials that may be accepted by the Engineer even though such materials have received test results that would cause the materials to be considered of "borderline quality" as that term is used in MnDOT 1503 and thus subject to the remedies specified in MnDOT 1512. If the Engineer accepts such materials, the Engineer will make the adjustment authorized in the tables below, not as a penalty, but as a pre-agreed adjustment to the Contract Unit Prices approximating a reduction in value of the project due to use of materials of borderline quality.

If, in the judgment of the Engineer, the Contractor fails to maintain concrete temperatures below the maximum peak concrete temperature specified herein, the Engineer will make determinations regarding the disposition, payment or removal. The Engineer will require the following monetary reductions in payment for the subject concrete in accordance with Table MC-4:

Table MC-4
Monetary Reduction for Exceeding Maximum Peak Concrete Temperature

Maximum Concrete Temperature	Monetary Reduction in Bid Price for Concrete
160º F [71º C] to 165º F [74º C]	$ 2.00 per cubic yard
> 165º F [74º C] to 170º F [77º C]	$ 35.00 per cubic yard
> 170º F [77º C] to 175º F [80º C]	$150.00 per cubic yard
> 175º F [80º C]	Remove and Replace

If, in the judgment of the Engineer, the Contractor fails to maintain concrete temperatures within the maximum temperature differential specified herein, the Engineer will make determinations regarding the disposition, payment or removal. The Engineer will require the following monetary reductions in payment for the subject concrete in accordance with Table MC-5:

Table MC-5
Monetary Reduction for Exceeding Allowable Temperature Differential

Temperature in Excess of Allowable Differential	Monetary Reduction in Bid Price for Concrete
0º F [71º C] to 5º F [2.8º C]	$ 2.00 per cubic yard
5º F [2.8º C] to 10º F [5.6º C]	$ 15.00 per cubic yard
10º F [5.6º C] to 15º F [8.3º C]	$45.00 per cubic yard
Over 15º F [8.3º C]	Remove and Replace

F. Basis of Payment

The Engineer will not make separate payment for the analysis, plan, materials, protection, labor, equipment and all other incidentals associated with and required for the proper control of the heat generated by the Mass Concrete. No payment for crack measurement and repair or other repairs deemed necessary by the Engineer. The Engineer will consider all such costs incidental to the Structure Concrete of each Grade or Mix as designated in the Contract Documents.

SB2014-2401.18

Use on projects requiring High Performance Concrete (3YLCHPC) when required by the Regional Construction Eng.

CREATED 4/22/2015
REVISED 4/22/2015

SB- **Structural Concrete – High Performance Concrete Bridge Decks (Contractor Concrete Mix Design)**

SB- Delete the contents of 2401.2.A, "Concrete," and replace with the following:

For Bridge No. _____, design a **3YLCHPC-M** or **3YLCHPC-S** concrete mixture that will minimize cracking. Perform the work in accordance with the applicable requirements of 2401, "Concrete Bridge Construction," 2461, "Structural Concrete," and the following:

2.A.1 Fine Aggregate Requirements

Provide fine aggregates complying with quality requirements of 3126.2.D, "Deleterious Material," 3126.2.E, "Organic Impurities," and 3126.2.F, "Structural Strength."

2.A.1.a Fine Aggregate Alkali Silica Reactivity (ASR) Requirements

The Department will routinely test fine aggregate sources for alkali silica reactivity (ASR) in accordance with the following:

(1) Multiple sources of certified portland cement in accordance with ASTM C 1260 MnDOT Modified.

The Concrete Engineer, in conjunction with the Engineer, will review the 14-day fine aggregate expansion test results to determine the acceptability of the proposed fine aggregate.

(1) Unmitigated fine aggregate and cement combinations previously tested by the Department must have a 14 day expansion ≤ 0.200.

(2) Alkali silica reactivity (ASR) ASTM C1260 test results are available on the MnDOT Concrete Engineering Unit website.

The Concrete Engineer may reject the fine aggregate if mortar bar specimens exhibit an indication of external or internal distress not represented by the expansion results. The Concrete Engineer will make the final acceptance of the aggregate.

2.A.2 Intermediate Aggregate Requirements

Provide intermediate aggregates complying with the quality requirements of 3137.2.D.2, "Coarse Aggregate for Bridge Superstructure," except as modified in Table HPC-1. If the intermediate aggregate is from the same source as the ¾ inches- fraction, the aggregate quality is determined based upon the composite of the ¾ inches- and intermediate aggregate.

The Concrete Engineer classifies intermediate aggregate in accordance with Table HPC-1.

Table HPC-1
Intermediate Aggregate for Use in Concrete

If the gradation meets the following:	Classify material type as:	Gradation Test Procedures	Quality Test Requirements
100% passing the 1/2" and ≤90% passing #4	Intermediate Aggregate	Coarse Aggregate (+4 Portion)	Spec. 3137.2.D.2 except 3137.2.D.2(i) modified to maximum 40% carbonate
		Fine Aggregate (-4 Portion)	Shale in Sand (-4 Portion)
100% passing the 1/2" and >90% passing #4	Intermediate Aggregate	Fine Aggregate (Minimum 1000 g sample)	Shale Content Test by AASHTO T113 MnDOT Modified (+4 Portion)
			Shale in Sand (-4 Portion)
100% passing the 3/8" and ≤90% passing #4	Coarse Sand	Fine Aggregate	Shale Content Test by AASHTO T113 MnDOT Modified (+4 Portion)
			Shale in Sand (-4 Portion)

For any intermediate aggregate size not previously tested by the Department, the Concrete Engineer reserves the right to test for alkali silica reactivity, in accordance with ASTM C1260, prior to allowing incorporation into the concrete mix design.

2.A.3 Coarse Aggregate Requirements

Provide Class A, B or C coarse aggregate meeting the quality requirements in accordance with 3137.2.D.2, "Coarse Aggregate for Bridge Superstructure."

When providing Class B aggregate, the maximum absorption percent by weight is 1.10%.

Coarse aggregate identified as quartzite or gneiss will not be allowed.

2.A.4 Cementitious Materials

Provide only cementitious materials from the Approved/Qualified Products List.

2.A.4.a Cement

Use Type I or Type I/II cement complying with 3101, "Portland Cement," or blended cement in accordance with 3103, "Blended Hydraulic Cement."

(1) Total alkalis (Na_2Oe) no greater than 0.60 percent in the portland cement, and
(2) Total alkalis (Na_2Oe) no greater than 3.0 lb per yd^3 of concrete resulting from the portland cement.

2.A.5 Allowable Admixtures

Use any of the following admixtures on the MnDOT Approved/Qualified Products list:
(A) Type A, Water Reducing Admixture
(B) Type B, Retarding Admixture
(C) Type C, Accelerating Admixture
(D) Type D, Water Reducing and Retarding Admixture
(E) Type F, High Range Water Reducing Admixture

(F) Type S, Specific Performance Based Admixture

Obtain a written statement from the manufacturer of the admixtures verifying:

(1) Compatibility of the combination of materials, and

(2) Manufacturer recommended sequence of incorporating the admixtures into the concrete.

The manufacturer will further designate a technical representative to dispense the admixture products.

The technical representative shall act in an advisory capacity and shall report to the Contractor any operations or procedures which are considered as detrimental to the integrity of the placement. Verify with the Engineer whether the Manufacturer's technical representative's presence is required during the concrete placement.

2.A.6 Concrete Mix Design Requirements

Submit the concrete mixes using the appropriate MnDOT Contractor Mix Design Submittal Workbook available on the Department's website at least 21 calendar days before the initial concrete placement. For mix design calculations, the Engineer, in conjunction with the Concrete Engineer, will provide specific gravity and absorption data.

The Concrete Engineer, in conjunction with the Engineer, will review the mix design submittal for compliance with the contract.

2.A.6.a Concrete Mix Design Requirements

Design and produce 3YLCHPC-M or 3YLCPHC-S concrete mixes based on an absolute volume of 27.0 ft^3 [1.0 m^3] in accordance with the Table HPC-2 and the following requirements:

Table HPC-2
High Performance Bridge Deck Concrete Mix Design Requirements

Concrete Grade	Mix Number *	Intended Use	w/c ratio	Air Content	Cement Content ‖	Slump Range †, *inches*	Minimum Compressive Strength, f'c (28-day)	3137 Spec.
HPC	3YLCHPC-M	Bridge Deck – Monolithic	0.42-0.45	8.0% ±1.0%	500-535lbs./yd^3	$1^1/_2$ - 3	4000 psi	2.D.2
	3YLCHPC-S	Bridge – Structural Slab						

* Provide a Job Mix Formula in accordance with 2401.2.A.7 per these special provisions. Use any good standard practice to develop a job mix formula and gradation working range by using procedures such as but not limited to 8-18, 8-20 gradation control, Shilstone process, FHWA 0.45 power chart or any other performance related gradation control to produce a workable and pumpable concrete mixture meeting all the requirements of this contract.

‖ The cement content shall be 100% Portland Cement.

† Keep the consistency of the concrete uniform during entire placement.

2.A.6.b Required Preliminary Testing

Prior to placement of any 3YLCHPC-M or 3YLCHPC-S Concrete, the Engineer will require preliminary batching and testing of the concrete mix design.

Submit the concrete mixes using the appropriate MnDOT Contractor Mix Design Submittal Workbook available on the Department's website at least 14 calendar days prior to the beginning of preliminary laboratory mixing and testing of the proposed mix designs. Any changes or adjustments to the material or mix design require a new Contractor mix design submittal. For mix design calculations, the Engineer, in conjunction with the Concrete Engineer, will provide specific gravity and absorption data.

The Concrete Engineer, in conjunction with the Engineer, will review the mix design submittal for compliance with the contract.

Test the concrete for the following hardened concrete properties in accordance with Table HPC-3:

Table HPC-3
Required Hardened Concrete Properties for Mixes 3YHPC-M and 3YHPC-S

Test	Requirement	Test Method
Required Strength (Average of 3 cylinders)	4000 psi at 28 days	ASTM C31
Rapid Chloride Permeability	≤ 2500 coulombs at 28 days (For Preliminary Approval) ≤ 1500 coulombs at 56 days	ASTM C1202
Freeze-Thaw Durability	Greater than 90% at 300 cycles	ASTM C666 Procedure A
Shrinkage	No greater than 0.040 percent at 28 days	ASTM C157
Scaling	Visual rating not greater than 1 at 50 cycles	ASTM C672

The Engineer will allow the maturity method for subsequent strength determination. Perform all maturity testing in accordance with ASTM C1074 and the MnDOT Concrete Manual.

If a mix is approved, the Concrete Engineer will consider the mix design and testing as acceptable for a period of 5 years provided the actual concrete mixed and placed in the field meets the Contract Requirements. The Concrete Engineer will not require new testing within that 5-year period as long as all the constituents (including the aggregates) of the proposed mix design are the same as the original mix design.

The Engineer determines final acceptance of concrete for payment based on satisfactory field placement and performance.

2.A.7 Job Mix Formula

A Job Mix Formula (JMF) contains the following:

(a) Proportions for each aggregate fraction,

(b) Individual gradations for each aggregate fraction; and

(c) Composite gradation of the combined aggregates including working ranges on each sieve in accordance with Table HPC-4.

Table HPC-4 Job Mix Formula Working Range	
Sieve Sizes	**Working Range, %***
1 in [25 mm] and larger	±5
¾ in [19 mm]	±5
½ in [12.5 mm]	±5
⅜ in [9.5 mm]	±5
No.4 [4.75 mm]	±5
No.8 [2.36 mm]	±4
No.16 [1.18 mm]	±4
No.30 [600 µm]	±4
No.50 [300 µm]	±3
No.100 [150 µm]	±2
No.200 [75 µm]	≤ 1.6
* Working range limits of the composite gradation based on a moving average of 4 tests (N=4).	

2.A.7.a Verification of JMF

Prior to beginning placements of bridge deck concrete, perform gradation testing to ensure current materials comply with the approved JMF. Perform gradation testing in accordance with the Schedule of Materials Control.

(1) Take samples at the belt leading to the weigh hopper or other locations close to the incorporation of the work as approved by the Engineer.

(2) Add fill-in sieves as needed during the testing process to prevent overloading.

The Producer and Engineer will test and record the individual gradation results using the Concrete Aggregate Worksheet.

(1) Using the JMF Moving Average Summary Worksheet, calculate the moving average of Producer aggregate gradation test results during production.

(2) The Engineer will randomly verify Producer combined aggregate gradation results as defined in the Schedule of Materials Control.

If, during production, the approved JMF falls outside of the allowable working range immediately sample and test additional gradation and continue production.

2.A.7.b JMF Adjustment

If it is determined that the current aggregates do not meet the approved JMF, submit a new mix design including JMF to the Concrete Engineer in accordance with 2401.2.A.7 in this special provision.

2.A.7.c JMF Acceptance

The Engineer will make monetary adjustments for the quantity of bridge deck concrete represented by the JMF Working Range failure, from the failing test to the next passing test, at a minimum rate of $500.00 or $5.00 per cubic yard, whichever is greater.

2.A.8 Laboratory batching, testing requirements and submittals:

To determine the characteristics of the Contractor proposed mix design, the Concrete Engineer will require the Contractor to prepare test batches and do laboratory testing. Conduct all batching and testing of concrete at a **single** AMRL certified laboratory using the exact materials proposed in the mix design.

Lab testing requirements:

(a) Slump and air content at <5 minutes, 15 minutes, and 30 minutes after the completion of mixing;
(b) Compressive strength (Make cylinders in accordance with AASHTO T126 and tested in accordance with AASHTO T22) at 1, 3, 7, 28, days (sets of 2);
(c) Hardened air content (ASTM C457) at a minimum of 7 days;
(d) Rapid chloride permeability (ASTM C1202) at 28 days and 56 days (2 specimens for 28 day test and 2 test specimens for 56 day test (Take 2 specimens from each batch of a 2 batch mix));
(e) Concrete Durability (ASTM C666, Procedure A) at 300 cycles; and
(f) Concrete Shrinkage (ASTM C 157) at 28 days.

The Contractor is required to contact the MnDOT Concrete Engineering Unit a minimum of 2-days prior to any mixing so that a MnDOT representative can observe the process. This same 2-day notification is required prior to any physical testing on hardened concrete samples. Additionally, retain any hardened concrete test specimens for a minimum of 90 days and make available for MnDOT to examine.

All test results are for informational purposes only.

Perform all testing for plastic concrete after all admixtures additions to the concrete mixture.

After completion of the laboratory testing specified herein and, at least, 15 working days prior to the trial placement, submit the laboratory test data to the MnDOT for review and acceptance.

Include the following information in the laboratory reports of the design mixes:
(a) Exact batch weights and properties of all ingredients used and all aggregate gradations;
(b) Slump and air content;
(c) Cylinder identification, including mix designation;
(d) Date and time of cylinder preparation;
(e) Date and time cylinder specimen was tested;
(f) Compressive strength of each cylinder specimen at 1, 3, 7, and , 28, day (sets of s);
(g) A graphic plot of age, from 0 to 28 days, vs. strength for each mix design;
(h) Hardened air content at a minimum of 7 days;
(i) Rapid chloride permeability at 28 days and 56 days;
(j) Concrete Durability at 300 cycles; and
(k) Concrete Shrinkage at 28 days.

2.A.9 Prior to Actual Bridge Deck Placement

2.A.9.a Trial Placement

A minimum of 14 calendar days prior to the actual placement of the bridge deck slab concrete, successfully complete a separate trial placement utilizing a minimum of two (2) - 10 yd^3 loads.

The Engineer may allow the incorporation of the concrete for trial batches into the bridge footings, abutments or end diaphragms. The Contractor may also choose to incorporate the trial batches into residential /commercial construction in the immediate vicinity of the project. In any case, the Engineer will require mixing, transporting, and placing the concrete using the same methods as the actual placement of the bridge deck.

If the concrete is incorporated into the permanent work, the Engineer will test the plastic concrete in accordance with the Schedule of Materials Control. The Engineer may require additional trial batches if the concrete delivered to the project does not comply with the plastic concrete requirements of the Contract.

The Engineer will waive a trial placement at the contractor's request provided the contractor submits a history of at least three successful bridge deck placements in the last 5 years using the same mix design and similar pumping or placement configuration.

The concrete mix design, laboratory batching and mixing, and the trial placement is incidental to the concrete furnished and placed.

Use the same materials, same supplier, and same supplier's manufacturing plant, and proportions in the permanent work as in the trial placement. Strength requirements specified for each mix are applicable to the cylinder tests taken during the production work.

2.A.9.b Slab Placement and Curing Plan

At least 14 calendar days prior to slab placement, provide a slab placement and curing plan for each bridge to the Engineer for approval. Include the following information in the placement and curing plan:

(1) Anticipated concrete delivery rates;
(2) Estimated start and finish time;
(3) Material, labor and equipment proposed for placing, finishing, and curing including placement of wet burlap, soaker hose, or other system to maintain the deck in a moist condition during the curing period;
(4) Number of work bridges proposed for use;
(5) Number of people responsible for the various tasks; and
(6) Bulkheading methods and materials proposed for use if the Contractor cannot maintain the proposed concrete placement rates.

A 10 ft [3 m] float is required for full-depth decks prior to carpet dragging regardless of whether texture planing is specified for the final ride surface. Float slab in accordance with MnDOT Construction Manual 5-393.358 to ensure the final surface does not vary by greater than ⅛ in [3 mm] within a 10 ft [3 m] straightedge laid longitudinally on the final surface. This surface tolerance includes areas near expansion devices and other breaks in the continuity of the bridge slab.

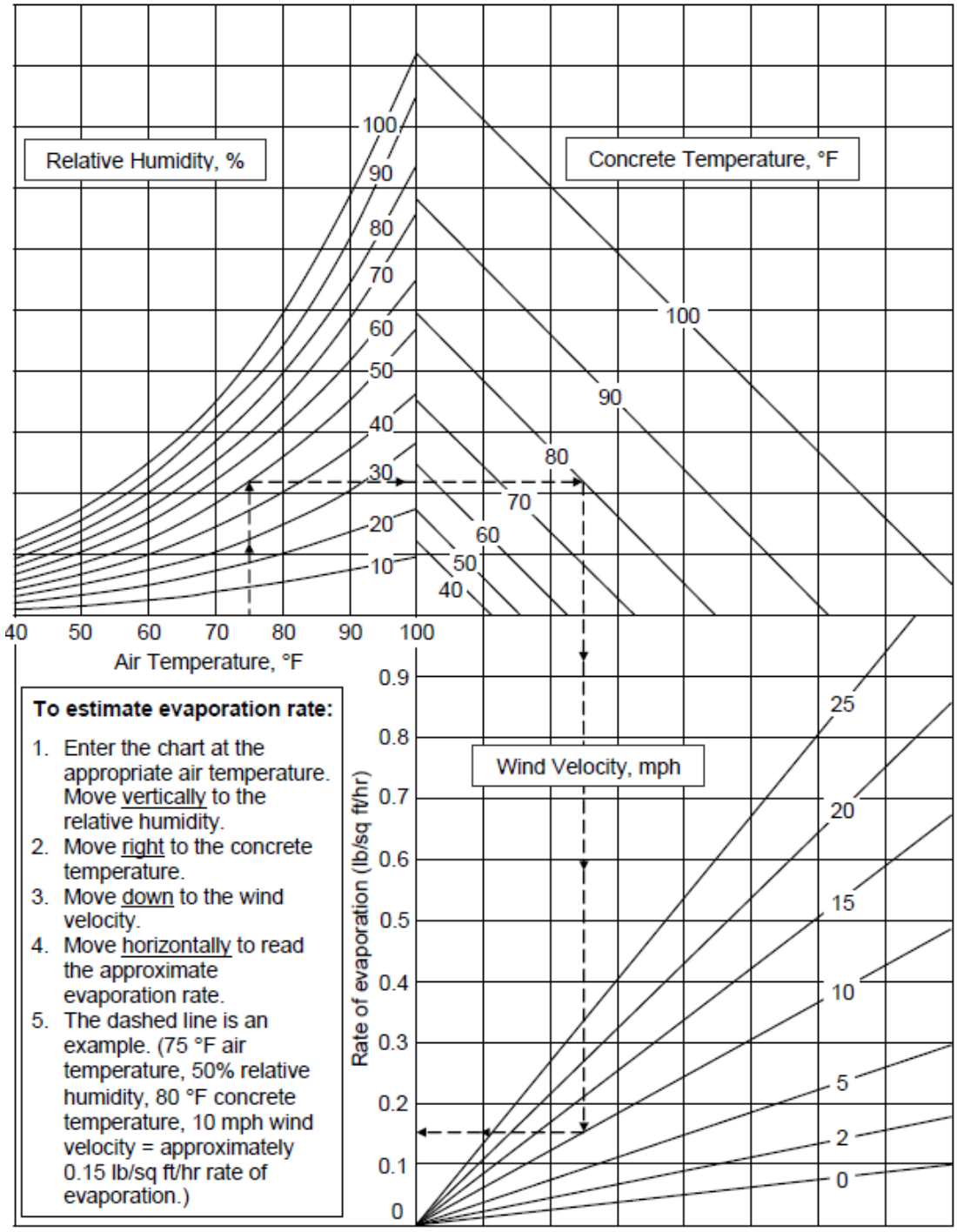
Attend a pre-placement meeting 2 calendar days to 4 calendar days before the slab placement to review the information and details provided in the placement and curing plan. The following project personnel are required to attend the pre-placement meeting:

(1) Contractor;
(2) Engineer;
(3) Concrete supplier; and
(4) If required by the Engineer, the concrete pump supplier.

2.A.9.c Three (3) Hours Prior to Beginning Bridge Deck Concrete Placement

The Engineer requires the Contractor to comply with <u>all</u> of the following conditions prior to allowing the Contractor to begin the bridge deck concrete placement:

(1) Provide a forecast to the Engineer three (3) hours before placement. The Engineer will review the forecast for the following:
    (a) No forecasted precipitation two (2) hours prior to the scheduled placement duration, nor up to two (2) hours after the anticipated completion of the placement.
    (b) Less than 30% chance of precipitation for the entire placement window; and
(2) Only if the combination of air temperature, relative humidity, concrete temperature and wind velocity produces an evaporation rate of less than 0.20 pounds per square foot of surface area per hour, according Figure HPC-1:



[1] Based on ACI 305 R, "Hot Weathering Concreting"

FIGURE HPC-1

SB- Delete the 16th paragraph through 18th paragraph of 2401.3.G, "Concrete Curing and Protection," and replaced with the following:

2.A.9.d Actual Bridge Deck Placement and Curing Requirements

In addition to the requirements set forth in 2461.3.G.4, "Field Adjustments," if any adjustments are necessary on site, comply with the following:

(1) The Engineer will only allow the addition of admixtures originally incorporated into the mix, except Viscosity Modifying Admixture (VMA) is allowed to adjust slump even if they were not used in the original testing;

(2) The Engineer will allow a maximum of 1 gallon of water additions per cubic yard of concrete on site provided additional water is available to add per the Certificate of Compliance, including any water necessary to dilute admixtures;

(3) Mix the load a minimum of 5 minutes or 50 revolutions after any additions; and

(4) Place the concrete at temperature s between 55 to 70 degrees Fahrenheit. If the temperatures exceed 70º F, ice may be added to the mixing water at the location where the temperature is measured.

The Engineer will not allow finishing aids or evaporation retarders for use in finishing of the concrete.

The Contractor is fully responsible for curing methods. Comply with the following curing methods unless other methods are approved by the Engineer in writing.

Table HPC-5
Required Curing Method Based on Final Bridge Deck Surface

Bridge Deck Type	Final Bridge Deck Surface	Required Curing Method ‖
Bridge structural slab curing (3YLCHPC-S)	Low Slump Wearing Course	Conventional wet curing after carpet drag
Bridge deck slab curing for full-depth decks (3YLCHPC-M)	Epoxy Chip Seal Wearing Course or Premixed Polymer Wearing Course	Conventional wet curing after carpet drag
	Bridge Deck Planing	Conventional wet curing after carpet drag.
	Tined Texturing*	Conventional wet curing after tine texturing AMS curing Compound after wet cure period
	Finished Sidewalk or Trail Portion of Deck (without separate pour above)*	Conventional wet curing after applying transverse broom finish AMS curing Compound after wet cure period

‖ Apply conventional wet curing to bridge slabs following the finishing machine or air screed.
* Prevent marring of broomed finish or tined textured surface by careful placement of wet curing.

Use conventional wet curing consisting of pre-wetted burlap covered with white plastic sheeting in accordance with the following:

(1) Place the burlap to cover 100 percent of the deck area without visible openings;

(2) Place the wet curing within 30 min after the finishing machine completes the final strike-off of the concrete surface;

(3) If the Contractor fails to place the wet curing within 30 min, the Department will monetarily deduct $500 for every 5 min period, or any portion thereof, after the initial time period until the Contractor places the wet curing as approved by the Engineer;

(4) The Department may assess the deduction more than once;

(5) Keep the slab surface continuously wet for an initial curing period of at least 7 calendar days;

(6) Use a work bridge to follow the finish machine or air screed; and

(7) Provide an additional center rail on wide bridges, if necessary.

Where marring of the broomed finish or tined texturing surface finish is a concern, the Engineer may authorize curing as follows:

(1) Apply a membrane curing compound meeting the requirements of 3754, "Poly-Alpha Methylsytrene (AMS) Membrane Curing Compound;"
(2) Apply curing compound using approved power-operated spray equipment;
(3) Provide a uniform, solid white, opaque coverage of membrane cure material on exposed concrete surfaces (equal to a white sheet of paper);
(4) Place the membrane cure within 30 min of concrete placement unless otherwise directed by the Engineer;
(5) Provide curing compound for moisture retention until the placement of a conventional wet curing;
(6) Apply conventional wet curing when walking on the concrete will not produce imprints deeper than $^{1}/_{16}$ in [1.6 mm];
(7) Keep the deck slab surface continuously wet for an initial curing period of at least 7 calendar days including weekends, holidays, or both if these fall within the 7-calendar-day curing period;
(8) The Engineer will not allow placement of membrane curing compound on any concrete surface that expects future placement of additional concrete on that surface; and
(9) If the Contractor fails to meet these requirements, the Department may reduce the contract unit price for the concrete item in accordance with 1512, "Conformity with Contract Documents."

SB- Delete 2401.3.I.2, "Crack Sealing," and replace with the following:

The Contractor is fully responsible for crack sealing all cracks identified by the Engineer in accordance with Table HPC-6.

Table HPC-6
Required Crack Sealing Requirements Based on Final Bridge Deck Surface

Bridge Deck Type	Final Bridge Deck Surface	Crack Sealing Requirements
Bridge structural slab (3YLCHPC-S) *	Low Slump Wearing Course	Seal cracks in accordance with 2401.3.I.2
Bridge deck slab for full-depth decks (3YLCHPC-M)	Epoxy Chip Seal Wearing Course or Premixed Polymer Wearing Course	See wearing course special provision
	Bridge Deck Texture Planing	Seal cracks in accordance with 2401.3.I.2 after texture planing
	Tined Texturing	Seal cracks in accordance with 2401.3.I.2
	Finished Sidewalk or Trail Portion of Deck (without separate pour above)	Seal cracks in accordance with 2401.3.I.2

* Shotblast the surface in preparation for low slump wearing course. Prior to placing the low slump wearing course, the Engineer will visually inspect the bridge structural slab, and will mark cracks that require sealing appearing on the top surface. Control the application of the crack sealer such that the maximum width of crack sealant does not exceed 1 in [25 mm]. If exceeding the permitted width of 1 in [25 mm], remove excess by means of surface grinding to prevent debonding of concrete wearing course. The Engineer requires the sealer to cure completely prior to pre-wetting of the deck, as required for placement of a low slump concrete wearing course.

Designer note: select the method that is required and remove the other.

SB- Method of Measurement

If measuring bridge slab concrete by area, the Engineer will base the measurement on end-of-slab stationing and out-to-out transverse dimensions of the slab.

If measuring bridge slab concrete by cubic yard, the Engineer will base the measurement on the basis of the dimensions of the structure shown in the plans of the slab.

Designer note: select the payment that is required and remove the others.

SB- **Basis of Payment**

Payment for Item No. 2401.618 "BRIDGE SLAB CONCRETE (3YLCHPC-M)" will be made at the Contract price per square foot and shall be compensation in full for all costs of forming, placing, finishing, curing, crack sealing, and all associated incidentals necessary to the construct the bridge deck and diaphragms as detailed in the Plans in accordance with these specifications.

Payment for Item No. 2401.618 "BRIDGE SLAB CONCRETE (3YLCHPC-S)" will be made at the Contract price per square foot and shall be compensation in full for all costs of forming, placing, finishing, curing, crack sealing, and all associated incidentals necessary to the construct the bridge deck and diaphragms as detailed in the Plans in accordance with these specifications.

Payment for Item No. 2401.607 "BRIDGE SLAB CONCRETE (3YLCHPC-M)" will be made at the Contract price per cubic yard and shall be compensation in full for all costs of forming, placing, finishing, curing, crack sealing, and all associated incidentals necessary to the construct the bridge deck and diaphragms as detailed in the Plans in accordance with these specifications.

Payment for Item No. 2401.607 "BRIDGE SLAB CONCRETE (3YLCHPC-S)" will be made at the Contract price per cubic yard and shall be compensation in full for all costs of forming, placing, finishing, curing, crack sealing, and all associated incidentals necessary to the construct the bridge deck and diaphragms as detailed in the Plans in accordance with these specifications.

SB- **Control Strength Cylinders**

Delete 2461.3.G.5.b, “Control Strength Cylinders,” and replace with the following:

3.G.5.b Curing and Transporting Standard (28-day) Strength Cylinders

Provide moist curing environments of adequate size and number for initial and final curing in accordance with ASTM C31 and in accordance with 2031.3.C, “Special Requirements.”

The Concrete Engineer defines the **initial curing period** as immediately after molding and finishing for a period of up to 48 hours in a temperature range from 60° F to 80° F [16° C and 27° C].”

After the initial curing period, the Engineer will both transport and further cure the test specimens in the provided curing tanks. The Engineer will deliver the test specimens to the laboratory for compressive strength testing.

Provide curing tanks of adequate size and number for curing all of the concrete test specimens in accordance with 2031.3.C, “Special Requirements.” Maintain the water in the curing tanks to a water temperature of 60° F to 80° F [16° C and 27° C]. When cured in the testing laboratory, maintain the cylinders at a temperature of 73.5° F ± 3.5° F [23.0° C ± 2.0° C].

The Engineer will allow the Contractor to submit a strength-maturity relationship curve for use in lieu of control cylinders. Perform all maturity testing and validation of the strength-maturity relationship curve in accordance with ASTM C1074 and the MnDOT Concrete Manual.

3.G.5.b (1) Acceptance of Concrete Compressive Strength

The Concrete Engineer defines a **strength test** as the average (28-day) strength of three (3) cylinders fabricated from a single sample of concrete and cured in accordance with the MnDOT Concrete Manual.

The Engineer will consider concrete acceptable in accordance with Table HPC-7 provided **both** conditions are met for a required f'c.

Table HPC-7
Acceptance Criteria for Standard 28-day Cylinders

	All strength tests	**Moving average of 3 consecutive strength tests ***
f'c ≤ 5000 psi	> (f'c – 500 psi)	≥ f'c
f'c > 5000 psi	> 0.90 * f'c	≥ f'c

* If a project does not establish a moving average of 3 consecutive strength tests, use either the single strength test or the average of 2 strength tests to determine acceptance.

3.G.5.b (2) Strength Test Below Acceptance Criteria

If any single strength test (3 cylinders) falls below the criteria established in Table HPC-7, the Engineer, in conjunction with the Concrete Engineer, will determine the following:

(A) If the concrete has attained critical load-carrying capacity;
(B) If investigation is required; The investigation may consist of, but is not limited to reviewing the following:
  (B.1) Sampling and testing plastic concrete,
  (B.2) Handling of cylinders,
  (B.3) Cylinder curing procedures,
  (B.4) Compressive strength testing procedures,
  (B.5) Certificate of Compliances
(C) If dispute resolution coring is required in accordance with 2461.3.G.5.b(4).

3.G.5.b (3) Moving Average Below Acceptance Criteria

If the moving average of three (3) consecutive strength tests falls below f'c, the Concrete Engineer will require a new mix design in accordance with Table HPC-4

3.G.5.b (4) Dispute Resolution Coring

The Engineer and Contractor will mutually agree on an Independent Third Party to core and test the concrete in accordance with ASTM C42.

(A) The Engineer will identify a minimum of three (3) locations for the Independent Third Party to core;
(B) The Independent Third Party will take one (1) core at each location;
(C) The Contractor will complete all coring within 14 days of notification of the low strength concrete; and
(D) The Contractor is responsible for ensuring the core holes are repaired.

The Engineer, in conjunction with the Concrete Engineer, will review the core test results and evaluate in accordance with Table HPC -8, providing all other concrete tests meet requirements.

Table HPC-8 Evaluation of Core Test Results			
Core (average of 3 cores) Test Results:	**Engineer considers concrete:**	**Cost of Coring and Testing:**	**Resolution:**
≥ 85% of f'c	Acceptable to remain in place	Engineer Responsibility	No monetary adjustment for single strength test failure.
< 85% of f'c	Unacceptable	Contractor Responsibility	Remove and replace concrete in accordance with 1503, "Conformity with Contract Documents," and 1512, "Unacceptable and Unauthorized Work," as directed by the Engineer. If the Engineer, in conjunction with the Concrete Engineer, determines the concrete can remain in place, the Engineer may not pay for the concrete or will pay at an adjusted Contract Unit Price and consider any additional actions in accordance with Table HPC-9.

3.G.5.b (5) Non-Conforming Material

If the Contractor inadvertently places concrete not meeting the strength requirements in accordance with Table HPC-8 into the work, the Engineer will not accept nonconforming concrete at the contract unit price.

For concrete not meeting the moving average of three (3) consecutive strength tests, the Engineer will make determinations regarding the disposition, payment, or removal. The Department will adjust the contract unit price for the contract item of the concrete in accordance with Tables HPC-9 based upon cylinder strength test results.

Table HPC-9 3YLCHPC-M and 3YLCHPC-S	
Moving average of 3 consecutive strength tests	**Adjusted Contract Unit Price**
< 100.00% of f'c	Remove and replace concrete in accordance with 1512, "Unacceptable and Unauthorized Work," as directed by the Engineer. If the Engineer, in conjunction with the Concrete Engineer, determines the concrete can remain in place, the Engineer may apply a monetary adjustment to the Contract unit price or not pay for the concrete.*
* When there is not a separate contract unit price for *Structural Concrete* for an item of work or the concrete is a minor component of the contract unit price, the Department will reduce payment based on a concrete price of $100.00 per cu. yd [$130.00 per cu. m] or the Contractor-provided invoice amount for the concrete in question, whichever is less.	

SB2014-2402
Use on ALL bridge jobs.
CREATED 2/5/1978
REVISED 5/16/2013 (5)

SB- (2402) STEEL BRIDGE CONSTRUCTION

The provisions of 2402, "Steel Bridge Construction," are supplemented as follows:

SB2014-2402.2
Use on ALL STEEL bridges.
CREATED 1/11/1995
REVISED 5/16/2013 (1)

SB- Dimensional Tolerances

Ensure maximum variation from flatness for fascia beam webs is ½ the limit given in the "ANSI/AASHTO/AWS D1.5, Bridge Welding Code".

SB2014-2402.3

Use with bridges that have Fracture Critical Members.

CREATED 1/11/1995

REVISED 5/16/2013 (1)

SB- Fracture Critical Steel Bridge Members

DESIGNER: For Section A, Plates thicker than 1½ in [40 mm] are available to a maximum length of 50 ft [15 M].

A. General

Furnish flange plates in available mill lengths with a minimum number of splices. Location of splices is subject to the Engineer's approval, but shall be a minimum of _____ - _____ from the midpoint of the beam or girder.

DESIGNER: For Section B, See Fabrication Methods and Structural Metals Engineer.

B. Definition of Fracture Critical Members

Fracture critical members are defined as _____.

SB2014-2402.4
Use for movements up to 4 in [100 mm].
CREATED 5/10/1996
REVISED 5/16/2013 (5)

SB- Expansion Joint Devices

Fabricate waterproof expansion devices in accordance with 2402, "Steel Bridge Construction," and supplemented as follows:

A. The Contractor shall:

1. Furnish a single diaphragm unreinforced neoprene gland whose physical and chemical properties conform to 3721, "Preformed Elastomeric Compression Joint Seals for Concrete," except:

(a) Substitute Durometer requirement of 60 plus or minus 5 for that which is shown in ASTM D 2628.

2. Make the gland ¼ in [6.4 mm] thick, subject to a minimum thickness of 7/32 in [5.6 mm].

3. Submit 12 in [300 mm] of seal material from each lot of material for testing if required by the Project Engineer.

4. Furnish certified test results from the manufacturer attesting to the physical and chemical properties of the expansion joint devices in accordance with 1603, "Materials: Specifications, Samples, Tests, and Acceptance". Provide copies of the test results for the Project Engineer, the Materials Engineer, and the Structural Metals Engineer.

B. Provide only one of the devices shown on the Department's "Approved/Qualified Product Lists for Bridge Products, Expansion Joint System" (http://www.dot.state.mn.us/products). For products not on the Department's prequalified list, provide information as required on the web site so it can be evaluated and potentially qualified.

C. The Fabricator will be permitted to weld pre-galvanized sections of expansion device steel rail, complete with anchorages. If the steel rail is pre-galvanized, the Fabricator shall:

1. Provide roadway sections that are not less than 10 ft [3 M] long,

2. Provide an anchorage within 9 in [229 mm] of each end of the sections. This may require inclusion of additional anchorages,

3. Bevel abutting ends ¼ in [6 mm] on 3 edges and de-burr the edges,

4. Prepare the surfaces to be welded as per 2471.3.F.2, "Preparation of Base Metal",

5. Groove weld the sections on 3 sides preventing weld metal from entering the gland groove,

6. Grind the weld smooth on the top of the extrusion, and

7. Repair the welded surface as per 2471.3.L.1, "Galvanizing".

D. Unless the gland is shop installed, the Fabricator shall install filler material in the gland groove in the steel rail to protect against entry of dirt and debris. Install filler material at the fabrication shop prior to storage or transportation of completed expansion device.

E. The Contractor shall:

1. Remove filler material and clean all gland to steel contact areas of all dirt, oil, grease, or other contaminants before installing the neoprene gland.

2. Lightly sandblast the contact areas so as to roughen but not damage the galvanized surface just before applying the lubricant adhesive.

3. Apply lubricant adhesive on both gland and steel contact areas when installing the gland.

4. Install the gland only with tools recommended by the manufacturer.

F. Lubricant Adhesive

Ensure the lubricant adhesive conforms to the requirements of ASTM D 4070. Provide only one of the approved lubricant adhesives shown on the Department's "Approved/Qualified Product Lists for Bridge Products, Expansion Joint Lubricant Adhesive" (http://www.dot.state.mn.us/products). For lubricant adhesives not on the Department's prequalified list, provide information as required on the web site so it can be evaluated and potentially qualified.

G. Ensure all expansion joint cover plates on pedestrian bridges and sidewalk areas are raised pattern plate.

SB- Modular Bridge Joint System

Furnish and install a waterproof modular bridge joint system (MBJS) at the expansion joints on Bridge(s) No. _____. Perform the work in accordance with 2402, "Steel Bridge Construction," the plans, and the following:

A. General

For the following paragraph, use a multiple support bar system if the number of elastomeric seals is 9 or less, or if movement ranges are 27 in [700 mm] or less. Use a single support bar system for larger movements. Use a swivel joint system if large transverse and/or swivel movements are anticipated at the expansion joints.

UAR

These support bars are suspended over the joint opening by sliding on bearings contained within steel support boxes attached to the edge beams and cast into the bridge deck (and abutment). A MBJS consists of preformed elastomeric expansion joint seals mechanically held in place by steel edge and center beams. Center beams are supported by solid steel support bars. MBJS can be classified as multiple or single-support bar and swivel joint systems. For Bridge(s) No. _____, provide a ((multiple) (single)-support bar) (swivel joint) system.

UAR

B. Acceptable Systems

Only manufacturers who have successfully completed fatigue and performance testing will be permitted to supply the MBJS. Submit final results of all required tests to the Engineer for approval prior to manufacture.

Provide only one of the devices shown on the Department's "Approved/Qualified Product Lists for Bridge Products, Modular Bridge Joint System" (http://www.dot.state.mn.us/products). For products not on the Department's prequalified list, provide information as required on the web site so it can be evaluated and potentially qualified.

C. Pre-qualification Testing Requirements

Before a MBJS can be accepted for installation on this project, the design must be pre-qualified by the manufacturer through successful fatigue and performance testing administered by an independent testing laboratory. Perform fatigue and performance testing in accordance with Section 19, Appendix A19 of the AASHTO LRFD Bridge Construction Specifications.

Perform all testing on a test specimen(s) of a model similar to that required of this project. Successful testing will prequalify that model—with allowable variations—for the project and no further testing will be required.

D. Materials

Meet the following physical and chemical properties:

1. Conform structural steel for the edge beams, center beams and support bars to 3309, "High-Strength Low-Alloy Structural Steel". Conform support boxes and anchorages to either 3306, "Low-Carbon Structural Steel," or 3309, "High-Strength Low-Alloy Structural Steel". (Conform sidewalk and (railing) cover-plates to 3306, "Low-Carbon Structural Steel"). Do not use aluminum components or hardware.

UAR

2. Conform stainless steel sheet for the sliding surfaces of support bars to ASTM A 240, Type 304. Polish the surface to a Number 8 mirror finish.

3. Conform fasteners to the same requirements as those used in the prequalification tests.

4. Conform welded studs for anchorage purposes to ASTM A108.

5. Ensure each elastomeric sealing element is a single-diaphragm unreinforced gland. Make sure the basic physical and chemical properties of the elastomer conform to the requirements of ASTM D 5973.

Each gland shall be ¼-in [6.35 mm] thick, subject to a minimum thickness of 7/32-in [5.6 mm] providing a minimum of 3 in [75 mm] of movement.

6. Ensure polytetrafluoroethylene (PTFE) is unfilled 100% virgin material, woven fabric or dimpled sheet conforming to the requirements of Section 18.8 of the AASHTO LRFD Bridge Construction Specifications.

7. The same material composition and formulation, manufacturer, fabrication procedure and configuration of bearings and springs must be used as was used in the Pre-qualification tests.

8. Provide only one of the approved lubricant adhesives shown on the Department's "Approved/Qualified Product Lists for Bridge Products, Expansion Joint Lubricant Adhesive" (http://www.dot.state.mn.us/products). For lubricant adhesives not on the Department's prequalified list, provide information as required on the web site. Lubricant/adhesive shall conform to ASTM D 4070.

9. Ensure control springs are a urethane foam product that conforms to the requirements of ASTM D 3574.

E. Design and Detailing Requirements

1. Loading and Movement

Design the MBJS in accordance with Article 14.5 of the AASHTO LRFD Bridge Design Specifications.

For the next few paragraphs, fill in blanks for specific job.

The theoretical thermal longitudinal expansion joint movement for the full design ambient temperature range of 150°F [65° C] is approximately _____ inches [____mm] at the (_____). (The actual movements may be more or less than the theoretical figures depending on influencing factors, such as (pier deflection) (creep and shrinkage of prestressed concrete units).

Design the MBJS to accommodate a minimum of ____ inches [___mm] of thermal movement between the lowest anticipated ambient temperature of ____-30° F [-35° C] and the highest anticipated ambient temperature of + ____120° F [____50° C]. Mean temperature for design shall be 45° F [7° C]. Do not allow physical contact of any beams at the minimum opening, and the maximum opening between beams shall be 3 in [75 mm]--measured perpendicular to the edge beams--under any conditions.

(To supplement the thermal movement described above, include in the MBJS provisions for an additional movement of ____ in [___ mm] caused by possible shifting of substructures on unstable soil and/or deflection of piers.)

2. Edge Beams

Ensure the edge beam cross-section is the same as the section used for the Seal Push Out Test for the performance testing.

Show in the plans concrete anchorages for the devices, or as modified by the manufacturer to be compatible with the devices furnished.

Design modified anchorages to resist vertical and horizontal forces from traffic, including impact. Anchor horizontal elements of the edge beams to resist the upward-acting impact (rebound) from wheel loads. If the skew is greater than 20 degrees, consider horizontal forces from impact from snowplows in the design of the anchorages.

3. Support Boxes

Make support boxes from steel plate or tubing with a minimum thickness of 3/8 in [9.5 mm]. If the support boxes are greater than 16 inches [406 mm] wide, increase the thickness of the top plate so that the width-to-thickness ratio does not exceed 45 unless stiffening ribs are used. For support boxes composed of nested steel tubes, the diameter or width-to-thickness ratio of each tube shall not exceed 45.

4. Bearings and Springs

Design the MBJS to allow removal and replacement of the support bearings, bearing springs, control springs and elastomeric seal elements. Give a procedure for removal and replacement of these elements on the shop drawings.

Positively lock support bar bearings into the support boxes with a non-metallic dowel or pin. The connection must permit removal and replacement of the bearing components.

Situate control springs for the equidistance control on the MBJS so that the direction of resistance will be parallel to the direction of movement and accommodate the full range of design movement without distress.

Provide for replacement of parts subject to wear in the design. Submit a written maintenance and parts replacement plan prepared by the MBJS manufacturer for the Engineer's approval. Include a list of parts and instructions for maintenance inspection, acceptable wear tolerances, methods for determining wear, and procedures for replacing worn parts.

5. Elastomeric Seals

Extend seals beyond the ends of the edge and center beams by at least 2 in [50 mm].

6. Field Splices in Edge and Center Beams

Fabricate and ship each MBJS to the project site as a single unit unless any or all of the following conditions apply:

a. The bridge will be constructed in stages with longitudinal construction joints.
b. The full length of a MBJS would make shipping impractical.
c. Other factors unique to the project that would require field splices.

Only field splice details that have been designed in accordance with AASHTO LRFD Bridge Design Specifications can be used for the MBJS. Locate splices away from wheel tracks and in areas of least live load stress. Edge beams may be field-welded with fillet welds covering only part of the beam profile.

Ensure center beam splices are welded connections. The span – between support beams – in which the field splices are located, cannot exceed the maximum length of 3 ft [900 mm].

If the MBJS contains only a single center beam, a field weld may be used. Fillet or partial-penetration welds are not permitted.

In the design of the MBJS, take into account any different installation procedures required under conditions that require field splices. Clearly indicate such procedures on the shop drawings.

7. Lifting and Preset Opening Devices

Provide lifting devices for the MBJS. Provide other devices to maintain the preset openings at a uniform spacing not greater than 15 ft [4580 mm] along its length. Use at least three such devices per fabricated segment.

F. Submittals

1. In accordance with 1603, "Materials: Specifications, Samples, Tests, and Acceptance," furnish Certificates of Compliance to:

Structural Metals Engineer
Minnesota Department of Transportation
Bridge Office
3485 Hadley Ave N
Oakdale, MN 55128-3307

Include the following information in the Certificates of Compliance:

a. Certification that the control springs are produced by the same manufacturer with the same process and in the same configuration as those used in the OMV Test. Certification that the same lubricant adhesive used for the Seal Push Out Test was also used to assemble the MBJS. These certifications shall include the manufacturer's name and contact information as well as production date and lot identifiers;

b. Certification that MBJS sub-assemblies with similar center beam and support bar cross-sections and joints have passed pre-qualification testing requirements described in SB-____C (Pre-qualification Testing Requirements);

c. Design calculations sealed by a Licensed Professional Engineer;

d. A written maintenance and part replacement plan prepared by the MBJS manufacturer, including a list of parts and instructions for maintenance inspection, acceptable wear tolerances, methods for determining wear, and procedures for replacing worn parts;

e. Method of installation including, but not limited to, sequence, installation gap setting for various temperatures, support during placement of the concrete, and installation at curbs;

f. Any required changes to the blockout reinforcement in order to accommodate the MBJS; and

g. A temporary bridging plan for any MBJS for which construction (and public) traffic is anticipated following installation.

2. Submit a 12-in [300 mm] section of elastomeric seal material from each lot of material furnished, and samples of the PTFE sheet, size 2 inches x 3 inches x 1/8-inch [50 mm x 75 mm x 3 mm] from the production material to the Engineer for testing.

3. Submit shop drawings for the MBJS in accordance with the requirements of 2471.3.B, "Shop Detail Drawings," and include, but do not limit to, the following additional items:

a. Plans and section views of the MBJS for each movement rating and roadway width showing dimensions and tolerances;

b. Show all welded center beam-to-support bar joints;

c. Show all welded shop splices and all welded field splices;

d. Complete details of all components and sections showing all material incorporated into the MBJS;

e. All appropriate material designations (MnDOT, ASTM, AASHTO. etc.);

f. Corrosion protection system;

g. Lifting locations and lifting mechanisms for installation; and

h. Opening adjustment devices for temperature variations and opening dimensions relative to temperature.

G. Fabrication Requirements

The same manufacturer must fabricate all MBJS components.

Galvanize all structural steel surfaces, except those made of stainless steel, after fabrication per 3394, "Galvanized Structural Shapes".

Weld stainless steel sheet at each end to the steel substrate by the tungsten-arc welding process in accordance with the current AWS specification. Clamp down the stainless steel sheet to have full contact with the substrate during welding. Do not allow welds to protrude beyond the sliding surface of the stainless steel. Intermittent fillet welds are not allowed.

Ultrasonically inspect the full-penetration weld that connects the center beam to the support bar in accordance with 2471, "Structural Metals," and AWS D1.1. Test twenty-five percent of the center beam-to-support bar welds, or as directed otherwise by the Engineer. If ultrasonic inspection reveals at least one rejectable weld defect, the fabricator shall then ultrasonically inspect another 25% of the center beam-to-support bar welds (25% of the original total of welds.) If rejectable defects are found in the second 25% set of welds (50% of total), all remaining non-inspected welds shall then be inspected. Repair each weld that is rejected by ultrasonic inspection using a welding procedure approved by the Engineer. Retest the repaired welds by ultrasonic inspection in accordance with the original requirements.

The fabricator will be permitted to shop-weld pre-galvanized sections of the edge and center beams if the following requirements are met:

1. Provide roadway sections that are not less than 10 ft [3 M] long,

2. Bevel abutting ends ¼-in [6 mm] and deburr the edges,

3. Prepare the surfaces to be welded as per 2471.3.F.2, "Preparation of Base Metal",

4. Groove-weld sections with care taken to prevent weld metal from entering the seal groove. Completely remove all galvanizing from the weld area. Grind smooth the weld across the top of the beams. Repair all areas of galvanizing damaged by welding operations in accordance with 2471.3.L.1, "Galvanizing," and,

5. Attach anchorages and support boxes to the edge beam section prior to galvanizing. Provide an anchorage within 9 in [229 mm] of each end of each pre-galvanized section.

UAR

(If field splices will be used, stagger the ends of the edge and center beams so that they are not at the same point on each beam.)

Assemble each MBJS at the fabrication shop. Install all elastomeric seals at the shop. Use continuous glands for the full length of each MBJS. Apply lubricant adhesive to all elastomer-to-steel contact areas for seal installation.

For the next paragraph, use when staged construction with a longitudinal joint is required.

(Fabricate each MBJS for shipment in separate sections sized in accordance with the slab construction joints required for the construction stages as shown in the plans. Stagger ends of the edge and center beams so that construction joints are not at the same point on each beam. Installation of seal elements is not required during fabrication since they must be continuous without splices for the full length of the device.)

H. Installation Requirements

To aid in assuring proper installation of the MBJS, the manufacturer shall furnish technical assistance to the Contractor and Engineer through a technical representative who is a full-time employee of the manufacturer. The representative shall be accessible to the Engineer and at the site during the work that involves the setting of all parts of each device. Inform the representative of the date of installation.

Immediately prior to installation, the Engineer will inspect the MBJS and the blockout for:

1. Proper alignment,

2. Complete bond between the seals and the edge/center beams, and

3. Placement and effectiveness of the anchorage devices. Correct any bends, kinks, disconnected seals, and other deficiencies, per the judgment of the Engineer, before installation at no expense to the owner. Perform an audio hammer test on the welded stud anchors. Replace studs that do not emit a ringing sound when struck lightly with a hammer as ordered by the Engineer.

Maintain the clearance shown in the plans and/or shop drawings between the bottoms of the support boxes and the tops of the beams.

Reposition reinforcement bars that are cast into the deck and abutment, if possible, in lieu of cutting to provide a minimum of 2 in [50 mm] of clearance to the support boxes, anchorage devices and edge beams. Also, maintain a minimum of 2 in [50 mm] of clearance for reinforcement bars placed during installation of the MBJS. Alter bar spacing shown in the plans to clear the MBJS.

If welded field splices are used for the edge and center beams, prevent weld metal from entering the seal retainer grooves.

Install each MBJS at the joint opening given on the shop drawings for a specific ambient temperature, or as adjusted by the manufacturer's installation technician for the temperature at time of installation. Ensure tops of the edge and center beams are in the same plane with a maximum tolerance of 1/8 in [3 mm] difference in elevation among the tops of the center beams or edge beams. Measure this variation vertically from a straight line connecting the top of the deck profile on each side of the MBJS. Ensure there is no more than 1/2 in [13 mm] longitudinal difference among gap widths at either end of a seal or among multiple gaps.

Ensure formwork for the blockout concrete prevents entry of concrete into the support boxes, and do not allow concrete to impede free movement of the MBJS.

Fully support the MBJS during placement of the concrete in the blockout. Grout pads under the support boxes are not recommended, but if used, shall terminate beyond the sides of the support boxes.

UAR

Do not pour concrete until the MBJS installation and joint opening(s)--at the time of the pour--has (have) been inspected and approved by the Engineer.

If there is a vertical grade on the bridge, place concrete on the down-grade side of the blockout first. Thoroughly vibrate the concrete so as to adequately consolidate the concrete underneath the support boxes and against the backside of the edgebeams.

Construction loads will not be allowed on the MBJS for at least 72 hours after installation, including concreting, is complete. If necessary to cross the joint during that 72-hour period, bridge over the MBJS in a manner approved by the Engineer.

Ensure the complete MBJS installation is watertight at all points and test it by filling the joint opening or portions thereof, as designated by the Engineer, with water and observe the results over a period of not less than one hour.

I. Method of Measurement

Measure each MBJS by length in linear feet [meters] based on the out-to-out installed length of the device.

J. Basis of Payment

Select ONE of the two following paragraphs.

Payment for Item No. 2402.603 “MODULAR BRIDGE JOINT SYSTEM, TYPE _____" will be made at the Contract unit price per linear foot and shall be compensation in full for all costs of furnishing and installing the MBJS complete inplace as described above, including all incidentals thereto.

Payment for Item No. 2402.603 “MODULAR BRIDGE JOINT SYSTEM, TYPE _____" will be made at the Contract unit price per meter and shall be compensation in full for all costs of furnishing and installing the MBJS complete inplace as described above, including all incidentals thereto.

SB2014-2402.6

Use with all metal railings except chain link fence railings.

CREATED 10/17/1997

REVISED 5/16/2013 (12)

SB- Metal Railing

Furnish, coat, and install metal railing, including all anchorages and fittings, in accordance with the applicable provisions of 2402, "Steel Bridge Construction," 2433, "Structure Renovation," 2471, "Structural Metals," 2478, "Organic Zinc-Rich Paint System," the plans and the following. The Contractor is responsible for communicating all applicable specifications, special provisions, standards, and requirements to all subcontractors.

A. Engineer

Engineer, as used herein, when relating to shop fabrication and coatings, shall mean the Department's Bridge Engineer.

B. Materials

Ensure all materials conform to the plan details. If not specified, ensure all steel complies with 3306, "Low-Carbon Structural Steel," except pipe and pipe sleeves, which complies with 3362, "Structural Steel Pipe". Ensure threaded rods, bolts, nuts, and washers meet 3391, "Fasteners," and galvanize in accordance with 3392, "Galvanized Hardware," or electroplate in accordance with ASTM B 633, Type III, SC 4.

C. Anchorages

Except when part of a proprietary anchorage assembly, ensure threaded rods and bolts meet the requirements of 3385, "Anchor Rods," and 3391," Fasteners," respectively.

Use cast-in-place type anchors unless otherwise specified in the contract.

Ensure bolt heads and/or nuts are in contact with the adjacent surface and torqued to

- 1/2 in [13 mm] diameter = 30 ft pounds [41 Nm]
- 5/8 in [16 mm] diameter = 60 ft pounds [81 Nm]
- 3/4 in [19 mm] diameter and larger = 80 ft pounds [108 Nm]

unless a different torque is recommended by the manufacturer.

For the following section (C1. Drilled in Anchorages), ONLY use this section when a drilled-in anchorage alternate is permitted by the contract. (DO NOT use this section for any NCHRP 350 crash tested barriers adjacent to vehicular traffic). Use only when anchorages having an ultimate pull-out tension greater than 5000 lbs. [22kN] are required.

C1. Drilled in Anchorages

Drilled in anchorages may be used in the following location(s) _____.

There is no MnDOT approved product list for adhesive anchorages having an ultimate pull-out tension greater than 5000 lbs. [22 kN]. Every adhesive system will need to be accepted by the Engineer in conjunction with the Regional Bridge Construction Engineer. To accomplish this, furnish independent laboratory test data certifying that static load tests for ultimate pull-out strengths were performed and are acceptable, as specified. Provide independent lab test data in accordance with ASTM E 488.

If adhesive anchors are chosen, submit for approval by the Engineer the following chemical adhesive supplier's product literature or calculations to establish embedment depth. This information will demonstrate compliance with the specification:

- Name of supplier
- Full product name (as given in supplier's literature)
- Embedment depth as determined from supplier's literature

Ensure anchorages for fastening rail posts have an ultimate pull out strength, as specified in the plan, and install in sound concrete to a depth equal to a minimum depth of six times the rod or bolt diameter. Ensure adhesive anchorages consist of a continuously threaded rod secured by an adhesive or mortar.

Perform laboratory tests, which include static load tests for ultimate pullout strengths, on anchorage systems that are subject to tensile loads. Perform the tests in accordance with ASTM E 488, and have them certified by an independent testing laboratory. Furnish the Engineer with the test reports and the specification sheets that are prescribed by ASTM E 488.

Demonstrate the anchorage system for drilled-in anchorage systems at the first site of field installation prior to actual use in the project. Include in the demonstration installation and a static tension test in the presence of the Engineer, in accordance with test procedures prescribed in ASTM E 488. No portion of the testing device shall bear on the concrete surface within a distance equal to the anchorage embedment depth. Test three anchorages to not less than ½ the required minimum ultimate pull out strength or the value given in Table 1, whichever is less. Failure of an anchorage test will require a modification of installation procedures or use of a different anchorage system.

In addition to the three tests stated above, the Engineer requires that each bridge have an additional 2% (not less than 1 test) of the remaining anchorages tested at a latter date. The Engineer will determine the locations of the additional anchors. If a failure occurs while testing the additional 2%, more testing will be required at the rate of an additional 1% per each failure at the Contractor's expense. Compensation for costs of testing is included in the payment for the metal railing.

Location	Bolt or Rod Diameter inches [mm]	Minimum Embedment Depth inches [mm]	Ultimate Pull-out Strength pounds [kN]

TABLE 1

ANCHOR ROD PROOF LOADS, kips [kN]
TYPE OF ROD, FROM 3385, "Anchor Rods"

DIA., inches [mm]	TYPE A kips [kN]	TYPE B kips [kN]	TYPE C kips [kN]	TYPE D kips [kN]
1/2" [13]	4.75 [21.0]	5.7 [25.0]	10.1 [45.0]	4.9 [22.0]
5/8" [16]	7.4 [33.0]	8.9 [39.5]	15.8 [70.0]	7.6 [34.0]
3/4" [19]	10.6 [47.0]	12.6 [56.0]	22.8 [101.0]	11.0 [49.0]
7/8" [22]	14.5 [65.0]	17.4 [77.0]	31.0 [138.0]	15.0 [67.0]
1" [25]	19.0 [85.0]	22.6 [100.0]	40.5 [180.0]	19.5 [86.0]

Perform installation of anchorages in accordance with the manufacturer's recommendations and as specified in the plan.

Fill with caulk any voids occurring between the top of the anchorages and the concrete in which it is embedded, as approved by the Engineer.

D. Fabrication and Inspection Requirements

Fabricator shall supply QA/QC documentation verifying that all fabricated railing components are within the necessary tolerances for proper fit up and installation of the railing, including measurements between railing base plates that indicate that the as fabricated base plate hole locations are within 1/8 inch (3 mm) of the specified plan dimensions, based on the plan specified rail post spacing.

Fabricate all metal railing in accordance with 2471, "Structural Metals," the plan, and the welding code AWS D1.1-Structural Welding Code-Steel. Submit Welding Procedure Specifications (WPSs) to the Engineer for approval prior to the start of fabrication.

Prior to fabrication, submit a Quality Control Plan (QCP) and fabrication drawings that are acceptable to the Engineer. Any work started prior to receiving approved drawings WPSs, and a QCP, is subject to 1512, "Unacceptable and Unauthorized Work". Also give the Engineer at least 5 working days notice prior to beginning work so that Quality Assurance (QA) inspection may be provided.

The Engineer will inspect all metal railing. The purpose of the inspection(s) is to establish compliance with the Contract Documents. The shop inspection(s) is not intended to supplement or replace the Contractor's own Quality Control (QC). The Contractor is ultimately responsible for the correction of errors and faulty workmanship or for the replacement of nonconforming materials.

The Fabricator will visually inspect all parts of the fabrication and have the inspections documented by QC personnel. The Fabricator will ensure that the rail meets a straightness tolerance of 1/8 in in 10 ft [3 mm in 3000 mm]. The Fabricator will perform and document any Nondestructive Testing required by the Contract Documents using an ASNT-TC-1A Level II qualified inspector.

Document parts found to be in nonconformance by using a Nonconformance Report form (NCR), and describe in detail the fabrication error and the proposed repair procedure(s) in accordance with the QCP. Repair(s) performed are subject to the written approval of the Engineer.

E. Galvanizing Requirements

For the following paragraph, delete if galvanized coating is not recommended by the Structural Metals and Bridge Inspection Engineer (e.g. Minneapolis rail).

For the following paragraph, color as recommended by the Bridge Office Architectural Specialist [(651) 366-4465].

Galvanize all railing material in accordance with 3394, "Galvanized Structural Shapes," after fabrication and paint (Duplex Coat) using the applicable provisions of 2478, "Organic Zinc-Rich Paint System". Do not use the primer coat on galvanized surfaces.

For the next 12 paragraphs (Pre-Galvanized Procedure(s) and Galvanizing Procedure(s), delete if galvanized coating is not recommended by the Structural Metals and Bridge Inspection Engineer (e.g. Minneapolis rail).

Pre-Galvanized Procedure(s):

1. Calibrate dry film thickness gages in accordance with SSPC-PA 2-Measurement of Dry Coating Thickness with Magnetic Gauges.

2. Prepare all fabricated material surfaces by abrasive blast cleaning to a minimum of SSPC-SP 6/NACE No. 3-Commercial Blast Cleaning prior to galvanizing.

3. Purchase Order(s) shall identify which specific items are to be duplex coated and which materials to be galvanized are reactive (e.g. 3309, "High-Strength Low-Alloy Structural Steel," etc.).

Galvanizing Procedure(s):

Galvanize per 3394, "Galvanized Structural Shapes," ASTM D6386, and this specification. All products supplied using this specification have higher aesthetic expectations than standard galvanized products. Produce the final product to comply with its intended use as an "architectural" railing with heightened aesthetics and/or visual qualities.

1. Process all metal railing to be galvanized utilizing a "dry" kettle. Preflux the metal railing prior to the galvanizing bath using an aqueous tank of zinc chloride/ammonium chloride. Do not use a "top flux" blanket on the molten zinc bath.

2. Air cool the metal railing to ambient temperature before handling for shipment and/or storage. Do not quench the metal railing or apply any post-galvanizing treatments.

3. All lumps, projections, globules, high spots, drip lines, heavy deposits, black and bare areas, blisters, flux deposits, thin spots, dross inclusions, etc., are considered unacceptable. An unacceptable zinc coating shall be repaired with an Engineer approved QCP plan. Zinc, which will interfere with the "intended use of the product", will not be permitted.

4. Repair galvanized material that does not meet the requirements of this specification, ASTM D6386, and/or 3394, "Galvanized Structural Shapes," in accordance with an approved QCP procedures.

5. Store galvanized metal railing in a manner that will prevent the formation of "white-rust" or wet storage staining. "White rust" or staining of the galvanizing is not acceptable.

6. The Galvanizer shall provide the Engineer with all galvanizing process-related Quality Control documents which demonstrate compliance to this specification and referenced specifications prior to shipment of the galvanized product.

7. The Galvanizer will ensure the metal railings meet a straightness tolerance of 1/8 in in 10 ft [3 mm in 3000 mm] prior to any subsequent paint applications.

8. It is the Galvanizer's responsibility to provide the Engineer with advanced notification of at least 5 working days of intent to galvanize so that the Engineer can perform a Quality Assurance audit.

F. Coating Requirements

1. Perform preparation of galvanized surfaces for painting in accordance with SSPC SP16 "Brush-off Blast Cleaning of Non-Ferrous Metals," and ASTM D6386.

Inspect brush-off blasted surfaces for fins or tears, or any surface that shows that the galvanize coating has been damaged. Repair damaged areas using approved procedures in accordance with the suppliers QCP. Any surface of insufficient galvanize coating DFT readings shall be repaired using 2478, "Organic Zinc-Rich Primer".

Match the color of the finish coat to Federal Standard 595 C No. _____ (fill in coating color here) with a semi-gloss finish.

If a galvanize coating is not required, coat the rail in accordance with 2478, "Organic Zinc-Rich Paint System" (e.g. Mpls. Rail).

2. Coat all sweep blasted galvanized railing with the subsequent coat(s) within the time frame defined in ASTM D 6386, Sect. 5.4.1, or within the same 8-hour shift, maintaining manufacturer defined control and environmental conditions. The Contractor’s QC personnel shall document that all parameters were followed.

3. Apply all coating material in accordance with the contract documents and the manufacturer's Product Data Sheet (PDS) and application guides for the material and system specified.

4. Ensure coating material(s) meet the requirements of 3520, "Zinc-Rich Paint Systems". Also ensure the color of the intermediate coat presents a distinct contrast from other applied coatings.

5. Accomplish all QC inspections of all coated products with an observer with normal color vision in a "well lighted" area during each coating phase and prior to final acceptance.

"Well-lighted" is defined as a minimum of 50 foot candles of artificial light or natural daylight. Use a light meter with readings in foot candles to verify the adequacy of the lighting.

Handling and Shipping of Coated Metal Railing:

Protect all completed, fabricated, and coated metal railing during handling and shipping to prevent any damage to the coating(s). Do not move or handle coated metal railing until the coating has cured, but in no case sooner than recommended by the coating manufacturer.

Metal railing may be padded to protect it from direct contact with wood, steel, or other packaging materials that could scratch, mar, stick to, or otherwise damage the final coated railing finish. Softeners may be used in conjunction with high-density foam or other acceptable packaging materials at all points of contact.

Storage of Coated Metal Railings:

Store all completed coated metal railing in accordance with MnDOT 1606 and the following:

1. The fabricator shall tag/piece mark all metal railing prior to final storage, and include the following identification markings, as a minimum: individual piece marks, bridge and/or project number(s), fabricator and applicator job numbers. All marking(s) shall not be visible to the public when the railing is in its installed position. Include the method of identification in the fabricators QCP.

2. Provide the Engineer with advance notification of at least 5 working days of intent to ship, so that the Engineer can perform a QA audit prior to shipping.

G. Construction Requirements

Provide the Engineer with a QA/QC plan that will be used to ensure that the cast-in-place anchorages are installed in the correct location using templates or other means ensuring that the exposed threads of the anchorages will not be damaged or contaminated and that the anchorages will not be displaced or allowed to move during concrete placement.

After the cast-in-place anchorages have been installed in the forms, but prior to placing the barrier concrete, the Contractor shall provide written documentation verifying that all of the anchorages are within the necessary tolerances to place the tubular railing without modifying the railing base plate configuration.

Adjust the steel posts to obtain the grade and alignment as shown in the plans by one of the following methods:

1. Shim the steel posts with steel shims or washers to the proper grade and alignment, not to exceed 1/4 in [6 mm] of shim height. Before attaching the nuts, **coat the entire surface between the base plate and concrete rail with an approved "Silicone Joint Sealant," as found on the Department's Approved Products website**. Tighten the anchor rod nuts (as per section "C"-Anchorages) and neatly smooth the caulk around the perimeter of the railpost base plate.

2. Thread the anchor rods with leveling nuts and turn down to the base of the anchor rods. Install the rails and set the steel posts to the proper grade and alignment by adjusting the leveling nuts. Install the top nuts and tighten them firmly to the base plate. Fill the space between the base plate and the concrete and neatly finish with grout that is approved by the Engineer.

Ground all metal railings. Install all electrical grounding in accordance with the applicable provisions of 2557, "Fencing," and the National Electrical Code. Clamp or braze the ground wires to the grounding device, then practicably route and attach to the nearest rail by clamping, brazing, or any other approved means that will provide a permanent positive connection. If rail has non-continuous sections, use a #6 AWG solid copper wire to connect adjacent railing panels.

If the bridge does not include exposed electrical equipment, then ground the rails at points directly below or adjacent to the railing at all abutment corners. Ensure the grounding system consists of a #6 AWG solid copper wire connected to the railing which in turn is connected to a copper coated steel rod having a nominal diameter of 5/8 in [16 mm] or more and a minimum length of 8 ft [2.4 m] installed to an elevation approximately flush with the ground surface.

If the bridge includes exposed electrical equipment, such as roadway lighting, traffic signals, variable message signs, surveillance cameras, or ramp metering, then bond the railing grounding system to the exposed electrical equipment grounding system. Refer to the electrical plans and electrical special provisions for details regarding bonding multiple electrical grounding systems.

H. Repairs of Coated Steel Railings:

Any damaged coated surfaces, identified through either Quality Control or Quality Assurance inspections as being unacceptable, either after the application of the paint or after shipping and handling, is subject to the provisions of 1512, "Unacceptable and Unauthorized Work".

For the following four paragraphs, ONLY use when you are not able to use an Item No. from MnDOT 2402.

I. Method of Measurement

UAR

Measurement will be by length in feet [M] based on plan dimensions between the outside ends of metal railings (with deductions for the lengths of concrete end posts).

J. Basis of Payment

For the following paragraph, Delete if galvanized coating is not recommended by the Structural Metals and Bridge Inspection Engineer (e.g. Minneapolis rail)

Duplex Coating

Payment for Item No. 2402.603 "_____" will be made at the contract price per foot [M] and shall be compensation in full for all costs of fabrication, surface preparation, galvanizing, brush blasting of galvanized surface, painting, delivery, and installation, as described above. Failure to comply with any of these requirements will result in rejection of the material and/or reduction in payment.

Three Coat Paint System

Payment for Item No. 2402.603 "_____" will be made at the contract price per foot [M] and shall be compensation in full for all costs of fabrication, surface preparation, coating, delivery, and installation, as described above. Failure to comply with any of these requirements will result in rejection of the material and/or reduction in payment.

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Use only when recommended by the Regional Bridge Engineer.
Use with metal railings that will be "Duplex Coated" with hot-dipped galvanizing and POWDER COATING (not Mpls rail), except chain link fence railings.

CREATED 12/10/2014
REVISED 4/20/2015 (1)

SB- Metal Railing ("Duplex Coated" using Hot-dipped Galvanizing and Powder Coating)

Furnish, coat, and install metal railing, including all anchorages and fittings, in accordance with the applicable provisions of 2402, "Steel Bridge Construction," 2433, "Structure Renovation," 2471, "Structural Metals," 3321, the plans and the following. The Contractor and the sub-contractors are responsible for communicating all applicable specifications, special provisions, standards, and requirements to all subcontractors.

A. Engineer

Engineer, as used herein, when relating to shop fabrication and coatings, means the Department's Bridge Engineer.

B. Materials

Ensure all materials conform to the plan details. If not specified, ensure all steel complies with 3306, "Low-Carbon Structural Steel," except pipe and pipe sleeves, which complies with 3362, "Structural Steel Pipe". Ensure threaded rods, bolts, nuts, and washers meet 3391, "Fasteners," and galvanize in accordance with 3392, "Galvanized Hardware," or electroplate in accordance with ASTM B 633, Type III, SC 4.

C. Anchorages

Except when part of a proprietary anchorage assembly, ensure threaded rods and bolts meet the requirements of 3385, "Anchor Rods," and 3391," Fasteners," respectively.

Use cast-in-place type anchors unless otherwise specified in the contract.

Ensure bolt heads and/or nuts are in contact with the adjacent surface and torqued to

- 1/2 in [13 mm] diameter = 30 ft pounds [41 Nm]
- 5/8 in [16 mm] diameter = 60 ft pounds [81 Nm]
- 3/4 in [19 mm] diameter and larger = 80 ft pounds [108 Nm]

unless a different torque is recommended by the manufacturer.

For the following section (C1. Drilled in Anchorages), ONLY use this section when a drilled-in anchorage alternate is permitted by the contract. (DO NOT use this section for any NCHRP 350 crash tested barriers adjacent to vehicular traffic). Use only when anchorages having an ultimate pull-out tension greater than 5000 lbs. [22kN] are required.

C1. Drilled in Anchorages

Drilled in anchorages may be used in the following location(s) _____.

There is no MnDOT approved product list for adhesive anchorages having an ultimate pull-out tension greater than 5000 lbs. [22 kN]. Every adhesive system will need to be accepted by the Engineer in conjunction with the Regional Bridge Construction Engineer. To accomplish this, furnish independent laboratory test data certifying that static load tests for ultimate pull-out strengths were performed and are acceptable, as specified. Provide independent lab test data in accordance with ASTM E 488.

If adhesive anchors are chosen, submit for approval by the Project Engineer the following chemical adhesive supplier's product literature or calculations to establish embedment depth. This information will demonstrate compliance with the specification:

- Name of supplier
- Full product name (as given in supplier's literature)
- Embedment depth as determined from supplier's literature

Ensure anchorages for fastening rail posts have an ultimate pull out strength, as specified in the plan, and install in sound concrete to a depth equal to a minimum depth of six times the rod or bolt diameter. Ensure adhesive anchorages consist of a continuously threaded rod secured by an adhesive or mortar.

Perform laboratory tests, which include static load tests for ultimate pullout strengths, on anchorage systems that are subject to tensile loads. Perform the tests in accordance with ASTM E 488, and have them certified by an independent testing laboratory. Furnish the Project Engineer with the test reports and the specification sheets that are prescribed by ASTM E 488.

Demonstrate the anchorage system for drilled-in anchorage systems at the first site of field installation prior to actual use in the project. Include in the demonstration installation a static tension test in the presence of the Project Engineer, in accordance with test procedures prescribed in ASTM E 488. No portion of the testing device shall bear on the concrete surface within a distance equal to the anchorage embedment depth. Test three anchorages to not less than ½ the required minimum ultimate pull out strength or the value given in Table 1, whichever is less. Failure of an anchorage test will require a modification of installation procedures or use of a different anchorage system. Three passing demonstrations are required to be able to move to the remaining installations.

In addition to the three tests stated above, the Project Engineer requires that each bridge have an additional 2% (not less than 1 test) of the remaining anchorages tested at a later date. The Project Engineer will randomly select the locations of these additional anchors to be tested. If a failure occurs while testing the additional 2%, more testing will be required at the rate of an additional 1% per each failure, at the Contractor's expense. Compensation for costs of testing is included in the payment for the metal railing.

Location	Bolt or Rod Diameter inches [mm]	Minimum Embedment Depth inches [mm]	Ultimate Pull-out Strength pounds [kN]

TABLE 1

ANCHOR ROD PROOF LOADS, kips [kN]
TYPE OF ROD, FROM 3385, "Anchor Rods"

DIA., inches [mm]	TYPE A kips [kN]	TYPE B kips [kN]	TYPE C kips [kN]	TYPE D kips [kN]
1/2" [13]	4.75 [21.0]	5.7 [25.0]	10.1 [45.0]	4.9 [22.0]
5/8" [16]	7.4 [33.0]	8.9 [39.5]	15.8 [70.0]	7.6 [34.0]
3/4" [19]	10.6 [47.0]	12.6 [56.0]	22.8 [101.0]	11.0 [49.0]
7/8" [22]	14.5 [65.0]	17.4 [77.0]	31.0 [138.0]	15.0 [67.0]
1" [25]	19.0 [85.0]	22.6 [100.0]	40.5 [180.0]	19.5 [86.0]

Perform installation of anchorages in accordance with the manufacturer's recommendations and as specified in the plan.

Fill with caulk any voids occurring between the top of the anchorages and the concrete in which it is embedded, as approved by the Project Engineer.

D. Fabrication and Inspection Requirements

Fabricator shall supply QA/QC documentation verifying that all fabricated railing components are within the necessary tolerances for proper fit up and installation of the railing, including measurements between railing base plates that indicate that the as fabricated base plate hole locations are within $^{1}/_{8}$ inch [3 mm] of the specified plan dimensions, based on the plan specified rail post spacing.

Fabricate all metal railing in accordance with 2471, "Structural Metals," the plan, and the welding code AWS D1.1-Structural Welding Code-Steel. Submit Welding Procedure Specifications (WPSs) to the Engineer for approval prior to the start of fabrication.

Prior to fabrication, submit a Quality Control Plan (QCP) and fabrication drawings that are acceptable to the Engineer. Any work started prior to receiving approved drawings WPSs, and a QCP, is subject to 1512, "Unacceptable and Unauthorized Work". Also give the Engineer at least 5 working days' notice prior to beginning work so that Quality Assurance (QA) inspection may be provided.

Designer note: Only use next paragraph for complex railings with multiple unique pieces. Questions regarding this use may be directed to the Structural Metals Unit.

The fabricator shall tag/piece mark all metal railing prior to final storage, and include the following identification markings, as a minimum: individual piece marks, bridge and/or project number(s), fabricator and applicator job numbers. All markings shall not be visible to the public when the railing is in its installed position. Include the method of identification in the fabricators QCP.

The Department QA shop inspections are not intended to supplement or replace the Fabricator's Quality Control (QC). The Contractor is ultimately responsible for the correction of errors and faulty workmanship or for the replacement of nonconforming materials.

The Fabricator will visually inspect all parts of the fabrication and have the inspections documented by QC personnel. The Fabricator will ensure that the rail meets a straightness tolerance of $^{1}/_{8}$ inch in 10 ft [3 mm in 3000 mm]. The Fabricator will perform and document any Nondestructive Testing required by the Contract Documents using an ASNT-TC-1A Level II qualified inspector.

Document parts found to be in nonconformance by using a Nonconformance Report form (NCR), and describe in detail the fabrication error and the proposed repair procedure(s) in accordance with the QCP. Repair(s) performed are subject to the written approval of the Engineer.

E. Galvanizing Requirements performed by the Galvanizing Applicator

Galvanize all railing material in accordance with 3394, "Galvanized Structural Shapes," after fabrication and then powder coat (Duplex Coat) using the methods described in this document.

Pre-Galvanized Procedure(s):

1. Calibrate dry film thickness gages in accordance with SSPC-PA 2-Measurement of Dry Coating Thickness with Magnetic Gauges.

2. Prepare all fabricated material surfaces by abrasive blast cleaning to a minimum of SSPC-SP 6/NACE No. 3-Commercial Blast Cleaning prior to galvanizing.

3. Purchase Order(s) shall identify which specific items are to be duplex coated and which materials to be galvanized are reactive (e.g. 3309, "High-Strength Low-Alloy Structural Steel," etc.).

Galvanizing Procedure(s):

Galvanize per 3394, "Galvanized Structural Shapes," and this specification. All products supplied using this specification have higher aesthetic expectations than standard galvanized products. Produce the final product to comply with its intended use as an "architectural" railing with heightened aesthetics and/or visual qualities.

1. Process all metal railing to be galvanized utilizing a "dry" kettle. Preflux the metal railing prior to the galvanizing bath using an aqueous tank of zinc chloride/ammonium chloride. Do not use a "top flux" blanket on the molten zinc bath.

2. Air cool the metal railing to ambient temperature before handling for shipment and/or storage. Do not quench the metal railing or apply any post-galvanizing treatments.

3. Lumps, projections, globules, high spots, drip lines, heavy deposits, blisters, flux deposits, thin spots, dross inclusions, etc., are considered unacceptable. Repair unacceptable zinc coatings in accordance with the Galvanizer’s approved QCP and powder coating applicator approved method. Zinc, which will interfere with the "intended use of the product", will not be permitted.

4. Repair galvanized material that does not meet the requirements of this specification, ASTM D 7803, and/or 3394, "Galvanized Structural Shapes," in accordance with the Galvanizer’s QCP.

5. Store galvanized metal railing in a manner that will prevent the formation of "white-rust" or wet storage staining. "White rust" or staining of the galvanize coating is not acceptable.

6. The Galvanizer shall provide the Engineer with all galvanizing process-related Quality Control documents which demonstrate compliance to this specification and referenced specifications prior to shipment of the galvanized product.

7. The Galvanizer will ensure the metal railings meet a straightness tolerance of $^{1}/_{8}$ inch in 10 ft [3 mm in 3000 mm] prior to any subsequent coating applications.

8. It is the Galvanizer's responsibility to provide the Engineer with advanced notification of at least 5 working days of intent to galvanize so that the Engineer can perform a QA audit.

F. Coating Requirements performed by the Powder Coating Applicator

This portion of the specification documents specific criteria that powder coated components must conform to in order to meet the quality and intent of the finished product.

Definitions:

Lot: The amount of components that is baked at one time in a curing oven. If however, a continuous feed type curing oven is used, specifically identify the definition in the QCP for acceptance by the Engineer.

Applicator Qualifications and Documentation

At least 30 calendar days before starting work submit a Quality Control Plan (QCP), meeting the requirements of this special provision to the Structural Metals Engineer, which outlines the program, procedures, and processes for assuring conformance to this special provision.

Establish QCP powder coating procedures in accordance with parameters set during the Powder Coating Applicator's Qualification Testing Procedure as defined in the "MnDOT Duplex Powder Coating Qualification Testing Procedure" located on the MnDOT Approved/Qualified Products web site www.dot.state.mn.us/products. Contact MnDOT Office of Materials Chemical Laboratory Director with any questions.

The following table represents the Properties and Specifications that are required for the Powder Coating Qualification Procedures.

MnDOT Powder Coating Performance Requirements		
Specification	**Standard**	**Requirement**
New Panels (initial testing)		
Total Film Thickness	Mils	4.0 mils [100 µm] minimum
Adhesion	ASTM D 4541- Type IV	Report
Color / Gloss	ASTM D 2244 ASTM D 523 - 60°	Color match to standard of $\Delta E < 2.0$ Gloss – report
Aged Panels (post testing)		
UV-Con	ASTM D 4587 Cycle 4 (1500 hours) ASTM D 4541- Type IV	- Photos - Report change in color from standard (ΔE, 5.0 max) - Gloss – report - Adhesion – report
Salt Spray of the entire system (hot-dipped galvanized steel with Powder Coating)	ASTM B117 (2000 hours) ASTM D 4541- Type IV	- Photos - Rust Creep ASTM D 1654 Procedure A Method 1, ≥ 7 - Blister Resistance ASTM D 714; blister size rating ≥ 7 with a frequency rating of Few - Adhesion - report

Perform QC inspections at the Powder Coating Facility in accordance with the QCP.

At least 30 calendar days before starting work, submit to the Quality Assurance Inspector (QAI) or the Engineer documentation showing that the coating manufacturer's technical representative trained the applicators, and Quality Control (QC) personnel how to properly apply the coating materials.

Provide the minimum requirements and frequencies in the QCP as shown in this table.

Powder Coating Inspection Requirements		
Requirement	**Criteria**	**Frequency/Extent**
Date and time	Each lot of work	Each lot of work
Compressed air test	ASTM D4285	Daily – When abrasive blasting or blow down operations are occurring
Final Coat Dry Film Thickness (DFT)	(4 mils - minimum)	SSPC-PA 2
Surface Preparation		
Abrasive blast clean	SSPC-SP 16/ASTM D7803	Each component to be powder coated
Pre-Bake for Outgassing		
Surface cleanliness	SSPC-PA 1	100% Visual examination prior to coating
Pre-bake oven temperature	Same procedure used to pass qualification in Section "F"	Each lot of work prior to each out-gassing event
Baking procedure	ASTM D7803 in conjunction with the same procedure used to pass qualification in Section "F"	Each lot of work
Prime Coat		
Powder product number	Track for each lot	Each batch of powder
Surface cleanliness inspection	SSPC-PA 1	Visual examination prior to coating (within 1 hr of coating)
Prime coat oven temperature	Same procedure used to pass qualification in Section "F"	Each lot of work
Temperature of component at time of coating	Same procedure used to pass qualification in Section "F"	Each lot of work
Verification of prime coat coverage	100% Coverage of powder	100% Visual Inspection
Top Coat		
Powder product number	Track for each lot	Each batch of powder
Surface cleanliness inspection	SSPC-PA 1	Visual examination prior to coating
Top coat oven temperature	Same procedure used to pass qualification in Section "F"	Each lot of work
Final cure temperature of component	Same procedure used to pass qualification in Section "F"	Each lot of work
Curing time	Per manufacturer Technical Data Sheet	Each lot of work
Coating evaluation / repair	Visual Inspection Coating shall be smooth and uniform free of runs, drips, sags, pinholes, blisters, and other deleterious conditions. (Pinhole density shall not be greater than 5 pin holes per sq. ft. in any given area)	100% Visual Inspection

Provide written documentation of the measurements to the QAI or to the Engineer, when requested, during the work, and in its entirety at the completion of the job. The QAI or the Engineer may reject the coating system or reduce payment if the Contractor did not adhere to the QCP or provided inadequate documentation of adherence to the QCP. Conduct subsequent testing with the QAI or the Engineer's approval, at no additional cost to the Department, to determine compliance.

1. Perform preparation of galvanized surfaces prior to application of powder coating in accordance with SSPC SP16 "Brush-off Blast Cleaning of Non-Ferrous Metals," and ASTM D 7803.

Inspect brush-off blasted surfaces for fins or tears, or any surface that shows that the galvanized coating has been damaged. Repair damaged areas using procedures in accordance with the applicator's QCP. Repair surface of insufficient galvanize coating Dry Film Thickness (DFT) readings using the powder coating applicator's QCP repair procedure.

The QAI or Engineer will inspect the surface preparation as it is done, after its completion, or review the QCP documentation, or any combination of the three. Notify the QAI or the Engineer at least 5 working days before beginning surface preparation.

For the following paragraph, insert color(s) as recommended by the MnDOT Bridge Office Architectural Specialist [(651) 366-4465].

Match the color of the finish coat to Federal Standard 595 C No. _____ with a semi-gloss finish.

1. Powder coat all sweep blasted galvanized railing with the subsequent coat(s) within the time frame defined in ASTM D 7803, or within the same 8-hour shift, maintaining manufacturer defined control and environmental conditions. The powder coating applicator's QC personnel shall document that all parameters were followed.

2. Apply all powder coating material in accordance with this special provision and the manufacturer's Product Data Sheet (PDS) and application guides for the material and system specified.

3. Accomplish QC inspections of coated products with an observer with normal color vision in a "well lighted" area during each coating phase and prior to final acceptance.

"Well-lighted" is defined as a minimum of 50 foot candles of artificial light or natural daylight. Use a light meter with readings in foot candles to verify the adequacy of the lighting.

4. Ensure the color of the first coat presents a distinct contrast from other coat(s).

Handling and Shipping by the Powder Coating Applicator of Duplex Coated Metal Railing:

Do not handle coated metal railing until the coating has cured as defined by the manufacturer of the powder coating, and is cooled to ambient temperature. Protect completed metal railing during handling and shipping to prevent damage to the coating.

Any damaged coated surfaces, identified through either Quality Control or Quality Assurance inspections as being unacceptable, either after the application of the powder coating or during handling of the Powder Coating Applicator, is subject to the provisions of 1512, "Unacceptable and Unauthorized Work" or will be repaired as described in the Powder Coating Applicators repair procedure.

Storage of Coated Metal Railings:

Store all completed coated metal railing in accordance with 1606, "Storage of Materials," and the following:

Provide the Engineer with advance notification of at least 5 working days of intent to ship, so that the Engineer can perform a QA audit prior to shipping.

G. Construction Requirements

Only use the following two paragraphs when a drilled-in anchorage alternate is not permitted by the contract. (Use these two paragraphs for any NCHRP 350 crash tested barriers adjacent to vehicular traffic). Use only when anchorages having an ultimate pull-out tension greater than 5000 lbs. [22kN] are required.

Provide the Engineer with a QA/QC plan that will be used to ensure that the cast-in-place anchorages are installed in the correct location using templates or other means ensuring that the exposed threads of the anchorages will not be damaged or contaminated and that the anchorages will not be displaced or allowed to move during concrete placement.

If cast-in-place anchorages have been installed in the forms, but prior to placing the barrier concrete, the Contractor shall provide written documentation verifying that all of the anchorages are within the necessary tolerances to place the tubular railing without modifying the railing base plate configuration.

Adjust the steel posts to obtain the grade and alignment as shown in the plans by one of the following methods:

1. Shim the steel posts with steel shims or washers to the proper grade and alignment, not to exceed $^{1}/_{4}$ in [6 mm] of shim height. Before attaching the nuts, **coat the entire surface between the base plate and concrete rail with an approved "Silicone Joint Sealant," as found on the Department's Approved Products website**. Tighten the anchor rod nuts (as per section "C"-Anchorages) and neatly smooth the caulk around the perimeter of the railpost base plate.

2. Thread the anchor rods with leveling nuts and turn down to the base of the anchor rods. Install the rails and set the steel posts to the proper grade and alignment by adjusting the leveling nuts. Install the top nuts and tighten them firmly to the base plate. Fill the space between the base plate and the concrete and neatly finish with grout that is approved by the Engineer.

Ground all metal railings. Install all electrical grounding in accordance with the applicable provisions of 2557, "Fencing," and the National Electrical Code. Clamp or braze the ground wires to the grounding device, then practicably route and attach to the nearest rail by clamping, brazing, or any other approved means that will provide a permanent positive connection. If rail has non-continuous sections, use a #6 AWG solid copper wire to connect adjacent railing panels.

If the bridge does not include exposed electrical equipment, then ground the rails at points directly below or adjacent to the railing at all abutment corners. Ensure the grounding system consists of a #6 AWG solid copper wire connected to the railing which in turn is connected to a copper coated steel rod having a nominal diameter of $^{5}/_{8}$ in [16 mm] or more and a minimum length of 8 ft [2.4 m] installed to an elevation approximately flush with the ground surface.

If the bridge includes exposed electrical equipment, such as roadway lighting, traffic signals, variable message signs, surveillance cameras, or ramp metering, then bond the railing grounding system to the exposed electrical equipment grounding system. Refer to the electrical plans and electrical special provisions for details regarding bonding multiple electrical grounding systems.

H. Repairs of Coated Metal Railings at the job site:

Any damaged coating surfaces, identified through either Quality Control or Quality Assurance inspections as being unacceptable, after handling and installation on the job site, is subject to the provisions of 1512, "Unacceptable and Unauthorized Work," and will be replaced or repaired using a procedure authorized by the Powder Coating Applicator and the Project Engineer.

I. Method of Measurement

Measurement will be by length in feet [M] based on plan dimensions between the outside ends of metal railings (with deductions for the lengths of concrete end posts).

J. Basis of Payment

Payment for Item No. 2402.603 "ORNAMENTAL METAL RAILING TYPE SPECIAL PC" will be made at the contract price per foot [M] and shall be compensation in full for all costs of fabrication, surface preparation, galvanizing, brush blasting of galvanized surface, coating, delivery, and installation, as described above. Failure to comply with any of these requirements will result in rejection of the material and/or reduction in payment.

SB- POT BEARING ASSEMBLIES

SB- Description of Work

Furnish pot bearing assemblies at _____. Disc bearings may be used as an alternate style, and must provide the same capabilities as specified for the three types of pot bearings. All bearing assemblies on a particular bridge shall be of one style. Pot bearings in combination with disc bearings are not allowed. The requirements for disc bearings are specified in SB- .4.

Perform the work in accordance with the applicable requirements of 1703, "Patented Devices, Materials, and Processes," 2402, "Steel Bridge Construction," the plans, and the following:

SB- General

A. Bearing Types

Three types of bearings are specified in the plans; fixed, guided and non-guided bearings, all of varying load capacities. The bearings are defined as follows:

1. Fixed bearings shall allow rotation in the vertical plane, but no longitudinal or transverse movement in the horizontal plane.

UAR

2. Guided bearings shall allow rotation in the vertical plane and movement in a horizontal plane in the (longitudinal) (transverse) direction of the bridge. Horizontal movement in a direction (transverse) (longitudinal) to the bridge shall be restricted.

3. Non-guided bearings shall allow rotation in the vertical plane and horizontal movements in all directions.

B. Shop Drawings

Shop drawings for the bearing assemblies shall include, but not be limited to, the following:

1. Complete details of all components and sections showing all materials used in the bearing assemblies.

2. A listing of all applicable MnDOT, ASTM and AASHTO specifications.

3. Load capacity for each bearing assembly.

4. Name and address of the manufacturer, and location of the fabrication plant.

5. Name and telephone number of the manufacturer's representative who will be responsible for coordination of production, inspection, sampling and testing.

6. Welding procedures used in the bearing assembly manufacture shall be clearly described and detailed.

7. Table of longitudinal offsets for installation at varying temperatures. Use 45°F [7°C]as the mean temperature for zero-inch offset.

Supplemental to the shop drawings, furnish design calculations which indicate that the bearings furnished by the manufacturer are adequate for the requirements of the Contract. Calculations shall include rotation and horizontal movement capacity, and compression stresses on all elastomeric and sliding surfaces.

Furnish an erection plan to the Engineer at or before the time of delivery showing the location and orientation of each of the bearings.

C. Bearing Dimension Options

Overall heights of the bearing assemblies, including the sole plates, are given in the plans. The bearing manufacturer shall determine the thickness of the masonry and sole plates through design of the bearing assemblies and set the final height – Dimension "H" – of each of the assemblies.

Horizontal dimensions given for the masonry plates may be changed by the manufacturer in accordance with design. Anchor rod offsets from the CL Pier/CL Bearing shall remain as shown in the plans to avoid causing interference of the anchor rods with the main reinforcement in the bearing seats.

If the final height of the bearing assemblies is different from that given in the plans, the manufacturer shall clearly indicate the revised Dimension "H" and provide new bearing seat elevations to the Engineer.

D. Design and Fabrication Requirements

Design the bearings so that the pot cylinder and piston assembly of pot bearings, and the disc and both mating surfaces of disc bearings, can be removed for replacement or repair.

Provide for all vertical and lateral loads, movements from temperature changes, rotation, camber changes, and the effects of creep/shrinkage of post-tensioned concrete box girders. Service and strength limit state design loads and movement values are given in the plans.

Ensure all materials used in the manufacture of pot and disc bearings are new and unused, with no reclaimed material incorporated into the finished product.

Size stainless steel sliding surfaces to completely cover the PTFE surfaces in all operating positions plus one additional inch in all directions of movement—as given in the plans—except transversely in guided bearings.

Do not start fabrication of the bearing assemblies until the shop drawings have been approved by the Engineer.

SB- Pot Bearings

Ensure pot bearings consist of a confined elastomeric element encased in steel, the function of which is to transfer loads and accommodate relative movement, including rotation, between the bridge superstructure and the piers and abutments. All material shown in the plans for a single pot bearing unit shall make up an assembly.

Ensure pot bearings are produced by a firm specializing in the design and manufacture of pot bearings, with a minimum of eight years of successful bearing installations.

Design, fabricate and test in accordance with the requirements of **AASHTO LRFD Bridge Design Specifications, Article 14.7.4 Pot Bearings** and the **AASHTO LRFD Bridge Construction Specifications, Article 18.3, Pot and Disc Bearings**.

Ensure brass sealing rings are rectangular cross-section conforming to Article 14.7.4.5.2 with no less than *three* rings per bearing assembly.

Provide the Engineer with written notification of bearing testing at least 30 calendar days prior to the start of testing operations.

SB- Disc Bearings

Ensure disc bearings consist of an elastomeric structural rotational element (disc) confined by upper and lower steel bearing plates plus masonry and sole plates. The function of the bearings is to transfer loads and accommodate relative movement, including rotation, between the bridge superstructure and the piers.

Ensure disc bearings are produced by a firm specializing in the design and manufacture of disc bearings, with a minimum of eight years of successful bearing installations.

Design, fabricate and test in accordance with the requirements of the **AASHTO LRFD Bridge Design Specifications, Article 14.7.8, Disc Bearings** and the **AASHTO LRFD Bridge Construction Specifications, Article 18.3, Pot and Disc Bearings**.

Provide the Engineer with written notification of bearing testing at least 30 calendar days prior to the start of testing operations.

Ensure fabrication of the disc bearings conforms to the applicable requirements of Article 18.3.3.

SB- Method of Measurement

Measure bearings by each individual unit, which consists of all components shown in the plans or on the approved shop drawings for a single bearing assembly, whether it is a pot or disc bearing.

SB- Basis of Payment

Payment for Item No. 2402.602 "POT-TYPE BEARING ASSEMBLY" will be made at the Contract price per each and shall be compensation in full for all costs of furnishing and installing bearing assemblies--whether it be pot or disc bearings--as described above.

SB2014-2402.9

Include when Regional Bridge Construction Engineer recommends inspection of cover plate welds.

CREATED 11/1/2002

REVISED 5/16/2013 (1)

SB- Existing Cover Plate Weld Inspection

A. Description of Work

Inspect the fillet welds located on the top flange at the ends of the cover plates. Perform work in accordance with the following:

B. General

The above-mentioned fillet welds are transverse to the primary direction of stress in the member, therefore making them prone to fatigue cracking. The twofold purpose for the inspection is to determine if fatigue cracking is present and whether the welds have defects that would enhance the likelihood of cracking in the future.

SB- Inspection of Cover Plates

After the bridge deck is removed, inspect the ends of the top flange cover plate(s) for defects at (____ locations). Inspect the in-place steel beams or girders using Nondestructive Tested (NDT) by Visual Testing (VT) and by Magnetic Particle Testing (MT) per AASHTO/AWS D1.5 Bridge Welding Code, latest edition. Ensure personnel performing NDT are qualified in conformance with the American Society for Nondestructive Testing's (ASNT) SNT-TC-1A and are NDT Level II operators with two years minimum experience.

Ensure the weld surface and adjacent area to be inspected is free of contaminants such as dirt, loose rust, oil, grease, paint, concrete, welding flux/slag, and weld spatter that may mask defects or restrict magnetic particle movement. Prepare the surface prior to inspection by mechanical means (i.e. wire brush, chipping hammer, etc.) only. Do not heat the members to remove surface contaminants.

Perform VT to ensure the fillet welds are acceptable for profile, undercut, and size in accordance to the workmanship and inspection standards of D1.5. Ensure undercut is no more than 0.01 in [0.25 mm] in depth. Perform MT to ensure the fillet welds have no cracks or unacceptable levels of porosity and/or fusion-type discontinuities in accordance with D1.5.

Repair welds that do not meet these standards or have defects 1/8 inch [3 mm] or less of depth into the flange in accordance with SB-___.3. Immediately bring to the Engineer's attention welds that have cracks or defects greater than 1/8 in [3 mm] of depth into the flange, and repair in accordance with SB-___.4 or as directed by the Engineer.

Furnish an NDT report of the VT and MT test results for each location on the bridge, whether defects are found or not, to the Engineer upon completion.

A. Method of Measurement

Inspection of all welds noted above will be measured as a single lump sum.

B. Basis of Payment

Payment for Item No. 2402.601 "INSPECTION OF COVER PLATE WELDS" will be made at the Contract price per lump sum and shall be compensation in full for all costs of surface preparation, and VT and MT inspection as described above.

SB- Weld and Minor Defect Repair

Repair minor defects and unacceptable profile of welds and base metal at the end of cover plates. Defects and weld profiles may be repaired by hand grinding. Conduct hand grinding in a manner such that grind marks are parallel to the direction of stress. Any grinding must taper at a minimum of 1 vertical to 10 horizontal. The Engineer shall determine the locations of the repairs based on the VT and MT test results indicated in SB-___. All repaired welds shall be re-inspected as described in SB-___ for final approval.

Report any defects more than 1/8 inch [3 mm] into the flange to the Engineer and repair as described in SB-___.4 or as directed by the Engineer.

Prepare all areas where paint was removed and will not be covered with concrete, and prime coat with an approved zinc-rich primer according to MnDOT 2478.

A. Method of Measurement

Measurement will be by the number of repairs conducted, at locations designated by the Engineer, for weld defect repair and re-inspections.

B. Basis of Payment

Payment for Item No. 2402.602 "WELD REPAIR" at the Contract price per each shall be compensation in full for all costs of repairing and re-inspecting the welds to acceptable conditions.

SB- Splice Plate Repair of Top Flange

Repair beam or girder flanges at the ends of cover plates when inspection of the cover plates reveals defects greater than 1/8 inch [3 mm] in depth into the top flange. The Engineer will determine locations of the repairs based on the results of the tests indicated in SB-___.2.

Repair by drilling holes through the top flange at the ends of the rack or linear defect and splice plate the area. Drill holes using core type drilling bits. Make holes 3/4 inch [19 mm] in diameter or as otherwise directed by the Engineer. Test removed core(s) to determine if the defect was removed by the drilling operation. Bolt splice plates to the top and bottom of the top flange as shown in the plan, or as directed by the Engineer.

A. Method of Measurement

Measurement will be by the number of repairs conducted, at locations designated by the Engineer, for top flange arrestor hole drilling and splice plating.

B. Basis of Payment

Payment for Item No. 2402.602 "SPLICE PLATE REPAIR" at the Contract price per each shall be compensation in full for all costs of drilling arrestor holes, and splice plate repairing the flanges as shown in the plans.

SB2014-2402.9A

Include when Regional Bridge Construction Engineer recommends Peening or Ultrasonic Impact Treatment (UIT) of cover plates.

CREATED 1/7/2015
REVISED 1/7/2015

SB- Ultrasonic Impact Treatment (UIT)

To enhance steel fatigue properties, perform UIT to retrofit the (top and/or bottom) flange welded cover plate and terminations.

Perform the retrofit work by completing the following three Tasks (A, B, C):

A. Preliminary Work and Mobilization Task

Prepare documentation and carry out the retrofit work under this task. Provide final retrofit drawings including details of weld configuration, length of weld treated, area of weld treated (i.e., toe of weld), machine settings and travel speed, along with installation procedures, and an inspection guide. Define the treatment methodology and parameters for successful operations in the final retrofit drawings, installation procedures, and inspection guide. Cover the details of the quality assurance program ensuring that the treatment methodology has been successfully applied as per the instructions within the technical procedure manual of the inspection guide. No field work will be allowed until the Engineer has reviewed the documents for general compliance and signed off in writing. Make arrangements for access equipment, materials, and the UIT equipment, following these submittals. Mobilization and demobilization to get the retrofit equipment to and from the bridge site(s) is included in this task.

B. Retrofit of Cover Plate Weld Terminations Task

Due to the sensitivity of the welded cover plate termination details to fatigue, this condition requires modification to upgrade the condition. On the original bridge structures, the top and bottom flange cover plate details will be retrofitted using the UIT peening equipment. UIT the cover plate terminations for a 6 in [150 mm] length along the taper on each side and across the entire end of the cover plate. Treat the weld toe adjacent to the girder flange material with a minimum of three passes. Perform the UIT treatment work utilizing trained and certified retrofit engineers and/or technicians. Training and certification is to be provided by the UIT equipment manufacturer. If engineers and technicians previously trained and with a minimum of two years field experience are used, UIT treatment training will not be necessary. Provide documentation of certification within 5 working days, when the Engineer requests it.

Repair any damage to the existing corrosion protection systems in accordance with MnDOT 2478 at no added expense to the Department and to the satisfaction of the Engineer.

C. Letter of Report Task

Prepare a summarization letter at the conclusion of the retrofit work, describing the retrofit work and the field procedures (including photographs of each repair location). Submit three hard copies of this report along with an electronic version (CD) to the Engineer.

For the following measurement, quantity is per cover plate treated and not each end.

D. Method of Measurement

Measurement will be by the each cover plate ultrasonic impact treated. This includes all affected areas as described above for each cover plate.

E. Basis of Payment

Payment for Item No. 2402.601 "ULTRASONIC IMPACT TREATMENT", at the Contract price per each shall be compensation in full for all costs of treatment of both ends of cover plate as described above.

SB2014-2402.10
Use for all steel bridge projects.
CREATED 5/20/2003
REVISED 5/16/2013 (3)

SB- Bolted Connections

Prepare and install all bolted field connections for steel bridges using Direct Tension Indicator (DTI) washers. Ensure DTIs conform to the requirements of 3391, "Fasteners," and ASTM F 959. All DTIs must have unique markings to indicate the gap locations between the protrusions and to allow the inspector to visibly differentiate them from a standard washer after installation. Mechanically galvanize supplied DTIs in accordance to 3392, "Galvanized Hardware".

Install fasteners in accordance with the DTI manufacturer's recommendations and 2402, "Steel Bridge Construction," as well as the requirements of AASHTO LRFD Bridge Construction Specifications, Third Edition, Article 11.5.6.4.7 Direct Tension Indicator Installation Method. Ensure a DTI manufacturer's representative is on-site at the beginning of the bolting operations to provide training and ensure proper installation.

Use of DTIs, as described above, are an incidental expense to the structural steel and no direct compensation will be made.

SB- (2403) TIMBER BRIDGE CONSTRUCTION

For the following two paragraphs, check with district or county for preservative treatment preference.

A. Preservative Treatment

Treat laminated panels after fabrication in accordance with the 2403, "Timber Bridge Construction," use a Treated Wood product as listed on the Approved/Qualified Products List for Treated Wood," and then only for the specific application for which each product is approved.

SB2014-2404

Use on all jobs that will receive a low slump concrete wearing course.

CREATED 10/3/1988

REVISED 12/12/2013 (6)

SB- (2404) CONCRETE WEARING COURSE FOR BRIDGES

The provisions of 2404, "Concrete Wearing Course for Bridges," are supplemented with the following:

SB- Crack Sealing Bridge Deck

Supplement 2404.3.C, "Deck Preparation," with the following:

After shotblasting the surface, the Engineer will perform a visual inspection of the bridge deck, and locate all cracks appearing on the top surface. Furnish only one of the materials listed on the Department's "Approved/Qualified Product List of Bridge Surface and Crack Sealers," (www.dot.state.mn.us/products/bridge). Fill all located cracks with an approved crack sealer following the manufacturer's recommendations, and as otherwise directed by the Engineer. Ensure the sealer is cured prior to preceding pre-wetting of the deck, as required for placement of a low slump concrete wearing course.

Control the application of the crack sealer such that the maximum width of crack sealant does not exceed ¾ in [20 mm]. If exceeding the permitted width of ¾ in [20 mm], remove excess by means of surface grinding to prevent debonding of concrete wearing course.

Furnishing and placing the sealer as specified above will be considered to be incidental work for which no direct compensation will be made.

SB- Crack Sealing Concrete Wearing Course

Supplement 2404.3.E.4, "Curing Requirements," with the following:

After completion of the wearing course curing period, the Engineer will perform a visual inspection of the wearing course, and will locate all cracks appearing on the top surface. Furnish only one of the materials listed on the Department's "Approved/Qualified Product List of Bridge Surface and Crack Sealers," (www.dot.state.mn.us/products/bridge). Fill all located cracks with an approved crack sealer following the manufacturer's recommendations, and as otherwise directed by the Engineer prior to opening the bridge to vehicular traffic.

Furnishing and placing the sealer as specified above will be considered to be incidental work for which no direct compensation will be made.

SB- Weather Conditions for Concrete Wearing Course Placement

Delete the 10th paragraph of 2404.3.D, "Concrete Placement and Texturing," and replace with the following:

If the National Weather Service predicts a daytime temperature of at least 80° F [27° C] for a scheduled concrete placement, reschedule the placement or begin the concrete placement between midnight and 5:00 a.m. Placements started after midnight, but not completed by 5:00 a.m., shall be terminated at 5:00 a.m. if the ambient air temperature is at or above 80° F [27° C]. If the air temperature is below 80° F [27° C] at 5:00 a.m., the placement may continue until such time as the temperature reaches 80° F [27° C]. Do not place concrete wearing course if the air temperature falls below 40° F [5° C] or if the slab surface shows signs of frost.

SB2014-2404.1

Use for low slump concrete wearing courses on new decks.

CREATED 4/4/1997

REVISED 5/16/2013 (6)

SB- Concrete Wearing Course 3U17A

For the following paragraph, use as recommended by Regional Construction Engineer.

Unless otherwise authorized, ensure the concrete wearing course placement widths do not exceed ____ feet [meters] in width for Bridge(s) _____ and _____ feet [meters] in width for Bridges _____.

SB2014-2404.2

Use for low slump concrete wearing course on deck repair work.

CREATED 4/4/1997

REVISED 8/1/2014 (9)

SB- Concrete Wearing Course 3U17A

For the following two paragraphs, use with Limited Service Wearing Course.

Delete the first paragraph of 2404.2, "Materials," delete 2404.2A, "Low Slump Concrete," in its entirety, and substitute the following:

Ensure the wearing course is composed of a 3 inch [76 mm] minimum depth Low Slump Concrete Course, produced in accordance with the following:

For the following four paragraphs, use in all other cases.

Delete the provisions of 2404.1, "Description," and substitute the following:

Construct a portland cement concrete wearing course to a 2 inch [50 mm] minimum depth on an existing bridge deck slab, monolithic partial depth patches resulting from Type 1 slab removal, and concrete approach tapers.

Delete the first paragraph of 2404.2, "Materials," delete 2404.2.A, "Low Slump Concrete," in its entirety, and substitute the following:

Ensure the wearing course monolithic partial depth patches and concrete approach tapers are composed of Low Slump Concrete, produced in accordance with the following:

UAR

For the following paragraph, use as recommended by the Regional Construction Engineer.

Delete the second sentence of the first paragraph of 2404.3.D, "Concrete Placement and Texturing," and substitute the following:

Unless otherwise authorized, ensure concrete wearing course placement widths do not exceed _____ feet [meters] in width for Bridge(s) _____ and _____ feet [meters] in width for Bridges _____.

Add the following to 2404.5, "Basis of Payment":

UAR

If the design batch volume of concrete for wearing courses (, approach tapers,) and Type 1 Removal areas, less accountable waste, exceeds the volume in yd^3 [m^3] computed as shown hereafter, payment will be made at the rate of $165.00 per yd^3 [$216.00 per m^3] for the excess amount.

UAR

Volumes will be computed using specified dimensions for the wearing courses and field measurements for Type 1 Removal (and taper) areas. Thicknesses shall be as follows:

A wearing course thickness of 2 3/8" [60 mm] 3/8" [86 mm] [, an average taper thickness of 2", [50 mm,] (_____,)] and an average Type 1 Removal thickness of _____.

Delete the second paragraph of MnDOT 2404.5 and substitute the following:

Use one of the two following paragraphs for payment.

Payment for concrete wearing course will be made as Item No. 2404.618, "CONCRETE WEARING COURSE (3U17A) ___"", at the Contract price per square foot.

SB2014-2404.3

Use when texture planing is required on the low slump wearing course.

Use in the Metro District unless otherwise recommended by the Metro Region Construction Engineer.

CREATED 7/24/2001

REVISED 4/21/2015 (9)

SB- Texture Planing of Bridge Slabs

Texture Planing of Bridge Slabs

Delete the 5th and 6th paragraphs of 2404.3.D, "Concrete Placement and Texturing," and substitute the following:

After completing required work to meet surface tolerance, texture the roadway surface in a longitudinal direction by planing the hardened concrete using a diamond saw-blade grinder. Plane the entire surface area of the roadway except the area within 20 inches [500 mm] of the curb to a uniform texture. Ensure the surface has a finished texture with groove width between 1/10 inch [2.5 mm] and 1/8 inch [3.3 mm] at a distance of between 5/64 inch [2.0 mm] and 1/8 inch [3.0 mm] apart. Make the grooves no less than 1/32 inch [0.8 mm] or more than 1/8 inch [3.0 mm] in depth. Ensure the actual textured surface in any selected 1.5 feet [0.5 meter] by 100 foot [30 meter] longitudinal strip is no less than 98% of the surface area.

Prior to planing operations, submit a procedure to the Engineer indicating how the expansion joint devices and plow finger straps will be protected from any damage during the planing operations. Do not begin planing before the Engineer approves the methods and procedures in writing. Damage, including coating damage, to the expansion joint devices and plow finger straps will be corrected or will be removed and replaced as unacceptable work, as directed by the Engineer. If the Engineer does not direct either repair or replacement of the unacceptable work, the Contractor may leave the work in-place and the Engineer will adjust the contract unit price of the affected items by 50 percent.

Perform planing in a manner that will provide a smooth riding surface at expansion joints and at the ends. After completion of the planing, the permissible surface deviation will be 1/8 inch [3 mm] in 10 feet [3 meters] measured with a straightedge laid longitudinally and 1/8 inch [3 mm] in 3 feet [1 meter] measured transversely at right angles to the centerline of roadway.

All slurry material is property of the Contractor and must be disposed of as per 2104.3.C.3, "Concrete and Masonry Structures," as approved by the Engineer, and as described in this special provision.

Continuously vacuum, capture and contain from the surface all concrete residue and water (slurry) resulting from concrete bridge deck texture planing operations for further handling or processing. The slurry must not be permitted to flow across lanes occupied by traffic, flow into drainage facilities or discharge anywhere within the highway Right of Way. Submit a slurry disposal or reuse plan at the preconstruction conference for approval by the Engineer.

The method to manage the slurry may require separation of the solids from the liquids. This separation may be achieved mechanically by centrifuging or passively by allowing settlement of the fines to occur in a temporary impermeable lines containment area. If a temporary containment area is used within the highway Right of Way, a Site Plan as per 1717, "Air, Land and Water Pollution," will be required for the Engineer's approval. Include at minimum in the Site Plan methods for storm water protection at the temporary containment area, a description of the proposed separation method, and the process for final removal and restoration of the disturbed containment area. For any method used to separate the liquid from the solids, identify the name and location of the POTW (publicly owned treatment works facility) that the liquids will be deposited in, or how the processed water will be reused.

As part of the slurry disposal or reuse plan, be able to provide, upon request, documentation that identifies the name and location of the MPCA permitted lined mixed municipal solid waste (MMSW) or industrial landfill that the solids will be deposited in, or identifies any alternative methods of disposal or reuse that meet environmental requirements of regulated industrial waste.

The Contractor shall hold MnDOT harmless for any fines or sanctions caused by the Contractor's actions or inactions regarding compliance with concrete slurry management and disposal. All materials and labor for installation of storm water protection practices, maintenance, control, removal and disposal for the management of concrete slurry is incidental to the bridge deck texture planing operation.

The Engineer will measure the surface of the finished concrete and all planed areas not meeting the requirements may, at the Engineer's option, be re-planed, be replaced as unacceptable work, or left as is and accepted for payment subject to a price reduction of 50 cents per sq ft [$5.40 per sq m] but, in all cases, provide positive surface drainage.

Select ONE of the two following paragraphs.

Measurement will be made to the nearest square foot of concrete area planed and textured based on surface area. Payment will be made under Item 2401.618 "BRIDGE DECK PLANING" at the Contract bid price per square foot, which shall be compensation in full for all costs relative to the specified texture planing.

Measurement will be made to the nearest square meter of concrete area planed and textured based on surface area. Payment will be made under Item 2401.604 "BRIDGE DECK PLANING" at the Contract bid price per square meter, which shall be compensation in full for all costs relative to the specified texture planing.

SB2014-2404.21A

Use with concrete wearing course when the Regional Engineer recommends 10 degree diagonal tining.

CREATED 7/1/2014

REVISED 7/1/2014

SB- Modified Transverse Texturing (Tining) on Bridge Slab

The 5th paragraph of 2404.3.D is supplemented with the following:

Immediately after carpet dragging, texture the concrete wearing course surface with a metal-tine pattern. Install the transverse texturing (tining) on a slight diagonal, at an angle of approximately 10 degrees to a line perpendicular to the roadway centerline, produced by using a device meeting the following characteristics and requirements:

1) Equipped with steel tines from 4 in to 6 in [100 mm to 150 mm] long and from 1/12 in to 1/8 in [2 mm to 3 mm] thick,

2) Steel tines arranged to obtain randomized grooves from 1/8 in to 5/16 in [3 mm to 8 mm] deep, and

3) Grooves variably spaced from 5/8 in to 1 in [16 mm to 25 mm].

Do not texture or tine within 1 ft [300 mm] of gutterline.

SB2014-2405
Use on all Prestressed Beam Jobs.
CREATED 11/17/1988
REVISED 5/16/2013 (7)

SB- **(2405) PRESTRESSED CONCRETE BEAMS**

The provisions of 2405, "Prestressed Concrete Beams," are supplemented with the following:

SB2014-2405.1

Use on all prestressed beam jobs.

CREATED 2/1/1994

REVISED 5/16/2013 (2)

SB- Prestressed Concrete Fabricator Certification

Ensure the Fabricator's quality control office maintains documentation containing the data required by the specifications and the State Materials Engineer. This documentation shall contain test data and measurements taken at times and locations approved by the Engineer, assuring that monitoring, by personnel not directly involved in production, is sufficient to ensure compliance with approved procedures.

If the Engineer's review of fabrication work discloses that approved procedures are not being followed, the Fabricator shall immediately correct the procedure.

The Engineer will determine what additional testing work must be done by the Fabricator or, if necessary, what part of the work must be repaired or replaced if fabrication work is not properly monitored and documented by the Fabricator.

Any and all costs of required additional monitoring and testing shall be at the expense of the Contractor with no additional compensation.

SB2014-2405.2

Use on all Prestressed Beam Jobs with "I" shaped beams.

CREATED 1/18/2013

REVISED 8/12/2013 (V14)

SB- Beam Camber and Deflection

Add the following 2405.3.J.1, "Beam Camber and Deflection," after the last paragraph of 2405.3.J, "Marking, Handling, Storage, and Transportation,":

J.1 Beam Camber and Deflection

The Erection Camber dimension shown in the Plans is the computed beam camber at midspan based on a time lapse of 30 to 180 calendar days after release of the prestressing strands. This camber may vary by + 1 in [100 mm] and is intended to advise the Contractor as to the expected camber at the time of deck forming. A positive (+) dimension indicates upward camber.

To help control camber, schedule fabrication of prestressed concrete beams between 30 and 180 calendar days prior to slab placement on the erected beams. For projects where the slab is placed; a) before the beams are 30 calendar days old, or b) after the beams are 180 calendar days old, the Contractor is responsible for controlling the beam camber and all associated costs, including but not limited to:

- bridge and roadway slab materials,
- form adjustments required to maintain specified steel reinforcing bar clearances and deck profiles,
- beam seat adjustments,
- application of load to the beams, and
- any additional expenses in connection with accommodating insufficient or excess beam camber.

Record the date and camber of each beam at the following times:

1. Initial – Just prior to removal of the beam from the casting bed; and
2. During Storage – At a frequency not to exceed 60 calendar days, and within a time frame of 7 to 21 calendar days prior to shipment.

In addition, record the date and camber of each beam if the support or bunking point (distance from point of support to end of beam) changes by more than 2 ft [600 mm] during storage (except during shipping to the job site).

Record the initial camber on the casting bed, just prior to lifting or removal of the beam from the bed.

Measure beam camber as the vertical dimension between the top of the beam at midspan and a theoretical line at the top of the beam between centerline of bearings.

Perform and record each check at a time when the camber and alignment of the beam is not influenced by temporary differences in surface temperature. Make these records available for the Engineer's inspection, and include in the "Record of Camber" (see attached sheet) document for each beam. Immediately notify the Materials Engineer and Bridge Construction Unit if any of the recorded cambers (other than initial) are outside a range of + 1 in [25 mm] of the Erection Camber dimension shown in the Plans. At the time of shipment, provide the "Record of Camber" document for each beam to the Materials Engineer and the Engineer.

To help control camber, place 27M, 36M, and MN45 beam shapes on storage bunks with at least 2 ft [600 mm] and no more than 4 ft [1200 mm] of beam end overhang. Place beams with a design height exceeding 45 inches [1150 mm] on storage bunks with at least 3 ft [900 mm] and no more than 6 ft [1800 mm] of beam end overhang. Place all beams within the same span and for each bridge, on storage bunks with beam end overhangs that differ by no more than 2 ft [600 mm] from one another. Include the location of the bunk or support point from the end of the beam on the "Record of Camber" for each end of each beam.

If it is anticipated that the beams will be older than 180 calendar days at time of slab placement, the Contractor shall submit calculations to the Engineer showing the estimated beam camber and the residual camber at midspan, at the beam age anticipated at time of slab forming and at time of deck placement (if more than 45 calendar days after slab forming). Include in the submittal the Contractor's proposal for accommodating or preventing any excess camber in the construction, including but not limited to; increased frequency of camber measurement, potential changes to beam seat elevations, etc.

Take elevations at top of beams after erection and allow for deflection shown to enable building deck forms to correct grade and specified slab thickness. Take elevations no more than 45 calendar days prior to slab placement.

Record of Camber (V3 -06/18/13)

Fabrication Company: _____

Bridge No.: _____ **Beam Size:** _____

S.P. or S.A.P. No.: _____

Fabrication Date: _____ **Date Shipped:** _____

Unique Beam ID (Per Fabricator)	Beam No. From Framing Plans	Erection Camber Shown in Plans	Beam Length (Feet-Inches) (i.e. 101'-7")	Camber Measurement Date	Beam Age (Days)	Camber at Midspan (Inches)*	Method Used**	Bunking Distance From "X" End (Feet-Inches)	Bunking Distance At Opposite End (Feet-Inches)	Measured By (Initials)
				/ /						
				/ /						
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***Beam camber shall be measured as the vertical dimension between the top of the beam at midspan and a theoretical line at the top of the beam between centerline of bearings. Immediately notify the Materials Engineer and Bridge Construction Unit if any of the recorded cambers (other than initial) are outside a range of ± 1 inch of the Erection Camber dimension shown in the Plan.**

****Indicate the method used to measure the camber, i.e. Stringline, Survey instrument, etc.**

Notes:

SB2014-2405.3

Use with prestressed concrete beams where special surface finish is NOT required.

CREATED 7/29/1983

REVISED 5/16/2013 (1)

SB- Concrete Finish of Exterior Beams

Delete the tenth paragraph of 2405.3.K, "Installation," and substitute the following:

A special surface finish on the outer surface of the exterior beams is not required on this bridge.

SB2014-2405.4
Use on all prestressed I-beam projects.
CREATED 10/8/2003
REVISED 5/16/2013 (4)

SB- Prestress Transfer of I Shaped Beams

The Fabricator of prestressed concrete beams must closely monitor the ends of the beams during the strand release process. The following sequence of releasing the individual prestressing strands is required if cracks occur in the ends of the beams during the Fabricator's releasing sequence.

Delete the first sentence of the second paragraph of 2405.3.G, "Prestress Transfer," and replace with the following:

Conduct prestress transfer in a sequential and alternating manner symmetrical to the vertical axis of the beam in order to minimize the lateral eccentricity of the prestress forces and diminish cracking of the concrete. Perform the sequence of individual prestressing strand release in accordance with the following criteria, unless different criteria are approved by the Engineer.

1) Beginning with the *straight* strands closest to the vertical axis of the beam and in the second row from the bottom of the beam, release the strands each side of center. Move two columns away from this column in the same row and release the strand on each side of the center. Then proceed to the outermost strands in this row and release the strand on each side of the center. Repeat the sequence for the third and subsequent rows from the bottom upward until approximately one-fourth of the straight strands have been released.

2) Release approximately one-half (+/- one strand) of the *draped* strands alternating about the vertical axis, starting from the bottom.

3) Release the hold-down anchors for the draped strands.

4) Release the remainder of the *draped* strands alternating about the vertical axis.

5) Release the remainder of the *straight* strands beginning with the strand in the bottom row nearest the vertical axis. The strands are released alternating each side of the center. Release all the strands in that column moving upward. Proceed two columns away from this column and release the strands bottom to top alternating each side of the center. Next, move to the outer most column and release strands bottom to top continuing to alternate each side of the center. Release the remainder of the strands bottom to top starting with the innermost column alternating each side of the center.

Once release has started, release all strands of that beam in the sequence described above even if cracking is noticed near the end of the beam. Notify the Engineer immediately of any cracking, and do not fabricate other beams with the same strand pattern until the Engineer has approved a revised release sequence.

SB2014-2405.5

Use on all rectangular prestressed beam projects.

CREATED 3/12/2009

REVISED 5/16/2013 (1)

SB- Prestress Transfer of Rectangular Beams

Monitor the ends of the rectangular prestressed concrete beam during the strand release process. If during the release of the individual prestressing strands cracks occur in the ends of the beam, the following release sequence will be required.

Delete the first sentence of the second paragraph of 2405.3.G, "Prestress Transfer," and replace with the following:

Conduct prestress transfer in a sequential and alternating manner symmetrical to the vertical axis of the beam in order to minimize the lateral eccentricity of the prestress forces and diminish cracking of the concrete. Release individual prestressing strands in the following sequence:

> Beginning with the bottom row of strands, proceed to the outermost strands in this row and release one strand each side of center. Move up one row, to the outermost strands in this row and release one strand each side of center. Move to the top row at the top of the beam, to the outermost strands and release one strand each side of center. Move to the second row from the top of the beam to the outermost strands and release one strand each side of center. Proceed to the bottom row of strands at the bottom of the beam, 3 columns from the vertical axis, and release one strand each side of center. Move up one row in the same column and release one strand each side of center. Then proceed to the innermost strands in the bottom row and release one strand each side of center. Move up one row and release the same strands. Proceed to the innermost strands in the top row at the top of the beam and release one strand each side of center. Proceed to the bottom row, 1 column in from the outmost strands and release one strand each side of center. Move up one row and release the same strands. Proceed to the bottom row, 2 columns out from the vertical axis of the beam and release one strand each side of center. Move up one row and release the same strands.

Once release has started, release all strands of that beam in the sequence described above even if cracking is noticed near the end of the beam. Notify the Engineer immediately of any cracking, and do not fabricate other beams with the same strand pattern until the Engineer has approved a revised release sequence.

SB2014-2405.6

Use for all prestressed I-beam shapes greater than 27M (36M, MN45, MN54, MN63, 82MW, 96MW).

CREATED 5/16/2013

REVISED 7/23/2014 (2)

SB- Prestressed Concrete Beam End Zone Crack Repair

Add the following as 2405.3.I.1, "**End of Beam Cracking and Repair**":

The Fabricator of the Prestressed Concrete Beam (PCB) is responsible for evaluating, supplying the products, and their application per the following:

Use feeler gauges to measure cracking in the beams. Report any cracks that appear to be perpendicular to the draped strands to the Department Precast Inspection Engineer, who will evaluate the cracks perpendicular to the draped strands and give further direction to the Fabricator.

A. Reject PCB with cracks exceeding 0.050 inches [1.25 mm].

B. Fill PCB cracks ranging in width from 0.025 inches [0.60 mm] to 0.050 inches [1.25 mm] using epoxy injection, approved by the Department Materials Engineer.

Follow these directions for Epoxy injection:

1. Within 48 hours of application, clean the crack area of any loose debris such as dirt, dust, curing compounds, waxes, laitance, oil, grease, or other contaminants with an oil free 125 psi compressed air blast leaving only clean sound concrete. No water washing is allowed,
2. Ensure the epoxy injection is performed by a trained, approved, and certified applier of the manufacturer of the epoxy meeting these specifications. Training curriculum shall consist of the theory behind the causes of cracking, selection of materials, and injection technology including flow rates, operating pressures, and temperature effects,
3. The applier shall submit for review by the Department Materials Engineer, a written description of the proposed epoxy materials, their acceptable approvals, and the injection procedure, at least 7 calendar days prior to proceeding. Include in the list the repair work proposed for each item,
4. Utilize an epoxy injection system approved in writing by the Department Materials Engineer,
5. The certified applier is responsible for crack preparation. Determine the exact location and length of the crack to be injected. Clean the crack and the adjacent surfaces or other areas of application of paint, dirt, dust, grease, oil, efflorescence, or other foreign matter detrimental to bond of epoxy injection surface seal system using a grinding wheel, wire brush, and compressed air. Open crack walls slightly along its length with a small crack chaser blade if the crack walls remain contaminated. Acids and corrosives are not permitted for cleaning, and
6. Inject the approved system as recommended by the manufacturer.

Then apply Euclid Dural Prep AC or BASF Degadeck® CSP to the ends and the sides of the PCB (no coating applied to the top of the top flange or bottom of the bottom flange) for the greater of the following lengths, end four feet or from the end of the beam to the end of the furthest crack. Prepare and apply per the manufacturer's recommendations and as approved by Department Materials Engineer.

C. Fill girder cracks ranging in width from 0.012 inches [0.32 mm] up to 0.025 inches [0.60 mm] with Hilti RM 800.

Follow these directions for packing the Repair Mortar:

1. Within 48 hours prior to this application, clean the crack area of any loose debris such as dirt, dust, curing compounds, waxes, laitance, oil, grease or other contaminants with an oil free 125 psi compressed air blast leaving only clean sound concrete. No water washing is allowed and do not apply moisture to crack prior to mortar repair,
2. Pack Hilti RM 800, a Portland cement based repair mortar, along the entire length of each crack, filling the voids of the crack, and
3. Mix and apply the material per the manufacturer's recommendation, and as approved by Department Materials Engineer.

Then apply Euclid Dural Prep AC or BASF Degadeck® CSP to the ends and the sides of the PCB (no coating applied to the top of the top flange or bottom of the bottom flange) for the greater of the following lengths, end four feet or from the end of the beam to the end of the furthest crack. Prepare and apply per the manufacturer's recommendations and as approved by Department Materials Engineer.

D. Do not fill girder cracks less than 0.012 [0.32 mm] in width but apply either Euclid Dural Prep AC or BASF Degadeck® CSP to the PCB sides and end (no coating applied to the top of the top flange or bottom of the bottom flange) for the greater of the following lengths, end four feet or from the end of the beam to the end of the furthest crack. Prepare and apply per the manufacturer's recommendations and as approved by Department Materials Engineer.

E. If there are no visible cracks, apply either Euclid Dural Prep AC or BASF Degadeck® CSP to the PCB sides and end (no coating applied to the top of the top flange or bottom of the bottom flange) four feet of the beam. Prepare and apply per the manufacturer's recommendations and as approved by Department Materials Engineer.

Make repairs at least three days after prestress transfer has been made, but no sooner than 3 weeks before shipping to site, unless approved by the Department Precast Inspection Engineer.

Give the Department Materials Engineer the opportunity to monitor all end of beam repair work.

The contract unit price for *Prestressed concrete Beams Type* _____ includes the cost for all the above mentioned.

SB2014-2406
Use ONLY when not in grading plan.
CREATED 8/3/1994
REVISED 5/16/2013 (2)

UAR

SB- (2406) BRIDGE APPROACH PANELS

Furnish all materials, labor, and equipment required to construct the bridge approach panel(s) detailed in the plans. Perform the work in accordance with all applicable provisions of 2406, "Bridge Approach Panels," the referenced standard details, and the following:

Use the next paragraph ONLY when bridge is open to traffic.

Schedule and perform approach panel construction in a manner consistent with the required traffic provisions.

SB- Use the following preformed material utilized for sealing the E8 expansion joints or an approved equal:

(A) "Pressure-Relief® (Ceramar®)" as marketed by the W.R. Meadows, Inc., P.O. Box 338, Hampshire, IL 60140. http://www.wrmeadows.com

(B) "EVA-SEAL®" manufactured by E-Poxy Engineered Materials, LLC, 10 Broadway, Albany, NY 12202. http://www.e-poxy.com

Install E8 Pressure-Relief joint material in accordance with the manufacturer's recommendations, as shown on the plans, and as follows:

(A) Expansion joint filler material used for a 4 inch [100 mm] pressure relief joint consists of a preformed foam product having minimum dimensions of 4.5 inches [115 mm] in width (may be laminated) and 8 inches [200 mm] in depth. Each section shall have a minimum length of 10 feet [3 meters]. When the concrete depth is greater than the depth of the pressure relief material, fill the void below the material with polystyrene. Install the material under compression with a lubricant adhesive applied to the concrete contact surfaces.

(B) Saw or form the joints 4 inches [100 mm] wide by the full-depth of the slab. Inspect to assure that the inside walls of the joint have been sandblasted, are dry, smooth and free of debris and loose particles. Apply tape to the top 1 inch [25 mm] of the inside walls to prevent the lubricant adhesive from contaminating the concrete bonding surfaces of the subsequently placed hot pour joint sealer.

(C) Paint the inside walls of the joint with lubricant adhesive at the rate of approximately 1 gallon per 50 lineal feet [1 liter per 4 meters] of joint.

(D) Pinch the bottom of the material together and push down into the joint. Walk the material down into the joint. When butting two pieces together, paint the ends with lubricant adhesive.

(E) Install the foam relief joint material so that the top surface is depressed to a depth of approximately **7/8 inch** [22 mm] below the concrete surface. After proper installation, remove the tape and fill the void on top of the foam material with approximately 1/2 inch [13 mm] of 3723, "Hot-Poured, Elastic Type Joint and Crack Sealer," or 3725, "Hot-poured, Extra Low Modulus, Elastic Type Joint and Crack Sealer," hot pour joint sealer to a level of 3/8 inch ±1/4 inch [9.5 mm ± 6.3 mm] below the surface. The hot joint sealer should only slightly melt into the foam pressure relief joint material. To prevent excessive melting of the joint material, place the hot-pour sealer at the lower end of the temperature specification. Check for correct temperature by placing hot pour sealer on a sample of waste foam material.

The Engineer will measure the surface of the concrete to top of finished hot-pour. The Engineer will allow a ±1/4 inch [6.3 mm] deviation from the required 3/8 inch [10 mm]. Remove and replace unacceptable work as directed by the Engineer.

If the Engineer does not direct the removal and replacement of the unacceptable work, the Contractor may leave the work in-place and the Engineer will adjust the contract unit price by 50 percent.

Use the next paragraph when required.

At locations where the Bridge Approach Treatment is deleted, all additional backfill work required to permit construction of the bridge approach panel will be incidental work for which no direct payment will be made.

Payment for Item No. 2406.553 "BRIDGE APPROACH PANELS", at the Contract price per square yard [square meter] and shall be compensation in full for all related work described in 2406, "Bridge Approach Panels," and above as complete in place.

Payment for Item No. 2406.531 "EXPANSION JOINTS, DESIGN E8H", at the Contract price per linear foot [meter] and shall be compensation in full for all related work described in 2406, "Bridge Approach Panels," and above as complete in place.

SB- **(2433) STRUCTURE RENOVATION**

The provisions of 2433, "Structure Renovation," are supplemented with the following:

SB- Structure Removals

Remove and dispose of _____

_____.

SB- Scarify Bridge Deck

UAR

Scarify the bridge roadway slab(s) in accordance with the following:

For the following paragraph, insert section number for "Remove Slab".

Ensure scarifying equipment complies with the requirements of SB-__(1)__.

UAR

Ensure scarifying of the bridge roadway slab(s) removes at least ½ inch [13 mm] of concrete.

Measurement will be by the area, in ft^2 [m^2], based on the bridge roadway dimensions between gutterlines and from end of slab to end of slab.

Select ONE of the two following paragraphs.

Payment for scarifying the bridge deck and disposal of the scarified material will be made as Item No. 2433.618 "SCARIFY BRIDGE DECK" at the contract price per ft^2.

Payment for scarifying the bridge deck and disposal of the scarified material will be made as Item No. 2433.604 "SCARIFY BRIDGE DECK" at the contract price per m^2.

SB- Scarify Concrete Approaches

Scarify the concrete approaches in accordance with the following:

For the following paragraph, insert section number for "Remove Slab".

Ensure scarifying equipment complies with the requirements of SB-__(1)__.

Scarify the area of the approaches, designated for concrete approach tapers, to remove at least ½ inch [13 mm] of concrete. Continue concrete removal below the ½ inch [13 mm] minimum to the extent necessary to place the approach taper concrete to a thickness of not less than 1½ inches [38 mm].

Measurement will be by the area, in ft^2 [m^2], based on the limits of scarification shown in the plans or as directed by the Engineer.

Select ONE of the two following paragraphs.

Payment for scarifying the bridge approaches and disposal of scarified material will be made as Item No. 2433.618 "SCARIFY CONCRETE APPROACHES" at the Contract price per ft^2.

Payment for scarifying the bridge approaches and disposal of scarified material will be made as Item No. 2433.604 "SCARIFY CONCRETE APPROACHES" at the Contract price per m^2.

SB- Scarify Bituminous Approaches

Scarify designated areas of the bituminous approaches in accordance with the following:

For the following paragraph, insert section number for "Remove Slab".

Ensure scarifying equipment complies with the requirements of SB-__(1)__.

Ensure scarifying of the bituminous approach areas designated removes sufficient material to assure that the new bituminous tapers will have a thickness of not less than 1 inch [25 mm]. Make the transverse edge at the end of the scarification nearly vertical.

Measurement will be by the area, in ft^2 [m^2], based on the limits of scarification shown in the plans or as directed by the Engineer.

Select ONE of the two following paragraphs.

Payment for scarifying the designated areas of the bituminous approaches and the disposal of the scarified material will be made as Item No. 2433.618 "SCARIFY BITUMINOUS APPROACHES" at the Contract price per ft^2.

Payment for scarifying the designated areas of the bituminous approaches and the disposal of the scarified material will be made as Item No. 2433.604 "SCARIFY BITUMINOUS APPROACHES" at the Contract price per m^2.

Designer Note: Insert "SB2433.1MONO" or "SB2433.1WC" in this location.

SB- Deck Drain Protection

Keep the inplace deck drains in place in the completed work and protect from damage during repair operations.

For the following paragraph, Use As Required.

Raise the drain grates on Bridge No. _____ as necessary to fit the roadway surface of the completed wearing course. Galvanize new bolts per 3392, "Galvanized Hardware". Galvanize new plates or shims per 3394, "Galvanized Structural Shapes".

For the following paragraph, Use As Required.

Support the grate in the raised position using a device or method that is satisfactory to the Engineer.

For the following paragraph, Use As Required.

Block the deck drain openings above the drain while the wearing course is being placed.

Slope the wearing course to drain for all drains.

UAR

Protecting the drain, (raising the drain grates,) (blocking out the drain,) and sloping the wearing course as necessary to drain will be considered to be incidental expense for which no direct compensation will be made.

SB- Drain Extensions

Furnish all materials and labor required to extend the deck drains as shown in the plans and perform in accordance with 2402, "Steel Bridge Construction," and the following:

All structural steel must meet the requirements of 3306, "Low-Carbon Structural Steel". Bolts must meet the requirements of 3391.2.A, "Requirements".

UAR

If the drains are welded, bevel the contact edge of the extensions 45 degrees. Repair galvanizing after welding per 2471.3.L.1, "Galvanizing". (In addition, use electrodes with high nickel content, ENiFeCI (55% Ni), or approved equal to ensure an adequate weld to cast iron.)

Galvanize all materials per 3392, "Galvanized Hardware," or 3394, "Galvanized Structural Shapes, whichever is applicable.

UAR

See SB-_____ for approved bolt anchorages for attaching (the drains) (or) (the bent plates) to the girder web. The detailed locations of the bolt anchors are approximate. The Engineer will determine final anchorage locations to ensure that inplace reinforcement will not be damaged by these operations.

Measurement will be made by the number of drain extensions placed.

Payment will be made as Item No. 2433.602 "EXTEND FLOOR DRAIN _____", at the Contract price per each.

SB- Reconstruct Expansion Joints

Provide all labor, materials, and equipment required to reconstruct the expansion joint openings as indicated in the plans and in accordance with 2401, "Concrete Bridge Construction," and the following:

Remove and dispose of concrete in accordance with the requirements of SB-_____ "Remove Slab" unless otherwise directed by the Engineer.

Completely remove all inplace joint material or joint forming materials, and all other incompressible materials that would impede the subsequent expansion device from performing throughout the full anticipated range of movement.

For new concrete use Mix No. 3Y33 or 3Y37.

Bond the new concrete to the inplace concrete with the same bonding grout used for placement of the concrete wearing course.

Brush or scrub the grout into the inplace concrete immediately prior to placement of new concrete.

Wet-cure new concrete in accordance with 2401.3.G, "Concrete Curing and Protection," until the concrete has reached 45% of the anticipated compressive strength. Derive all strength gain percentages from the strength gain chart in Table 2401-1. The Engineer may allow control cylinders to be used to determine required strength gain, but in no case will any curing be considered completed in less than 72 hours.

UAR

Measure expansion joint reconstruction by length, in linear feet [meters], based on the distance along the centerline of the joint opening from (face of rail to face of rail) (edge of slab to edge of slab).

Select ONE of the two following paragraphs.

Payment for Item No. 2433.603, "RECONSTRUCT EXPANSION JOINT TYPE _____", at the contract price per linear foot shall be compensation in full for performing all work described above, including all slab forming (and reinforcement bars) required.

Payment for Item No. 2433.603, "RECONSTRUCT EXPANSION JOINT TYPE _____", at the contract price per linear meter shall be compensation in full for performing all work described above, including all slab forming (and reinforcement bars) required.

SB- **Reconstruct Fixed Joints**

UAR

Provide all labor, materials, and equipment required to (reconstruct) (eliminate) the fixed joints as indicated in the plans and in accordance with 2401, "Concrete Bridge Construction," and the following:

Remove and dispose of concrete in accordance with the requirements of SB-_____ "Remove Slab" unless otherwise directed by the Engineer.

For new concrete use Mix No. 3Y33 or 3Y37.

Bond the new concrete to the inplace concrete with the same bonding grout used for placement of the concrete wearing course.

Brush or scrub the grout into the inplace concrete immediately prior to placement of new concrete.

Wet-cure new concrete in accordance with 2401.3.G, "Concrete Curing and Protection," until the concrete has reached 45% of the anticipated compressive strength. Derive all strength gain percentages from the strength gain chart in Table 2401-1. The Engineer may allow control cylinders to be used to determine required strength gain, but in no case will any curing be considered completed in less than 72 hours.

UAR

Measure fixed joint reconstruction by length, in linear feet [meters], based on the distance along the centerline of the joint from (gutterline to gutterline) (face of rail to face of rail) (edge of slab to edge of slab).

Select ONE of the two following paragraphs.

Payment for Item No. 2433.603, "RECONSTRUCT FIXED JOINT TYPE _____", at the contract price per linear foot shall be compensation in full for performing all work described above, including any slab forming and reinforcement bars required.

Payment for Item No. 2433.603, "RECONSTRUCT FIXED JOINT TYPE _____", at the contract price per linear meter shall be compensation in full for performing all work described above, including any slab forming and reinforcement bars required.

SB- **Reconstruct Expansion Joint Devices**

Provide all labor, materials, and equipment required to raise the inplace expansion joint devices as indicated in the plans and in accordance with 2401, "Concrete Bridge Construction," 2402, "Steel Bridge Construction," and the following:

Remove and dispose of concrete in accordance with the requirements of SB-_____ "Remove Slab" unless otherwise directed by the Engineer.

Completely remove all joint forming materials and all other incompressible materials that would impede the subsequent expansion device from performing throughout the full anticipated range of movement.

For new concrete use Mix No. 3Y33 or 3Y37.

Bond the new concrete to the inplace concrete with the same bonding grout used for placement of the concrete wearing course.

Brush or scrub the grout into the inplace concrete immediately prior to placement of new concrete.

Wet-cure new concrete in accordance with 2401.3.G, "Concrete Curing and Protection," until the concrete has reached 45% of the anticipated compressive strength. Derive all strength gain percentages from the strength gain chart in Table 2401-1. The Engineer may allow control cylinders to be used to determine required strength gain, but in no case will any curing be considered completed in less than 72 hours.

UAR

Measure raising expansion joints by length in meters based on the distance along the centerline of the joint from (face of rail to face of rail) (edge of slab to edge of slab).

Select ONE of the two following paragraphs.

Payment for Item No. 2433.603, "RECONSTRUCT EXPANSION JOINT TYPE _____", at the contract price per linear foot shall be compensation in full for performing all work described above, including any slab forming (and reinforcement bars) required.

Payment for Item No. 2433.603, "RECONSTRUCT EXPANSION JOINT TYPE _____",.at the contract price per linear meter shall be compensation in full for performing all work described above, including any slab forming (and reinforcement bars) required.

SB- Grease Expansion Bearing Assemblies

Jack the bridge and clean and grease the lubricated bronze sliding expansion bearings at _____.

UAR

Jack the bridge uniformly about ½ inch [13 mm] to permit the cleaning and greasing of the bearings. Perform jacking to provide access for greasing in a manner that will not damage the structure or any utility conduits crossing the expansion joint openings. Remove the expansion device cover plates (before the wearing course is placed). Submit the proposed jacking scheme to the Engineer for review and approval.

On bearings having grease zerks, jack to relieve pressure on the sliding surfaces and then apply grease using a grease gun.

Use Department-approved grease from the "Approved/Qualified Product List for Bridge Products, Bridge Bearing Lubricant" (http://www.dot.state.mn.us/products). For products not on the Department's prequalified list, provide information as required on the web site.

Each bearing greased will be paid for under Item No. 2433.602 "GREASE EXP BEARING ASSEMBLIES", at the Contract price per each.

SB- Reconstruct Pavement Joints

Provide all labor, materials, and equipment required to reconstruct the pavement joints as indicated in the plans and in accordance with 2401, "Concrete Bridge Construction," and the following:

Perform concrete removal and disposal in accordance with the requirements of SB-_____ "Remove Slab" unless otherwise directed by the Engineer.

For the following paragraph, Use As Required.

For preformed joint filler material for the 4 inch [100 mm] relief joints, use "Pressure Relief" as distributed by W. R. Meadows, Inc., "Eva Seal" manufactured by Epoxy Industries, Inc., or an approved equal.

For the following paragraph, Use As Required.

Perform installation of joint filler material in the 4 inch [100 mm] relief joint in accordance with the manufacturer's recommendations, a copy of which must be supplied with the joint material. At completion of the work, securely bond or compress the relief joint material in the joint cavity so as to resist entrance of moisture and foreign material, and so as to resist ejection from or depression into the joint recess. If the joint filler material does not bottom on the pavement base, adjust the height by inserting a rigid polystyrene or polyurethane foam spacer. Spacer material must be readily compressible.

For new concrete use Mix No. 3Y33 or 3Y37.

Bond the new concrete to the inplace concrete with the same bonding grout used for placement of the concrete wearing course.

Brush or scrub the grout into the inplace concrete immediately prior to placement of new concrete.

Wet-cure new concrete in accordance with 2401.3.G, "Concrete Curing and Protection," until the concrete has reached 45% of the anticipated compressive strength. Derive all strength gain percentages from the strength gain chart in MnDOT Table 2401-1. The Engineer may allow control cylinders to be used to determine required strength gain, but in no case will any curing be considered completed in less than 72 hours.

UAR

Measure pavement joint reconstruction by length, in meters, based on the distance along the centerline of the joint opening from (gutterline to gutterline) (_____).

Select ONE of the two following paragraphs.

Payment for Item No. 2433.603, "RECONSTRUCT PAVEMENT JOINT TYPE_____", at the contract price per linear foot shall be compensation in full for performing all work described above, including any forming (and reinforcement bars) required.

Payment for Item No. 2433.603, "RECONSTRUCT PAVEMENT JOINT TYPE_____", at the contract price per linear meter shall be compensation in full for performing all work described above, including any forming (and reinforcement bars) required.

SB2014-2433.1Mono

Use on jobs where bridge decks being renovated is monolithic.

CREATED 12/12/2014

REVISED 12/12/2014

Designer may choose to delete either: figure and associated description for Type A, B, & C deck repairs, or figure and description for Type D, E, & F deck repairs according to repair methods used on Project.

SB- Remove and Patch Monolithic Slab

Repair Type *Materials*

* Concrete mix 3U17A permitted if depth from top of roadway to bottom of total patch is less than 4 in [100 mm]. Otherwise use concrete mix 3Y36 from the bottom of patch up to the bottom of the concrete wearing course.

** Alternatively, overpour the patch and grind the surface to a smoothness tolerance of 1/8 inch in 10 ft [3 mm in 3 m] after wet cure has been completed.

Figures above demonstrate special provision intent. If there is a discrepancy, all written special provisions below these figures supersede the guidance given within the figure shown.

A. Description of Work

Remove and repair concrete bridge deck surfaces, in accordance with the applicable provisions of 2433, "Structure Renovation," the plans and the following:

B. Removal Requirements

After traffic control has been established, the Engineer will sound the deck and identify removal locations by defining the areas for repair. Remove only that portion of the deck that has been defined for repair by the Engineer.

Restrict removal to methods which, in the Engineer's judgment, will not damage the structure.

Restrictions for the power equipment:

1. Perform removal with power equipment which has previously demonstrated satisfactory performance on the type of work for which it is to be used. If permitted by the Engineer, use newly developed power equipment on a performance basis, but discontinue such usage if so directed by the Engineer.

2. Do not use jack-hammers heavier than a nominal 30 pound [14 kg] class for removal above the top layer of reinforcement; except that the Engineer may permit the use of up to a nominal 60 pound [27 kg] hammer by individual operators on a performance basis, but discontinue such usage if the Engineer determines that the heavier hammers are creating additional delamination, or that they are not being used with proper discretion.

3. Pointed bits for jack-hammers are not permitted except in areas where full depth removal is specifically defined by the Engineer.

4. Do not use jack-hammers heavier than a nominal 15 pound [7 kg] class for removal below the top layer of reinforcing bars unless full depth removal is specifically defined by the Engineer.

Ensure that the edges of all removal areas are near vertical and clean immediately before placing the concrete patching mix.

After removal operations are completed, clean the removal area of all remaining loose concrete by sandblasting. Clean exposed reinforcing bars by sandblasting to remove loose rust. Tightly adherent rust and mill scale may remain on the surface. Remove spent sand and debris.

Follow provisions of SB-_____ 1717, "Air, Land, and Water Pollution," as supplemented in these Special Provisions, referring to MPCA Rule 7011.0150 (http://www.pca.state.mn.us) as it relates to sandblasting and or concrete removal operations.

Leave all deck reinforcement steel in place as it was before concrete removal, unless otherwise directed by the Engineer. Repair and/or replace all reinforcement bars damaged by Contractor's operations, as directed by the Engineer. All costs incurred are considered incidental expenses for which no direct compensation will be made.

Use this paragraph when authorized by the Regional Construction Engineer.

Augment inplace reinforcement displaying loss of more than _____% of cross sectional area with additional reinforcement as directed by the Engineer.

All damage to other portions of the structure which are to remain inplace which is due to the removal operations will be repaired. All costs incurred are considered incidental expenses for which no direct compensation will be made.

Do not perform removal in any area until the perimeters for removal in that area have been defined by the Engineer for that type of removal.

Dispose of all materials removed in accordance with 2104.3.C, "Removal Operations".

SB- **Remove and Patch Slab, Type A (With New Concrete Wearing Course)**

Use if wearing course is being placed on the Entire Deck

Perform work in accordance with the requirements of SB- _____. Remove and dispose of portions of the bridge surface to the depth of the top of the bottom bars in the top mat of reinforcement. (In extensive areas of Type A removal, this removal will be considered to be accomplished when 80% of these bars are exposed in any 100 ft^2 [9 m^2] area.) The Engineer may require additional removal of deteriorated concrete below the top of these bars but only to the extent that the additional removal can be performed by sandblasting. (Removal below these limits, if required by the Engineer, will be measured and paid for separately under "Remove and Patch Slab, Type B" SB- _____.)

Patch the area after removals have been completed, damaged reinforcement has been repaired or replaced, and areas inspected. Furnish, place, finish, and cure concrete for partial depth patches. Perform work in accordance with 2401, "Concrete Bridge Construction," and the following:

Bond the patching concrete to the inplace concrete per 2404.2.B, "Bonding Grout". Brush or scrub the grout into the inplace concrete immediately prior to placement of patching concrete.

For patches that will be 4 in [100 mm] or more from the bottom of repair to the top of the deck use the patching concrete mix 3Y36 to fill up to the bottom of the future wearing course and concrete mix 3U17A for a depth matching the inplace concrete wearing course. For repairs less than 4 in [100 mm] in depth fill with concrete mix 3U17A during wearing course placement. Strike off the concrete at the approximate level of the surrounding concrete and internally vibrate. Roughen, groove or serrate the surface of the patches to the extent – and by methods and equipment – approved by the Engineer.

Use the next paragraph for typical applications. Use 72 hours unless 24 hours is recommended by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection." to the greatest duration possible (up to 7 calendar days). In all cases, wet cure until the concrete has reached 45% of the anticipated compressive strength, but no less than 24, 72 hours. Derive all strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A.

Use this paragraph when authorized by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection," to the greatest duration possible (up to 7 calendar days). In all cases, wet cure to the greater of 20 hours or until the concrete has reached 45% of the anticipated compressive strength. Derive strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A.

Use this paragraph when authorized by the Regional Construction Engineer.

Where the Plan indicates high early strength concrete, or as otherwise required to meet staging and traffic control requirements, propose a compatible patching mix, subject to the approval of the Engineer. Use of high early strength concrete mix or contractor designed high early strength concrete mix is subject to the approval of the Engineer and the proposed area shall not exceed 5% of the bridge deck area. If proposing a patching mix ensure it is cementitious based and that it closely matches the cement content and aggregate size of the surrounding concrete wearing course. Submit test results of the proposed patching mix that show:

1. Shrinkage, when performed in accordance with ASTM C157 "Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete," is not to be greater than .040 percent at 28 calendar days,
2. Relative dynamic modulus of 95% or better when tested for freeze/thaw resistance in accordance with ASTM C 666A,
3. Chloride ion permeability test results according to ASTM C1202, "Standard Test Method for Electrical Induction of Concrete's Ability to Resist Chloride Ion Penetrating," and

4. Predicted strength gain chart for proposed mix. Expected concrete strength prior to opening to traffic is 3000 psi minimum with the anticipated cure time and temperatures.

Use this next paragraph when authorized by the Regional Construction Engineer.

Where an Epoxy Chip Seal Wearing Course is to be placed over patches in less than 28 calendar days from time of placement, demonstrate material compatibility at an offsite area prior to production use. Make the test area (i.e. patch qualification area) a minimum of 4 ft^2 [.5 m^2] milled area and have a depth between 3 in [75 mm] and 4 in [100 mm], and resultant volume of patch material between 1 and 2 ft^3 [.1 and .2 m^3]. Place and cure the patch in a manner equivalent to that proposed for production patching prior to Epoxy Chip Seal Placement. Place the proposed Epoxy Chip Seal Wearing Course over the patch area and demonstrate 250 psi adhesion through a minimum of three pull-off tests per ASTM C 1583, "Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)." At least 90% of pull-off tests must meet the tension test in order to place the Epoxy Chip Seal Wearing Course over patches matching the proposed curing and age. No separate payment will be issued for testing and qualifying contractor-proposed mixes with the Epoxy Chip Seal Wearing Course.

Use this paragraph if allowing less than 72 hours wet cure of patches.

When High Early Strength Concrete or High Early Contractor Mixes are used, immediately after completion of the finishing operations, cover the concrete with pre-wetted burlap and insulated curing blankets (to retain heat and speed hydration) for a minimum curing period of 20 hours. Where a contractor mix is used, propose a curing process, subject to the approval of the Engineer. The Engineer may allow control cylinders to be used to determine required strength gain, but in no case will curing be considered completed in less than 20 hours.

A. Method of Measurement

The Engineer will measure the repaired area based on the actual surface dimensions as defined earlier, and include only those areas where the repair does not extend below the bottom bar in the top mat.

B. Basis of Payment

The contract unit price for *Remove and Patch Slab, Type A*, includes: removal, furnishing, placing, finishing, grinding, and curing the concrete for partial depth patches complete in place, cleaning of reinforcement bars, clean-up & disposal of all materials removed from deck, and all other items needed to complete the patch will be considered incidental to item.

Payment will be made as Item 2433.618 "REMOVE AND PATCH SLAB TYPE A" at the Contract price per ft^2 [m^2], complete in place. **Payment will only be made for one type of repair for each ft^2 [m^2] area satisfactorily repaired**.

SB- Remove and Patch Slab, Type B (With New Concrete Wearing Course)

Use if wearing course is being placed on the Entire Deck

Perform work in accordance with the requirements of SB- _____. Remove and dispose of portions of the bridge slab which the Engineer specifically designates for Type B removal, after Type A removal has been performed. Type B removal includes all removal which the Engineer designates after the Type A removal is completed but which is not full depth removal. The minimum depth of Type B removal is ¾ in [19 mm] below the bottom of the bottom bars in the top mat of reinforcement and the maximum depth of Type B removal is to within 1 in [25 mm] of the top bar of the of the bottom mat. Any removals exposing more than 10% of the bottom mat are Type C Removals.

Use the following statement for box girder bridges that are not post-tensioned. Designer to modify limits as required.

Restrict Type B removal on box girder bridges to areas of 10 ft^2 [1 m^2] or less in a 2 ft [600 mm] maximum width longitudinal stripe.

After removals have been completed and damaged reinforcement has been repaired or replaced, patch the slab. This work consists of furnishing, placing, finishing and curing concrete for partial depth patches. Perform work in accordance 2401, "Concrete Bridge Construction," and the following:

Bond the patching concrete to the inplace concrete per 2404.2.B, "Bonding Grout." Brush or scrub the grout into the inplace concrete immediately prior to placement of patching concrete.

Use the patching concrete mix 3Y36 (with the maximum dosage of approved water reducer as permitted by the Department's Concrete Manual) for the portion of the patch below the bottom of the future wearing course. Fill the area to be repaired above the bottom of the future wearing course with concrete mix 3U17A. At Contractors option, if total thickness of repair is less than 4 in [100 mm], then repair can be made with a single pour of 3U17A during wearing course replacement. Strike off the concrete at the approximate level of the surrounding concrete and internally vibrate. Roughen, groove or serrate the surface of the patches to the extent – and by methods and equipment – approved by the Engineer.

Use the next paragraph for typical applications. Use 72 hours unless 24 hours is recommended by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection." to the greatest duration possible (up to 7 calendar days). In all cases, wet cure until the concrete has reached 45% of the anticipated compressive strength, but no less than 24, 72 hours. Derive all strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A.

Use this paragraph when authorized by the Regional Construction Engineer.

Where the Plan indicates high early strength concrete, or as otherwise required to meet staging and traffic control requirements, propose a compatible patching mix, subject to the approval of the Engineer. Use of high early strength concrete mix or contractor designed high early strength concrete mix is subject to the approval of the Engineer and the proposed area shall not exceed 5% of the bridge deck area. If proposing a patching mix ensure it is cementitious based and that it closely matches the cement content and aggregate size of the surrounding concrete wearing course. Submit test results of the proposed patching mix that show:

1. Shrinkage, when performed in accordance with ASTM C157 "Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete," is not to be greater than .040 percent at 28 calendar days,
2. Relative dynamic modulus of 95% or better when tested for freeze/thaw resistance in accordance with ASTM C 666A,
3. Chloride ion permeability test results according to ASTM C1202, "Standard Test Method for Electrical Induction of Concrete's Ability to Resist Chloride Ion Penetrating," and
4. Predicted strength gain chart for proposed mix. Expected concrete strength prior to opening to traffic is 3000 psi minimum with the anticipated cure time and temperatures.

Use this paragraph when authorized by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection", to the greatest duration possible (up to 7 calendar days). In all cases, wet cure to the greater of 20 hours or until the concrete has reached 45% of the anticipated compressive strength. Derive strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A.

Use this next paragraph when authorized by the Regional Construction Engineer.

Where an Epoxy Chip Seal Wearing Course is to be placed over patches in less than 28 calendar days from time of placement, demonstrate material compatibility at an offsite area prior to production use. Make the test area (i.e. patch qualification area) a minimum of 4 ft^2 [.5 m^2] milled area and have a depth between 3 in [75 mm] and 4 in [100 mm], and resultant volume of patch material between 1 and 2 ft^3 [.1 and .2 m^3]. Place and cure the patch in a manner equivalent to that proposed for production patching prior to Epoxy Chip Seal Placement. Place the proposed Epoxy Chip Seal Wearing Course over the patch area and demonstrate 250 psi adhesion through a minimum of three pull-off tests per ASTM C 1583, "Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)." At least 90% of pull-off tests must meet the tension test in order to place the Epoxy Chip Seal Wearing Course over patches matching the proposed curing and age. No separate payment will be issued for testing and qualifying contractor-proposed mixes with the Epoxy Chip Seal Wearing Course.

Use this paragraph if allowing less than 72 hours wet cure of patches.

When High Early Strength Concrete or High Early Contractor Mixes are used, immediately after completion of the finishing operations, cover the concrete with pre-wetted burlap and insulated curing blankets (to retain heat and speed hydration) for a minimum curing period of 20 hours. Where a contractor mix is used, propose a curing process, subject to the approval of the Engineer. The Engineer may allow control cylinders to be used to determine required strength gain, but in no case will any curing be considered completed in less than 20 hours.

A. Method of Measurement

The Engineer will measure the repaired area based on the actual surface dimensions as defined earlier, and include only those areas where the removal was specifically authorized to extend below the top layer of deck reinforcement and the **removals were made with a 15 pound class hammer.**

B. Basis of Payment

The contract unit price for *Remove and Patch Slab, Type B*, includes: removal, furnishing, placing, finishing, grinding, and curing the concrete for partial depth patches complete in place, cleaning of reinforcement bars, clean-up & disposal of all materials removed from deck, and all other items needed to complete the patch will be considered incidental to item.

Payment will be made as Item 2433.618 "REMOVE AND PATCH SLAB TYPE B" at the Contract price per ft^2 [m^2], complete in place. **Payment will only be made for one type of repair for each ft^2 [m^2] area satisfactorily repaired**.

SB- Remove and Patch Slab, Type C (Full Depth Slab Removal and Patching with New Concrete Wearing Course)

Use if wearing course is being placed on the Entire Deck

Perform work in accordance with the requirements of SB-_____. Remove and dispose of portions of the bridge slab which the Engineer specifically designates for full depth removal, after Type A and Type B removals have been performed. Provide formwork, furnish, place, cure, and grind concrete for full depth patches in the bridge slab. Perform work in accordance with 2401, "Concrete Bridge Construction," and the following:

Bond the patching concrete to the inplace concrete per 2404.2.B, "Bonding Grout." Brush or scrub the grout into the inplace concrete immediately prior to placement of patching concrete.

Use the patching concrete mix 3Y36 (with the maximum dosage of approved water reducer as permitted by the Department's Concrete Manual) to fill up to the bottom of the future concrete wearing course. Strike off the 3Y36 concrete and internally vibrate. Roughen, groove or serrate the surface of the full depth patches to the extent – and by methods and equipment – approved by the Engineer.

Use the next paragraph for typical applications. Use 72 hours unless 24 hours is recommended by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection," to the greatest duration possible (up to 7 calendar days). In all cases, wet cure until the concrete has reached 45% of the anticipated compressive strength , but for no less than 24, 72 hours. Derive strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A.

Use this paragraph when authorized by the Regional Construction Engineer.

Where the Plan indicates high early strength concrete, or as otherwise required to meet staging and traffic control requirements, propose a compatible patching mix, subject to the approval of the Engineer. Use of high early strength concrete mix or contractor designed high early strength concrete mix is subject to the approval of the Engineer and the proposed area shall not exceed 5% of the bridge deck area. If proposing a patching mix ensure it is cementitious based and that it closely matches the cement content and aggregate size of the surrounding concrete wearing course. Submit test results of the proposed patching mix that show:

1. Shrinkage, when performed in accordance with ASTM C157 "Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete," is not to be greater than .040 percent at 28 calendar days,
2. Relative dynamic modulus of 95% or better when tested for freeze/thaw resistance in accordance with ASTM C 666A,
3. Chloride ion permeability test results according to ASTM C1202, "Standard Test Method for Electrical Induction of Concrete's Ability to Resist Chloride Ion Penetrating," and
4. Predicted strength gain chart for proposed mix. Expected concrete strength prior to opening to traffic is 3000 psi minimum with the anticipated cure time and temperatures.

Use this paragraph where authorized by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection," to the greatest duration possible (up to 7 calendar days). In all cases, wet cure to the greater of 20 hours or until the concrete has reached 45% of the anticipated compressive strength. Derive strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A.

Use this next paragraph when authorized by the Regional Construction Engineer.

Where an Epoxy Chip Seal Wearing Course is to be placed over patches in less than 28 calendar days from time of placement, demonstrate material compatibility at an offsite area prior to production use. Make the test area (i.e. patch qualification area) a minimum of 4 ft^2 [.5 m^2] milled area and have a depth between 3 in [75 mm] and 4 in [100 mm], and resultant volume of patch material between 1 and 2 ft^3 [.1 and .2 m^3]. Place and cure the patch in a manner equivalent to that proposed for production patching prior to Epoxy Chip Seal Placement. Place the proposed Epoxy Chip Seal Wearing Course over the patch area and demonstrate 250 psi adhesion through a minimum of three pull-off tests per ASTM C 1583, "Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)." At least 90% of pull-off tests must meet the tension test in order to place the Epoxy Chip Seal Wearing Course over patches matching the proposed curing and age. No separate payment will be issued for testing and qualifying contractor-proposed mixes with the Epoxy Chip Seal Wearing Course.

Use this paragraph if allowing less than 72 hours wet cure of patches.

When High Early Strength Concrete or High Early Contractor Mixes are used, immediately after completion of the finishing operations, cover the concrete with pre-wetted burlap and insulated curing blankets (to retain heat and speed hydration) for a minimum curing period of 20 hours. Where a contractor mix is used, propose a curing process subject to the approval of the Engineer. The Engineer may allow control cylinders to be used to determine required strength gain, but in no case will any curing be considered completed in less than 20 hours.

Cure patches made above the top mat of reinforcement in accordance with 2404.3.E.4, "Concrete Wearing Course".

A. Method of Measurement

The Engineer will measure the repaired area based on the actual surface dimensions as defined earlier, and include only those areas specifically designated or authorized for full depth slab patching. Only areas where bottom of patch is formed will be paid for as a Type C repair. Full depth patching of areas of the slab where full depth removal was not designated or authorized by the Engineer will not be measured for payment.

B. Basis of Payment

The contract unit price for *Remove and Patch Slab, Type C*, includes: removal, furnishing, placing, finishing, grinding, and curing the concrete for full depth patches complete in place, cleaning of reinforcement bars, clean-up & disposal of all materials removed from deck, and all other items needed to complete the patch will be considered incidental to item.

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Payment will be made as Item 2433.618 "REMOVE AND PATCH SLAB TYPE C" at the Contract price per ft^2 [m^2], complete in place, and shall include all necessary slab forming. **Payment will only be made for one type of repair for each ft^2 [m^2] area satisfactorily repaired.**

SB- Remove and Patch Slab, Type D (No New Wearing Course)

Perform work in accordance with the requirements of SB- _____. Remove and dispose of portions of the bridge surface to the depth of the top of the bottom bars in the top mat of reinforcement. (In extensive areas of Type D removal, this removal will be considered to be accomplished when 80% of these bars are exposed in any 100 ft^2 [9 m^2] area.) The Engineer may require additional removal of deteriorated concrete below the top of these bars but only to the extent that the additional removal can be performed by sandblasting. (Removal below these limits, if approved by the Engineer, will be measured and paid for separately under SB- _____ "Remove and Patch Slab, Type E.")

Patch the area after removals have been completed, damaged reinforcement has been repaired or replaced, and areas inspected. This work shall consist of furnishing, placing, finishing, and curing concrete for partial depth patches. Perform work in accordance with 2401, "Concrete Bridge Construction," and the following:

Bond the patching concrete to the inplace concrete per 2404.2.B, "Bonding Grout." Brush or scrub the grout into the inplace concrete immediately prior to placement of patching concrete.

Use the patching concrete mix 3Y36 (with the maximum dosage of approved water reducer as permitted by the Department's Concrete Manual) to fill the area to be repaired. If the total thickness of repair is 4 in (100 mm) or greater, then repair must be made in two separate lifts in order for the surface to be a consistent profile. Strike off the concrete and internally vibrate. Roughen, groove or serrate the surface of the patches to the extent – and by methods and equipment – approved by the Engineer. Alternatively, the contractor may overpour the patch and grind the surface to a smoothness tolerance of 1/8 inch in 10 ft [3 mm in 3m] (after the concrete has been wet cured).

Use the next paragraph for typical applications. Use 72 hours unless 24 hours is recommended by the Regional Construction Engineer.

Wet-cure patches that extend to top of finished deck in accordance with 2401.3.G, "Concrete Curing and Protection", until concrete has reached 45% of anticipated compressive strength, but no less than 24 or 72 hours. Derive strength gain from Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5.b, "Control Strength Cylinders." For patches that don't extend to the top of deck, wet cure until the concrete has reached 45% of anticipated compressive strength, but no less than 24 hours. Allow a bottom patch to air dry for at least 4 hours before placing a concrete patch above it.

Use this section where authorized by the Regional Construction Engineer.

Where the Plan indicates high early strength concrete, or as otherwise required to meet staging and traffic control requirements, propose a compatible patching mix, subject to the approval of the Engineer. Use of high early strength concrete mix or contractor designed high early strength concrete mix shall be subject to the approval of the Engineer and the proposed area shall not exceed 5% of the bridge deck area. If proposing a patching mix, ensure it is cementitious based and that it closely matches the cement content and aggregate size of the surrounding concrete wearing course. Submit test results of the proposed patching mix that show:

1. Shrinkage, when performed in accordance with ASTM C157 "Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete," is not to be greater than .040 percent at 28 calendar days,
2. Relative dynamic modulus of 95% or better when tested for freeze/thaw resistance in accordance with ASTM C 666A,
3. Chloride ion permeability test results according to ASTM C1202, "Standard Test Method for Electrical Induction of Concrete's Ability to Resist Chloride Ion Penetration," and
4. Predicted strength gain chart for proposed mix. Expected concrete strength prior to opening to traffic is 3000 psi minimum with the anticipated cure time and temperatures.

Use this next paragraph when authorized by the Regional Construction Engineer.

Where an Epoxy Chip Seal Wearing Course is to be placed over patches in less than 28 calendar days from time of placement, demonstrate material compatibility at on offsite area prior to production use. Make the test area (i.e. Patch qualification area) a minimum of 4 ft^2 [.5 m^2] milled area and have a depth between 3 in [75 mm] and 4 in [100 mm], and resultant volume of patch material shall be between 1 and 2 ft^3 [.1 and .2 m^3]. Place and cure the patch in a manner equivalent to that proposed for production patching prior to Epoxy Chip Seal Placement. Place the proposed Epoxy Chip Seal Wearing Course over the patch area and demonstrate 250 psi adhesion through a minimum of three pull-off tests per ASTM 1583. At least 90% of pull-off tests must meet the tension test in order to place the Epoxy Chip Seal Wearing Course over patches matching the proposed curing and age. No separate payment will be issued for testing and qualifying contractor-proposed mixes with the Epoxy Chip Seal Wearing Course.

Use this paragraph if allowing less than 72 hours wet cure of patches.

When High Early Strength Concrete or High Early Contractor Mixes are used, immediately after completion of the finishing operations, cover the concrete with wet burlap and insulated curing blankets (to retain heat and speed hydration) for a minimum curing period of 20 hours. Where a contractor mix is used, propose a curing process subject to the approval of the Engineer. The Engineer may allow control cylinders to be used to determine required strength gain, but in no case will curing be considered completed in less than 20 hours.

A. Method of Measurement

The Engineer will measure the repaired area based on the actual surface dimensions as defined earlier, and include only those areas where the repair does not extend below the bottom bar in the top mat.

B. Basis of Payment

The contract unit price for *Remove and Patch Slab, Type D*, includes: removal, furnishing, placing, finishing, grinding, and curing the concrete for partial depth patches complete in place, cleaning of reinforcement bars, clean-up & disposal of all materials removed from deck, and all other items needed to complete the patch will be considered incidental to item.

Payment will be made as Item 2433.618 "REMOVE AND PATCH SLAB TYPE D" at the Contract price per ft^2 [m^2], complete in place. **Payment will only be made for one type of repair for each ft^2 [m^2] area satisfactorily repaired.**

SB- **Remove and Patch Slab, Type E (No New Wearing Course)**

Perform work in accordance with the requirements of SB- _____. Remove and dispose of that portion of the bridge slab which the Engineer specifically designates for Type E removal after Type D removal has been performed. Type E removal includes all removal which the Engineer designates after the Type D removal is completed but which is not full depth removal. The minimum depth of Type E removal is ¾ in [19 mm] below the bottom of the bottom bars in the top mat of reinforcement and the maximum depth of Type E removal is to within 1 in [25 mm] of the top bar of the of the bottom mat. Any removals exposing more than 10% of the bottom mat are Type F Removals.

Use the following statement for box girder bridges that are not post-tensioned. Designer to modify limits as required.

Restrict Type E removal on box girder bridges to areas of 10 ft^2 [1 m^2] or less in a 2 ft [600 mm] maximum width longitudinal stripe.

After removals have been completed and damaged reinforcement has been repaired or replaced, patch the slab. This work consists of furnishing, placing, finishing, and curing concrete for partial depth patches. Perform work in accordance with 2401, "Concrete Bridge Construction," and the following:

Bond the patching concrete to the inplace concrete per 2404.2.B, "Bonding Grout." Brush or scrub the grout into the inplace concrete immediately prior to placement of patching concrete.

Use the patching concrete mix 3Y36 (with the maximum dosage of approved water reducer as permitted by the Department's Concrete Manual) to fill area to be repaired. If total thickness of repair is 4 in [100 mm] or greater, then repair in two separate pours, the upper pour being at least 2 in (50 mm), but no more than 4 in (100mm) thick in order for the final surface to be a consistent profile. Strike off the concrete and internally vibrate. Roughen, groove or serrate the surface of the patches to the extent – and by methods and equipment – approved by the Engineer. As an option, use an over pour patch filled high and then ground (after the concrete has been wet-cured) to a smoothness tolerance of $^1/_8$ inch in 10 ft. [3 mm in 3 m] with inplace surface.

Use the next paragraph for typical applications. Use 72 hours unless 24 hours is recommended by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection," to the greatest duration possible (up to 7 calendar days). In all cases wet cure until the concrete has reached 45% of the anticipated compressive strength, but no less than 24, 72 hours. Derive strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing a concrete patch above it.

Use this paragraph when authorized by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection," to the greatest duration possible (up to 7 calendar days). In all cases wet cure to the greater of 20 hours or until the concrete has reached 45% of the anticipated compressive strength. Derive all strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing a concrete patch above it.

Use this paragraph if allowing less than 72 hours wet cure of patches.

When High Early Strength Concrete or High Early Contractor Mixes are used, immediately after completion of the finishing operations, cover the concrete with pre-wetted burlap and insulated curing blankets (to retain heat and speed hydration) for a minimum curing period of 20 hours. Where a contractor mix is used, propose a curing process subject to the approval of the Engineer. The Engineer may allow control cylinders to be used to determine required strength gain, but in no case will curing be considered completed in less than 20 hours.

Cure patches extending to top of finished deck in accordance with 2404.3.E.4, "Concrete Wearing Course".

A. Method of Measurement

The Engineer will measure the repaired area based on the actual surface dimensions as marked earlier, and include only those areas where the removal was specifically authorized to extend below the top layer of deck reinforcement **and the removals were made with a 15 pound class hammer.**

B. Basis of Payment

The contract unit price for *Remove and Patch Slab, Type E*, includes: removal, furnishing, placing, finishing, grinding, and curing the concrete for partial depth patches complete in place, cleaning of reinforcement bars, clean-up & disposal of all materials removed from deck, and all other items needed to complete the patch will be considered incidental to item.

Payment will be made as Item 2433.618 "REMOVE AND PATCH SLAB TYPE E," at the Contract price per ft^2 [m^2], complete in place. **Payment will only be made for one type of repair for each ft^2 [m^2] area satisfactorily repaired**.

SB- Remove and Patch Slab, Type F (No New Concrete Wearing Course)

Perform work in accordance with the requirements of SB-_____. Remove and dispose of that portion of the bridge slab which the Engineer specifically designates for full depth removal, after Type D and Type E removals have been performed. Provide formwork, furnish, place, cure, and grind concrete for full depth patches in the bridge slab. Perform work in accordance with 2401, "Concrete Bridge Construction," and the following:

Bond the patching concrete to the inplace concrete per 2404.2.B, "Bonding Grout." Brush or scrub the grout into the inplace concrete immediately prior to placement of patching concrete.

Use the patching concrete mix 3Y36 (with the maximum dosage of approved water reducer as permitted by the Department's Concrete Manual) to fill area to be repaired. If total thickness of repair is 4 in [100 mm] or greater, then repair in two separate pours, the upper pour being at least 2 in (50 mm), but no more than 4 in (100 mm) thick in order for the final surface to be a consistent profile. Strike off the 3Y36 concrete, and internally vibrate. Roughen, groove or serrate the surface of the patch to the extent – and by methods and equipment – approved by the Engineer. As an option, use an over pour patch filled high and then ground (after the concrete has been wet-cured) to a smoothness tolerance of $^1/_8$ inch in 10 ft. [3 mm in 3 m] with inplace surface.

Use the next paragraph for typical applications. Use 72 hours unless 24 hours is recommended by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection," to the greatest duration possible (up to 7 calendar days). In all cases, wet cure until the concrete has reached 45% of the anticipated compressive strength, but no less than 24, 72 hours. Derive all strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing a concrete patch above it.

Use this paragraph when authorized by the Regional Construction Engineer.

Where the Plan indicates high early strength concrete, or as otherwise required to meet staging and traffic control requirements, propose a compatible patching mix, subject to the approval of the Engineer. Use of high early strength concrete mix or contractor designed high early strength concrete mix is subject to the approval of the Engineer and the proposed area shall not exceed 5% of the bridge deck area. If proposing a patching mix ensure it is cementitious based and that it closely matches the cement content and aggregate size of the surrounding concrete wearing course. Submit test results of the proposed patching mix that show:

1. Shrinkage, when performed in accordance with ASTM C157 "Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete," is not to be greater than .040 percent at 28 calendar days,
2. Relative dynamic modulus of 95% or better when tested for freeze/thaw resistance in accordance with ASTM C 666A,

3. Chloride ion permeability test results according to ASTM C1202, "Standard Test Method for Electrical Induction of Concrete's Ability to Resist Chloride Ion Penetrating," and
4. Predicted strength gain chart for proposed mix. Expected concrete strength prior to opening to traffic is 3000 psi minimum with the anticipated cure time and temperatures.

Use this paragraph where authorized by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection," to the greatest duration possible (up to 7 calendar days). In all cases, wet cure to the greater of 20 hours or until the concrete has reached 45% of the anticipated compressive strength. Derive all strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing a concrete patch above it.

Use this next paragraph when authorized by the Regional Construction Engineer.

Where an Epoxy Chip Seal Wearing Course is to be placed over patches in less than 28 calendar days from time of placement, demonstrate material compatibility at an offsite area prior to production use. Make the test area (i.e. patch qualification area) a minimum of 4 ft^2 [.5 m^2] milled area and have a depth between 3 in [75 mm] and 4 in [100 mm], and resultant volume of patch material between 1 and 2 ft^3 [.1 and .2 m^3]. Place and cure the patch in a manner equivalent to that proposed for production patching prior to Epoxy Chip Seal Placement. Place the proposed Epoxy Chip Seal Wearing Course over the patch area and demonstrate 250 psi adhesion through a minimum of three pull-off tests per ASTM C 1583, "Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)." At least 90% of pull-off tests must meet the tension test in order to place the Epoxy Chip Seal Wearing Course over patches matching the proposed curing and age. No separate payment will be issued for testing and qualifying contractor-proposed mixes with the Epoxy Chip Seal Wearing Course.

Use this paragraph if allowing less than 72 hours wet cure of patches.

When High Early Strength Concrete or High Early Contractor Mixes are used, immediately after completion of the finishing operations, cover the concrete with pre-wetted burlap and insulated curing blankets (to retain heat and speed hydration) for a minimum curing period of 20 hours. Where a contractor mix is used, propose a curing process subject to the approval of the Engineer. The Engineer may allow control cylinders to be used to determine required strength gain, but in no case will curing be considered completed in less than 20 hours.

Wet cure patches extending to top of finished deck in accordance with 2401.3.G, "Concrete Curing and Protection".

A. Method of Measurement

The Engineer will measure the repaired area based on the actual surface dimensions as defined earlier, and include only those areas specifically designated or authorized for full depth slab patching. Only areas where bottom of patch is formed will be paid for as a Type F repair. Full depth patching of areas of the bridge slab where full depth removal was not designated or authorized by the Engineer will not be measured for payment

B. Basis of Payment

The contract unit price for *Remove and Patch Slab, Type F*, includes: removal, furnishing, placing, finishing, grinding, and curing the concrete for full depth patches complete in place, cleaning of reinforcement bars, clean-up & disposal of all materials removed from deck, and all other items needed to complete the patch will be considered incidental to item.

Payment will be made as Item 2433.618 "REMOVE AND PATCH SLAB TYPE F," at the Contract price per ft^2 [m^2], complete in place, and shall include all necessary slab forming. **Payment will only be made for one type of repair for each ft^2 [m^2] area satisfactorily repaired.**

SB2014-2433.1WC

Use on jobs where bridge decks being renovated have an inplace concrete wear course.

CREATED 12/12//2014

REVISED 3/4/2015 (1)

Designer may choose to delete either: figure and associated description for Type A, B, & C deck repairs, or figure and description for Type D, E, & F deck repairs according to repair methods used on Project.

SB- Remove and Patch Structural Slab

Repair Type *Materials*

* Concrete mix 3U17A permitted if depth from top of roadway to bottom of total patch does not exceed 4 in [100 mm]. Otherwise use concrete mix 3Y36 from the bottom of patch up to a depth between the top of the topmost bar and the bottom of the concrete wearing course.

** Alternatively, overpour the patch and grind the surface to a smoothness tolerance of 1/8inch in 10 ft [3 mm in 3 m] after wet cure has been completed.

Figures above demonstrate special provision intent. If there is a discrepancy, all written special provisions below these figures supersede the guidance given within the figure shown.

A. Description of Work

Remove and repair concrete bridge deck surfaces, in accordance with the applicable provisions of 2433, "Structure Renovation," the plans and the following:

B. Removal Requirements

After traffic control has been established, the Engineer will sound the deck and identify removal locations by defining the areas for repair. Remove only that portion of the deck that has been defined for repair by the Engineer.

Restrict removal to methods which, in the Engineer's judgment, will not damage the structure.

Restrictions for the power equipment:

1. Perform removal with power equipment which has previously demonstrated satisfactory performance on the type of work for which it is to be used. If permitted by the Engineer, use newly developed power equipment on a performance basis, but discontinue such usage if so directed by the Engineer.

2. Do not use jack-hammers heavier than a nominal 30 pound [14 kg] class for removal above the top layer of reinforcement; except that the Engineer may permit the use of up to a nominal 60 pound [27 kg] hammer by individual operators on a performance basis, but discontinue such usage if the Engineer determines that the heavier hammers are creating additional delamination, or that they are not being used with proper discretion.

3. Pointed bits for jack-hammers are not permitted except in areas where full depth removal is specifically defined by the Engineer.

4. Do not use jack-hammers heavier than a nominal 15 pound [7 kg] class for removal below the top layer of reinforcing bars unless full depth removal is specifically defined by the Engineer.

Ensure that the edges of all removal areas are near vertical and clean immediately before placing the concrete patching mix.

After removal operations are completed, clean the removal area of all remaining loose concrete by sandblasting. Clean exposed reinforcing bars by sandblasting to remove loose rust. Tightly adherent rust and mill scale may remain on the surface. Remove spent sand and debris.

Follow provisions of SB-_____ 1717, "Air, Land, and Water Pollution," as supplemented in these Special Provisions, referring to MPCA Rule 7011.0150 (http://www.pca.state.mn.us) as it relates to sandblasting and or concrete removal operations.

Leave all deck reinforcement steel in place as it was before concrete removal, unless otherwise directed by the Engineer. Repair and/or replace all reinforcement bars damaged by Contractor's operations, as directed by the Engineer. All costs incurred are considered incidental expenses for which no direct compensation will be made.

Use this paragraph when authorized by the Regional Construction Engineer.

Augment inplace reinforcement displaying loss of more than _____% of cross sectional area with additional reinforcement as directed by the Engineer.

All damage to other portions of the structure which are to remain inplace which is due to the removal operations will be repaired. All costs incurred are considered incidental expenses for which no direct compensation will be made.

Do not perform removal in any area until the perimeters for removal in that area have been defined by the Engineer for that type of removal.

Dispose of all materials removed in accordance with 2104.3.C, "Removal Operations".

SB- **Remove and Patch Slab, Type A (Where Wearing Course is being Replaced on the Entire Deck)**

Use if wearing course is being replaced on the Entire Deck

Perform work in accordance with the requirements of SB- _____. Remove and dispose of portions of the bridge surface to the depth of the top of the bottom bars in the top mat of reinforcement. (In extensive areas of Type A removal, this removal will be considered to be accomplished when 80% of these bars are exposed in any 100 ft^2 [9 m^2] area.) The Engineer may require additional removal of deteriorated concrete below the top of these bars but only to the extent that the additional removal can be performed by sandblasting. (Removal below these limits, if required by the Engineer, will be measured and paid for separately under "Remove and Patch Slab, Type B" SB- _____.)

Patch the area after removals have been completed, damaged reinforcement has been repaired or replaced, and areas inspected. Furnish, place, finish, and cure concrete for partial depth patches. Perform work in accordance with 2401, "Concrete Bridge Construction," and the following:

For patches that will be 4 in [100 mm] or more from the bottom of repair to the top of the deck use the patching concrete mix 3Y36 to fill up to the bottom of the inplace wearing course and concrete mix 3U17A for a depth matching the inplace concrete wearing course. For repairs less than 4 in [100 mm] in depth fill with concrete mix 3U17A during wearing course placement.

Bond the patching concrete to the inplace concrete per 2404.2.B, "Bonding Grout". Brush or scrub the grout into the inplace concrete immediately prior to placement of patching concrete.

Strike off the concrete at the approximate level of the surrounding concrete and internally vibrate. Roughen, groove or serrate the surface of the patches to the extent – and by methods and equipment – approved by the Engineer.

Use the next paragraph for typical applications. Use 72 hours unless 24 hours is recommended by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection," to the greatest duration possible (up to 7 calendar days). In all cases, wet cure to the greater of 24, 72 hours or until the concrete has reached 45% of the anticipated compressive strength. Derive strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A.

Use this paragraph when authorized by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection," to the greatest duration possible (up to 7 calendar days). In all cases, wet cure to the greater of 20 hours or until the concrete has reached 45% of the anticipated compressive strength. Derive strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A.

Use this paragraph when authorized by the Regional Construction Engineer.

Where the Plan indicates high early strength concrete, or as otherwise required to meet staging and traffic control requirements, propose a compatible patching mix, subject to the approval of the Engineer. Use of high early strength concrete mix or contractor designed high early strength concrete mix is subject to the approval of the Engineer and the proposed area shall not exceed 5% of the bridge deck area. If proposing a patching mix ensure it is cementitious based and that it closely matches the cement content and aggregate size of the surrounding concrete wearing course. Submit test results of the proposed patching mix that show:

1. Shrinkage, when performed in accordance with ASTM C157 "Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete," is not to be greater than .040 percent at 28 calendar days,
2. Relative dynamic modulus of 95% or better when tested for freeze/thaw resistance in accordance with ASTM C 666A,

3. Chloride ion permeability test results according to ASTM C1202, "Standard Test Method for Electrical Induction of Concrete's Ability to Resist Chloride Ion Penetrating," and
4. Predicted strength gain chart for proposed mix. Expected concrete strength prior to opening to traffic is 3000 psi minimum with the anticipated cure time and temperatures.

Use this next paragraph when authorized by the Regional Construction Engineer.

Where an Epoxy Chip Seal Wearing Course is to be placed over patches in less than 28 calendar days from time of placement, demonstrate material compatibility at an offsite area prior to production use. Make the test area (i.e. patch qualification area) a minimum of 4 ft^2 [.5 m^2] milled area and have a depth between 3 in [75 mm] and 4 in [100 mm], and resultant volume of patch material between 1 and 2 ft^3 [.1 and .2 m^3]. Place and cure the patch in a manner equivalent to that proposed for production patching prior to Epoxy Chip Seal Placement. Place the proposed Epoxy Chip Seal Wearing Course over the patch area and demonstrate 250 psi adhesion through a minimum of three pull-off tests per ASTM C 1583, "Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)." At least 90% of pull-off tests must meet the tension test in order to place the Epoxy Chip Seal Wearing Course over patches matching the proposed curing and age. No separate payment will be issued for testing and qualifying contractor-proposed mixes with the Epoxy Chip Seal Wearing Course.

Use this paragraph if allowing less than 72 hours wet cure of patches.

When High Early Strength Concrete or High Early Contractor Mixes are used, immediately after completion of the finishing operations, cover the concrete with pre-wetted burlap and insulated curing blankets (to retain heat and speed hydration) for a minimum curing period of 20 hours. Where a contractor mix is used, propose a curing process, subject to the approval of the Engineer. The Engineer may allow control cylinders to be used to determine required strength gain, but in no case will curing be considered completed in less than 20 hours.

A. Method of Measurement

The Engineer will measure the repaired area based on the actual surface dimensions as defined earlier, and include only those areas where the repair does not extend below the bottom bar in the top mat.

B. Basis of Payment

The contract unit price for *Remove and Patch Slab, Type A*, includes: removal, furnishing, placing, finishing, grinding, and curing the concrete for partial depth patches complete in place, cleaning of reinforcement bars, clean-up & disposal of all materials removed from deck, and all other items needed to complete the patch will be considered incidental to item.

Payment will be made as Item 2433.618 "REMOVE AND PATCH SLAB TYPE A" at the Contract price per ft^2 [m^2], complete in place. **Payment will only be made for one type of repair for each ft^2 [m^2] area satisfactorily repaired**.

SB- Remove and Patch Slab, Type B (Where Wearing Course is being Replaced on the Entire Deck)

Use if wearing course is being replaced on the Entire Deck

Perform work in accordance with the requirements of SB- _____. Remove and dispose of portions of the bridge slab which the Engineer specifically designates for Type B removal, after Type A removal has been performed. Type B removal includes all removal which the Engineer designates after the Type A removal is completed but which is not full depth removal. The minimum depth of Type B removal is ¾ in [19 mm] below the bottom of the bottom bars in the top mat of reinforcement and the maximum depth of Type B removal is to within 1 in [25 mm] of the top bar of the of the bottom mat. Any removals exposing more than 10% of the bottom mat are Type C Removals.

Use the following statement for box girder bridges that are not post-tensioned. Designer to modify limits as required.

Restrict Type B removal on box girder bridges to areas of 10 ft^2 [1 m^2] or less in a 2 ft [600 mm] maximum width longitudinal stripe.

After removals have been completed and damaged reinforcement has been repaired or replaced, patch the slab. This work consists of furnishing, placing, finishing and curing concrete for partial depth patches. Perform work in accordance 2401, "Concrete Bridge Construction," and the following:

Bond the patching concrete to the inplace concrete per 2404.2.B, "Bonding Grout." Brush or scrub the grout into the inplace concrete immediately prior to placement of patching concrete.

Use the patching concrete mix 3Y36 (with the maximum dosage of approved water reducer as permitted by the Department's Concrete Manual) for the portion of the patch below the bottom of the future wearing course. Fill the area to be repaired above the bottom of the future wearing course with concrete mix 3U17A. At Contractors option, if total thickness of repair is less than 4 in [100 mm], then repair can be made with a single pour of 3U17A during wearing course replacement. Strike off the concrete at the approximate level of the surrounding concrete and internally vibrate. Roughen, groove or serrate the surface of the patches to the extent – and by methods and equipment – approved by the Engineer.

Use the next paragraph for typical applications. Use 72 hours unless 24 hours is recommended by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection." to the greatest duration possible (up to 7 calendar days). In all cases, wet cure until the concrete has reached 45% of the anticipated compressive strength, but no less than 24, 72 hours. Derive all strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A.

Use this paragraph when authorized by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection", to the greatest duration possible (up to 7 calendar days). In all cases, wet cure to the greater of 20 hours or until the concrete has reached 45% of the anticipated compressive strength. Derive strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A.

Use this paragraph if allowing less than 72 hours wet cure of patches.

When High Early Strength Concrete or High Early Contractor Mixes are used, immediately after completion of the finishing operations, cover the concrete with pre-wetted burlap and insulated curing blankets (to retain heat and speed hydration) for a minimum curing period of 20 hours. Where a contractor mix is used, propose a curing process, subject to the approval of the Engineer. The Engineer may allow control cylinders to be used to determine required strength gain, but in no case will any curing be considered completed in less than 20 hours.

A. Method of Measurement

The Engineer will measure the repaired area based on the actual surface dimensions as defined earlier, and include only those areas where the removal was specifically authorized to extend below the top layer of deck reinforcement and the **removals were made with a 15 pound class hammer.**

B. Basis of Payment

The contract unit price for *Remove and Patch Slab, Type B*, includes: removal, furnishing, placing, finishing, grinding, and curing the concrete for partial depth patches complete in place, cleaning of reinforcement bars, clean-up & disposal of all materials removed from deck, and all other items needed to complete the patch will be considered incidental to item.

Payment will be made as Item 2433.618 "REMOVE AND PATCH SLAB TYPE B" at the Contract price per ft^2 [m^2], complete in place. **Payment will only be made for one type of repair for each ft^2 [m^2] area satisfactorily repaired**.

SB- **Remove and Patch Slab, Type C (Full Depth Slab Removal and Patching)**

Use if wearing course is being replaced on the Entire Deck

Perform work in accordance with the requirements of SB-_____. Remove and dispose of portions of the bridge slab which the Engineer specifically designates for full depth removal, after Type A and Type B removals have been performed. Provide formwork, furnish, place, cure, and grind concrete for full depth patches in the bridge slab. Perform work in accordance with 2401, "Concrete Bridge Construction," and the following:

Use the patching concrete mix 3Y36 (with the maximum dosage of approved water reducer as permitted by the Department's Concrete Manual) for the portion of the patch below the bottom of the inplace wearing course. Use concrete mix 3U17A for a depth matching the inplace wearing course.

Bond the patching concrete to the inplace concrete per 2404.2.B, "Bonding Grout." Brush or scrub the grout into the inplace concrete immediately prior to placement of patching concrete.

Strike off the 3Y36 concrete at the approximate lower limit of the inplace wearing course, and internally vibrate. Roughen, groove or serrate the surface of the full depth patches to the extent – and by methods and equipment – approved by the Engineer.

Use the next paragraph for typical applications. Use 72 hours unless 24 hours is recommended by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection," to the greatest duration possible (up to 7 calendar days). In all cases, wet cure until the concrete has reached 45% of the anticipated compressive strength , but for no less than 24, 72 hours. Derive strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A.

Use this paragraph where authorized by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection," to the greatest duration possible (up to 7 calendar days). In all cases, wet cure to the greater of 20 hours or until the concrete has reached 45% of the anticipated compressive strength. Derive strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A.

Use this paragraph if allowing less than 72 hours wet cure of patches.

When High Early Strength Concrete or High Early Contractor Mixes are used, immediately after completion of the finishing operations, cover the concrete with pre-wetted burlap and insulated curing blankets (to retain heat and speed hydration) for a minimum curing period of 20 hours. Where a contractor mix is used, propose a curing process subject to the approval of the Engineer. The Engineer may allow control cylinders to be used to determine required strength gain, but in no case will any curing be considered completed in less than 20 hours.

Cure patches made above the top mat of reinforcement in accordance with 2404.3.E.4, "Concrete Wearing Course".

A. Method of Measurement

The Engineer will measure the repaired area based on the actual surface dimensions as defined earlier, and include only those areas specifically designated or authorized for full depth slab patching. Full depth patching of areas of the slab where full depth removal was not designated or authorized by the Engineer will not be measured for payment.

B. Basis of Payment

The contract unit price for *Remove and Patch Slab, Type C*, includes: removal, furnishing, placing, finishing, grinding, and curing the concrete for full depth patches complete in place, cleaning of reinforcement bars, clean-up & disposal of all materials removed from deck, and all other items needed to complete the patch will be considered incidental to item.

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Payment will be made as Item 2433.618 "REMOVE AND PATCH SLAB TYPE C" at the Contract price per ft^2 [m^2], complete in place, and shall include all necessary slab forming. **Payment will only be made for one type of repair for each ft^2 [m^2] area satisfactorily repaired.**

SB- Remove and Patch Slab, Type D (Wearing Course Replacement on Patched Areas Only)

Perform work in accordance with the requirements of SB- _____. Remove and dispose of portions of the bridge surface to the depth of the top of the bottom bars in the top mat of reinforcement. (In extensive areas of Type D removal, this removal will be considered to be accomplished when 80% of these bars are exposed in any 100 ft^2 [9 m^2] area.) The Engineer may require additional removal of deteriorated concrete below the top of these bars but only to the extent that the additional removal can be performed by sandblasting. (Removal below these limits, if approved by the Engineer, will be measured and paid for separately under SB- _____ "Remove and Patch Slab, Type E.")

Patch the area after removals have been completed, damaged reinforcement has been repaired or replaced, and areas inspected. This work shall consist of furnishing, placing, finishing, and curing concrete for partial depth patches. Perform work in accordance with 2401, "Concrete Bridge Construction," and the following:

For patches that will be 4 in [100 mm] or more from the bottom of repair to the top of the deck use the patching concrete mix 3Y36 to fill up to the bottom of the inplace wearing course and concrete mix 3U17A for a depth matching the inplace concrete wearing course. Alternatively, overpour the patch with 3U17A and grind the surface to a smoothness tolerance of 1/8 inch in 10 ft [3mm in 3 m] after wet cure has been completed. For repairs that will be less than 4 in [100 mm] thick use concrete mix 3U17A.

Bond the patching concrete to the inplace concrete per 2404.2.B, "Bonding Grout." Brush or scrub the grout into the inplace concrete immediately prior to placement of patching concrete.

Strike off the concrete at the approximate level of the surrounding concrete and internally vibrate. Roughen, groove or serrate the surface of the patches to the extent – and by methods and equipment – approved by the Engineer.

Use the next paragraph for typical applications. Use 72 hours unless 24 hours is recommended by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3G, "Concrete Curing and Protection," to the greatest duration possible (up to 7 calendar days). In all cases wet cure to the greater of 24, 72 hours or until the concrete has reached 45% of the anticipated compressive strength. Derive strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A.

Cure patches extending to top of finished deck in accordance with 2404.3.E.4, "Curing Requirements".

Use this section where authorized by the Regional Construction Engineer.

Where the Plan indicates high early strength concrete, or as otherwise required to meet staging and traffic control requirements, propose a compatible patching mix, subject to the approval of the Engineer. Use of high early strength concrete mix or contractor designed high early strength concrete mix shall be subject to the approval of the Engineer and the proposed area shall not exceed 5% of the bridge deck area. If proposing a patching mix, ensure it is cementitious based and that it closely matches the cement content and aggregate size of the surrounding concrete wearing course. Submit test results of the proposed patching mix that show:

1. Shrinkage, when performed in accordance with ASTM C157 "Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete," is not to be greater than .040 percent at 28 calendar days,
2. Relative dynamic modulus of 95% or better when tested for freeze/thaw resistance in accordance with ASTM C 666A,
3. Chloride ion permeability test results according to ASTM C1202, "Standard Test Method for Electrical Induction of Concrete's Ability to Resist Chloride Ion Penetration," and
4. Predicted strength gain chart for proposed mix. Expected concrete strength prior to opening to traffic is 3000 psi minimum with the anticipated cure time and temperatures.

Use this next paragraph when authorized by the Regional Construction Engineer.

Where an Epoxy Chip Seal Wearing Course is to be placed over patches in less than 28 calendar days from time of placement, demonstrate material compatibility at on offsite area prior to production use. Make the test area (i.e. Patch qualification area) a minimum of 4 ft^2 [.5 m^2] milled area and have a depth between 3 in [75 mm] and 4 in [100 mm], and resultant volume of patch material shall be between 1 and 2 ft^3 [.1 and .2 m^3]. Place and cure the patch in a manner equivalent to that proposed for production patching prior to Epoxy Chip Seal Placement. Place the proposed Epoxy Chip Seal Wearing Course over the patch area and demonstrate 250 psi adhesion through a minimum of three pull-off tests per ASTM 1583. At least 90% of pull-off tests must meet the tension test in order to place the Epoxy Chip Seal Wearing Course over patches matching the proposed curing and age. No separate payment will be issued for testing and qualifying contractor-proposed mixes with the Epoxy Chip Seal Wearing Course.

Use this paragraph if allowing less than 72 hours wet cure of patches.

When High Early Strength Concrete or High Early Contractor Mixes are used, immediately after completion of the finishing operations, cover the concrete with wet burlap and insulated curing blankets (to retain heat and speed hydration) for a minimum curing period of 20 hours. Where a contractor mix is used, propose a curing process subject to the approval of the Engineer. The Engineer may allow control cylinders to be used to determine required strength gain, but in no case will curing be considered completed in less than 20 hours.

A. Method of Measurement

The Engineer will measure the repaired area based on the actual surface dimensions as defined earlier, and include only those areas where the repair does not extend below the bottom bar in the top mat.

B. Basis of Payment

The contract unit price for *Remove and Patch Slab, Type D*, includes: removal, furnishing, placing, finishing, grinding, and curing the concrete for partial depth patches complete in place, cleaning of reinforcement bars, clean-up & disposal of all materials removed from deck, and all other items needed to complete the patch will be considered incidental to item.

Payment will be made as Item 2433.618 "REMOVE AND PATCH SLAB TYPE D" at the Contract price per ft^2 [m^2], complete in place. **Payment will only be made for one type of repair for each ft^2 [m^2] area satisfactorily repaired.**

SB- **Remove and Patch Slab, Type E (Wearing Course Replacement on Patched Areas Only)**

Perform work in accordance with the requirements of SB- _____. Remove and dispose of that portion of the bridge slab which the Engineer specifically designates for Type E removal after Type D removal has been performed. Type E removal includes all removal which the Engineer designates after the Type D removal is completed but which is not full depth removal. The minimum depth of Type E removal is ¾ in [19 mm] below the bottom of the bottom bars in the top mat of reinforcement and the maximum depth of Type E removal is to within 1 in [25 mm] of the top bar of the of the bottom mat. Any removals exposing more than 10% of the bottom mat are Type F Removals.

Use the following statement for box girder bridges that are not post-tensioned. Designer to modify limits as required.

Restrict Type E removal on box girder bridges to areas of 10 ft^2 [1 m^2] or less in a 2 ft [600 mm] maximum width longitudinal stripe.

After removals have been completed and damaged reinforcement has been repaired or replaced, patch the slab. This work consists of furnishing, placing, finishing, and curing concrete for partial depth patches. Perform work in accordance with 2401, "Concrete Bridge Construction," and the following:

Bond the patching concrete to the inplace concrete per 2404.2.B, "Bonding Grout." Brush or scrub the grout into the inplace concrete immediately prior to placement of patching concrete.

Use the patching concrete mix 3Y36 (with the maximum dosage of approved water reducer as permitted by the Department's Concrete Manual) for the portion of the patch below the bottom of the inplace wearing course. Fill the area to be repaired above the bottom of the inplace wearing course with concrete mix 3U17A. Strike off the concrete at the approximate level of the surrounding concrete and internally vibrate. Roughen, groove or serrate the surface of the patches to the extent – and by methods and equipment – approved by the Engineer. At Contractors option, if total thickness of repair is less than 4 in [100 mm], then repair can be made with a single pour of 3U17A.

Use the next paragraph for typical applications. Use 72 hours unless 24 hours is recommended by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection," to the greatest duration possible (up to 7 calendar days). In all cases wet cure until the concrete has reached 45% of the anticipated compressive strength, but no less than 24, 72 hours. Derive strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A.

Use this paragraph when authorized by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection," to the greatest duration possible (up to 7 calendar days). In all cases wet cure to the greater of 20 hours or until the concrete has reached 45% of the anticipated compressive strength. Derive all strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A.

Use this paragraph if allowing less than 72 hours wet cure of patches.

When High Early Strength Concrete or High Early Contractor Mixes are used, immediately after completion of the finishing operations, cover the concrete with pre-wetted burlap and insulated curing blankets (to retain heat and speed hydration) for a minimum curing period of 20 hours. Where a contractor mix is used, propose a curing process subject to the approval of the Engineer. The Engineer may allow control cylinders to be used to determine required strength gain, but in no case will curing be considered completed in less than 20 hours.

Cure patches extending to top of finished deck in accordance with 2404.3.E.4, "Concrete Wearing Course".

A. Method of Measurement

The Engineer will measure the repaired area based on the actual surface dimensions as marked earlier, and include only those areas where the removal was specifically authorized to extend below the top layer of deck reinforcement **and the removals were made with a 15 pound class hammer.**

B. Basis of Payment

The contract unit price for *Remove and Patch Slab, Type E*, includes: removal, furnishing, placing, finishing, grinding, and curing the concrete for partial depth patches complete in place, cleaning of reinforcement bars, clean-up & disposal of all materials removed from deck, and all other items needed to complete the patch will be considered incidental to item.

Payment will be made as Item 2433.618 "REMOVE AND PATCH SLAB TYPE E," at the Contract price per ft^2 [m^2], complete in place. **Payment will only be made for one type of repair for each ft^2 [m^2] area satisfactorily repaired**.

SB- Remove and Patch Slab, Type F (Wearing Course Replacement on Patched Areas Only)

Perform work in accordance with the requirements of SB-_____. Remove and dispose of that portion of the bridge slab which the Engineer specifically designates for full depth removal, after Type D and Type E removals have been performed. Provide formwork, furnish, place, cure, and grind concrete for full depth patches in the bridge slab. Perform work in accordance with 2401, "Concrete Bridge Construction," and the following:

Bond the patching concrete to the inplace concrete per 2404.2.B, "Bonding Grout." Brush or scrub the grout into the inplace concrete immediately prior to placement of patching concrete.

Use the patching concrete mix 3Y36 (with the maximum dosage of approved water reducer as permitted by the Department's Concrete Manual) for the portion of the patch below the bottom of the inplace wearing course. Use concrete mix 3U17A for a depth matching the inplace wearing course.

Strike off the 3Y36 concrete at the approximate lower limit of the inplace wearing course, and internally vibrate. Roughen, groove or serrate the surface of the full depth patches to the extent – and by methods and equipment – approved by the Engineer.

Use the next paragraph for typical applications. Use 72 hours unless 24 hours is recommended by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection," to the greatest duration possible (up to 7 calendar days). In all cases, wet cure until the concrete has reached 45% of the anticipated compressive strength, but no less than 24, 72 hours. Derive all strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A

Use this paragraph where authorized by the Regional Construction Engineer.

Wet-cure the patches in accordance with 2401.3.G, "Concrete Curing and Protection," to the greatest duration possible (up to 7 calendar days). In all cases, wet cure to the greater of 20 hours or until the concrete has reached 45% of the anticipated compressive strength. Derive all strength gain percentages from the strength gain chart in Table 2401-2 or as verified by breaking control cylinders in accordance with 2461.3.G.5, "Test Methods and Specimens". Allow the bottom patch to air dry for at least 4 hours before placing the concrete wear course, 3U17A.

Use this paragraph if allowing less than 72 hours wet cure of patches.

When High Early Strength Concrete or High Early Contractor Mixes are used, immediately after completion of the finishing operations, cover the concrete with pre-wetted burlap and insulated curing blankets (to retain heat and speed hydration) for a minimum curing period of 20 hours. Where a contractor mix is used, propose a curing process subject to the approval of the Engineer. The Engineer may allow control cylinders to be used to determine required strength gain, but in no case will curing be considered completed in less than 20 hours.

Cure patches extending to top of finished deck in accordance with 2404.3.E.4, "Concrete Wearing Course".

A. Method of Measurement

The Engineer will measure the repaired area based on the actual surface dimensions as defined earlier, and include only those areas specifically designated or authorized for full depth slab patching. Full depth patching of areas of the bridge slab where full depth removal was not designated or authorized by the Engineer will not be measured for payment

B. Basis of Payment

The contract unit price for *Remove and Patch Slab, Type F*, includes: removal, furnishing, placing, finishing, grinding, and curing the concrete for full depth patches complete in place, cleaning of reinforcement bars, clean-up & disposal of all materials removed from deck, and all other items needed to complete the patch will be considered incidental to item.

Payment will be made as Item 2433.618 "REMOVE AND PATCH SLAB TYPE F," at the Contract price per ft^2 [m^2], complete in place, and shall include all necessary slab forming. **Payment will only be made for one type of repair for each ft^2 [m^2] area satisfactorily repaired.**

SB2014-2433.2

Use with jobs requiring partial or total deck removal.

CREATED 3/5/1996

REVISED 5/16/2013 (1)

SB- **Remove Concrete Bridge Deck**

UAR

Remove and dispose of the (railings, curbs, slab, bituminous wearing course and membrane, end webs and tops of wingwalls) in accordance with 2433, "Structure Renovation," the plan, and the following:

No salvage is required.

For the following 2 paragraphs, use when beams will be reused.

At the beginning of the work, demonstrate proposed method of removal in the presence of the Engineer. If the Engineer determines that continued use of the method could result in damage to structural members that are to be reused, change the removal method to one that will preclude such damage. In addition, individual workmen must be qualified to do the work and are required to use reasonable care so they do not cause damage to the said structural members. In no case use wrecking balls, Whiphammer® machines, or other similar devices for concrete removal.

Use jackhammers for slab removal from the area over the beams and up to one foot [300 mm] beyond the top edges of the beams. The Engineer may permit the use of up to 60 pound [27 kg] jackhammers by individual operators, provided they demonstrate their ability to operate the hammers without damaging the beams.

Damage due to the operations to portions of the structure that are to remain in place shall be repaired at the Contractor's expense.

For the following paragraph, use only for total deck removal.

Measurement for payment will be from out-to-out of coping and end-to-end of slab. (Wingwall removals will not be measured for payment but will be considered included in the costs of "Remove Concrete Bridge Deck.")

SB2014-2433.3

Use on all jobs requiring anchorages. EXCEPTIONS: Do not use for metal railings or chain link fences.

CREATED 4/4/1997

REVISED 5/16/2013 (5)

SB- Anchorages

Furnish and install each anchorage in accordance with the applicable requirements of 2433, "Structure Renovation," and the following:

For the following paragraph, adhesive anchors are not permitted in sustained tensile-load applications. Use As Required.

Use adhesive, cast-in-place type anchors, or mechanical anchorages unless otherwise specified in the plans.

Except when part of a proprietary anchorage assembly, use threaded rods and bolts that meet the requirements of 3385, "Anchor Rods," and 3391, "Fasteners," respectively.

Galvanize threaded rods, bolts, nuts, and washers not encased in concrete after project completion in accordance with 3392, "Galvanized Hardware," or electroplate in accordance with ASTM B 633, Type III, SC 4. As an alternate to galvanizing or electroplating, fabricate from stainless steel threaded rods, bolts, nuts, and washers which are part of a proprietary anchorage in accordance with 3391, "Fasteners".

For the following table, 5 paragraphs and Table 1 use for anchorages having ultimate pull-out strengths that are specified in the Contract and are greater than 5000 pounds [22kN].

Location	Anchor Rod Type	Bolt or Rod Diameter inches [mm]	Minimum Embedment Depth inches [mm]	Minimum Ultimate Pull-out Strength pounds [kN]

Install anchorages for which the Contract specifies an ultimate pull-out strength into sound concrete to a depth of at least six times the bolt or rod diameter, unless a different depth is specified elsewhere in the Contract. Bolt heads and/or nuts for such anchorages must be in contact with the adjacent surface and torqued to approximately 80 ft pounds [108 N·m] unless a different torque is recommended by the manufacturer. Ensure adhesive anchorages consist of a continuously threaded rod secured by an adhesive or mortar. Install anchorages in accordance with the manufacturer's recommendations and as specified in the plans.

Perform laboratory tests that include static load tests for ultimate pullout strengths on anchorage systems that are subject to tensile loads. The tests, in accordance with ASTM E 488, must be performed and certified by an independent testing laboratory. Furnish the Engineer with the test reports and the specification sheets that are prescribed by ASTM E 488.

Submit for approval by the Engineer the following anchorage supplier's product literature or calculations to establish embedment depth. This information will demonstrate compliance with the specification:

- Name of supplier
- Full product name as given in supplier's literature
- Embedment depth as determined from supplier's literature

Demonstrate the anchorage system for drilled-in anchorage systems at the first site of field installation prior to actual use in the project. Include installation and static tension tests in the presence of the Engineer in accordance with test procedures prescribed in ASTM E 488. No portion of the testing device shall bear on the concrete surface within a distance equal to the anchorage embedment depth. Test three anchorages to not less than 1/2 the required minimum ultimate pull out strength or the value given in Table 1, whichever is less. Failure of any anchorage tested will require modification of installation procedures or use of a different anchorage system.

In addition to the three tests stated above, the Engineer requires that each bridge have an additional 2% (not less than 1 test) of the remaining anchorages tested at a latter date. The Engineer will determine the locations of the additional anchors. If a failure occurs while testing the additional 2%, more testing will be required at the rate of an additional 1% per each failure at the Contractor's expense. Compensation for costs of testing is included in the payment for anchorage type reinforcement bars.

TABLE 1

ANCHOR ROD PROOF LOADS, kips [kN]
TYPE OF ROD, FROM SPEC. 3385

DIA., inches [mm]	TYPE A	TYPE B	TYPE C	TYPE D
1/2" [13]	4.75 [21.0]	5.7 [25.0]	10.1 [45.0]	4.9 [22.0]
5/8" [16]	7.4 [33.0]	8.9 [39.5]	15.8 [70.0]	7.6 [34.0])
3/4" [19]	10.6 [47.0]	12.6 [56.0]	22.8 [101.0]	11.0 [49.0]
7/8" [22]	14.5 [65.0]	17.4 [77.0]	31.0 [138.0]	15.0 [67.0]
1" [25]	19.0 [85.0]	22.6 [100.0]	40.5 [180.0]	19.5 [86.0]

If anchorages are installed vertically and are not encased in concrete after project completion, fill any voids occurring between the top of the anchorages and the concrete in which it is embedded with approved caulk.

For the following paragraph, Use As Required.

Payment will be made as 2433.516 "ANCHORAGES TYPE _____", at the contract price per each, which shall include all costs of furnishing, testing, and installing the anchorages.

For the following paragraph, Use As Required.

Payment for all costs of furnishing, testing, and installing the anchorages is included in payment for Metal Railings.

SB2014-2433.4

Use for grouted reinforcement bar anchorages with a pull-out strength less than 5000 lbs. [22 kN]. (ex. rock anchors, limited tension, compression steel).

CREATED 12/11/1995

REVISED 5/16/2013 (2)

SB- Grouted Anchorages

Place grouted reinforcement bar anchorages at the interface of _____ and the adjacent existing _____.

A. Construction Requirements

Each anchorage must consist of drilling and grouting a reinforcement bar into the inplace concrete. Drill the holes for the anchorages to the diameter and depth given in the plans. Use a type of grout formulated for this usage and approved by the Engineer.

B. Method of Measurement

Measurement will be by the single unit for each acceptable anchorage installed. Anchorages installed that are not shown in the plans or ordered by the Engineer will not be measured for payment.

C. Basis of Payment

Payment for Item 2433.602 "GROUTED REINFORCEMENT BARS", at the Contract price per each shall be compensation in full for all costs of furnishing, placing, and grouting the reinforcement bars complete inplace.

SB2014-2433.5

Use when recommended by the Region Bridge Const. Engineer (used to rehab a failing deck, not for new decks).

CREATED 1/18/1996
REVISED 5/16/2013 (7)

SB- BRIDGE PENETRATING SEALER

SB- Description

Furnish and apply a penetrating sealer to the entire concrete roadway surface area of Bridge No. _____, excluding the vertical faces of median barrier and concrete railings. Perform this work in accordance with the applicable provisions of 2433, "Structure Renovation," the plans, as directed by the Engineer, and the following:

SB- General

Apply a MnDOT approved, penetrating, solvent based silane sealer. Provide the Engineer with the sealer Manufacturer's written instructions for application and use, at least 30 calendar days before the start of the work.

SB- Materials

Furnish only one of the materials listed on the Department's "Approved/Qualified Product Lists of Bridge Penetrating Sealers" (http://www.dot.state.mn.us/products/index.html). For products not on the Department's prequalified list, provide information as required on the web site and as stated in the following table.

Table 1: Qualification Requirements for Penetrating Sealer	
Active Ingredient	Solvent-based alkylalkoxysilane with 40% solids minimum for the 40% Silane Solvent-based alkylalkoxysilane with 100% solids minimum for the 100% Silane
Resistance to Chloride Ion Penetration AASHTO T259 and T260	Less than 0.55 Chloride Content Ratio of Sealed /Unsealed at 1/2 inch level (Adjusted for baseline chloride)
Penetration Depth OHD L-40	0.15 inch
NCHRP 244 Series II	
Water Absorption	80 % reduction minimum
Absorbed chloride	85 % reduction minimum
NCHRP 244 Series IV - Southern Exposure	
Absorbed chloride	95 % reduction minimum
Alberta DOT Tests	
Waterproofing after Abrasion, % Alberta DOT Type 1b Penetrating Sealer Test	86.0 %
Moisture Vapor Transmission Alberta DOT Type 1b Penetrating Sealer Test	70 % minimum

The manufacturer of the silane product must directly ship a one quart sample of the sealer to the MnDOT Materials Lab (1400 Gervais Avenue; Maplewood, MN 55109) for quality assurance testing and IR scanning at least 30 days prior to the start of the work.

SB- Application Requirements

A. Surface Preparation

Clean all areas to be sealed by removing dirt, dust, oil, grease, curing compounds, laitance, or other contaminants that would impede the penetration of the sealant. Collect all debris and other material removed from the surface and cracks, and dispose of it in accordance with applicable federal, state, and local regulations. Immediately before applying the sealer direct a 125 psi air blast, from a compressor unit with a minimum pressure of 365 ft^3 / min. [10 m^3/min.], over the entire surface to remove all dust and debris paying special attention to carefully clean all deck cracks. Use a suitable oil trap between the air supply and nozzle. Use ASTM D 4285 "Standard Test Method for Indicating Oil or Water in Compressed Air" to ensure the compressed air is oil and moisture free. Provide shielding as necessary to prevent dust or debris from striking vehicular traffic. Have the Engineer approve the prepared surface prior to applying the sealer.

Air dry a wet deck for a minimum of seventy-two hours before applying the sealer.

Cover all expansion joints in a manner that will prevent the sealer from contacting the strip seals but will allow sealer to penetrate the steel/concrete interface on each side of the joint. Secure the materials used to cover the strip seals with duct tape or another material approved by the Engineer.

B. Weather Limitations

Do not apply sealer materials during wet weather conditions or if adverse weather conditions are anticipated within 12 hours of the completion of sealer application. Do not mix or apply any of these products at temperatures lower or higher than those specified in their product literature. Apply the sealant at the coolest time of the day within these limitations. Application by spray methods will not be permitted during windy conditions, if the Engineer predicts unsatisfactory results.

C. Sealer Application

Do not thin or alter the sealer unless specifically required in the Manufacturer's instructions. Mix the sealer before and during its use as recommended by the Manufacturer. Distribute the sealant with a spray bar near the surface so the spray pattern and coverage rates are reasonably uniform to the satisfaction of the Engineer. Do not allow running or puddling of the sealer to occur. Apply the sealant at a minimum rate of 180 $ft.^2$ / gal [17 m^2 / gal] and apply in two coats if running or puddling cannot be controlled.

Allow the sealant to dry according to the Manufacturer's instructions. Do not allow vehicular traffic onto the treated areas until the sealer has dried and the treated surfaces provide safe skid resistance and traction.

D. Test Section

Apply the sealant to a test area, of at least 50 $ft.^2$ [4.6 m^2], on the shoulder of Bridge No. _____. The test section will be used to evaluate the application equipment, coverage rate, drying times, traffic control, etc. Propose the specific location and application time for the test section at least 5 days prior to applying the sealer. A technical representative from the sealer manufacturer must be present during application and drying of the test section. Prior to application of the sealant, hold a meeting with the Manufacturer's Representative, the Engineer, and the Contractor to discuss all necessary safety precautions and application considerations

SB- Method of Measurement

Measurement will be made to the nearest square foot of concrete area sealed based on surface area.

SB- **Basis of Payment**

Payment for Item No. 2433.618 "BRIDGE PENETRATING SEALER" will be made at the Contract price per square foot and shall be compensation in full for all costs of furnishing and applying the sealer to the bridge decks, as described above, including surface preparation, and all incidentals thereto.

SB2014-2433.6

Use when steel members coated with lead paint are being demolished or replaced.

CREATED 1/18/2005

REVISED 1/15/2014 (3)

SB- Removal of Existing Steel Members

The provisions of 2433, "Structure Renovation," are supplemented as follows:

Stabilize all lead paint that has been identified as peeling by coating with an approved Lead Paint Encasement Product, as listed on http://www.dot.state.mn.us/products, that will prevent the peeling paint from flaking during demolition, or scrape and contain the peeling paint. If abatement by encasement using a Lead Paint Encasement Product is selected, follow manufacturer's product data sheet. Applying more than the manufacturer's suggested mils of product on a bridge over any water will require that the bridge have a diaper apron be attached under the bridge to contain all drips, as required by the Engineer. Complete all work as per the *MnDOT Asbestos and Regulated Waste Manual for Structure Demolition or Relocations for Construction Projects*, and as approved by the Engineer.

SB2014-2433.7

Only use when recommended by the Regional Br. Const. Eng. {[use for new or rehab. when crack width is .007 (just wide enough to see at five feet from the surface) - .025 inches, bigger cracks will require a more appropriate filler to be used first] [ACI states: the crack width of.025+ was selected because this is the size that the epoxies will fill easily and also the cracks are usually smaller below the surface]}

CREATED 4/2/2007

REVISED 5/16/2013 (4)

SB- BRIDGE DECK CRACK SEALER

SB- Description

UAR

Furnish and apply a protective (methyl methacrylate) or (epoxy) sealer to _____ of the roadway surface areas of Bridge No. _____, excluding the sidewalk, raised median and concrete railings. Perform this work in accordance with the applicable provisions of 2433, "Structure Renovation," the plans, as directed by the Engineer, and the following:

SB- General

Apply a MnDOT approved, methyl methacrylate or epoxy sealer. Provide the Engineer with the sealer Manufacturer's written instructions for application and use, at least 30 calendar days before the start of the work.

SB- Materials

Furnish only one of the materials on the Department's "Approved/Qualified Product Lists of Bridge Crack Sealers" (http://www.dot.state.mn.us/products/index.html). For products not on the Department's prequalified list, provide information as required on the web site and as stated in the following tables.

Qualification Requirements for Epoxy Crack Sealers	
Viscosity, ASTM C 881	125 cps -
Gel Time, ASTM C 881	20 minutes minimum
14 Day Bond Strength, ASTM C882	1500 psi minimum
Gel Time (ASTM 2471)	60 minutes (max.)
Compressive Yield Strength , ASTM C 881	4000 psi 7 day minimum
Tensile Strength, ASTM C881	4,000 psi minimum
Tensile Elongation, (ASTM C881)	2.5 % minimum
Shear Bond Adhesion (ASTM C882)	>1500 psi

Qualification Requirements for HMW Methacrylate Resin	
Viscosity (Brookfield RVT)	25cps -
Surface Cure	8 Hours @ 73° F maximum
Gel Time, ASTM 2471	60 minutes maximum
Tack Free Time	5 Hours maximum at 72° F and 50 % R.H.
Tensile Elongation, ASTM D638	5% minimum
Shear Bond Adhesion, ASTM C882	>1500psi

The manufacturer of the selected product must directly ship a one quart sample of the sealer to the MnDOT Materials Lab (1400 Gervais Avenue; Maplewood, MN 55109) for quality assurance testing and IR scanning at least 30 days prior to the start of the work.

SB- Application Requirements

A. Surface Preparation

Clean all areas to be sealed by removing dirt, dust, oil, grease, curing compounds, waxes, laitance, or other contaminants by performing a light sweep sandblast that does not expose the aggregate. Collect all debris and other material removed from the surface and cracks, and dispose of it in accordance with applicable federal, state, and local regulations. Immediately before applying the sealer direct a 125 psi air blast, from a compressor unit with a minimum pressure of 365 ft^3 / min. [10 m^3 / min.], over the entire surface to remove all dust and debris paying special attention to carefully clean all deck cracks. Use a suitable oil trap between the air supply and nozzle. Provide shielding as necessary to prevent dust or debris from striking vehicular traffic. Have the Engineer approve the prepared surface prior to applying the sealer.

Air dry a wet deck for a minimum of seventy-two hours before applying the sealer.

Cover all expansion joints in a manner that will prevent the sealer from contacting the neoprene seals but will allow sealer to penetrate the steel/concrete interface on each side of the joint. Secure the materials used to cover the neoprene seals with duct tape or another material approved by the Engineer.

B. Weather Limitations

Do not apply sealer materials during wet weather conditions or if adverse weather conditions are anticipated within 12 hours of the completion of sealer application. Do not mix or apply any of these products at temperatures lower or higher than those specified in their product literature. Apply the sealant at the coolest time of the day within these limitations. Application by spray methods will not be permitted during windy conditions, if the Engineer predicts unsatisfactory results.

C. Sealer Application

Do not thin or alter the sealer unless specifically required in the Manufacturer's instructions. Mix the sealer before and during its use as recommended by the Manufacturer. Distribute the sealant as a flood coat in a gravity-fed process by broom or roller, or with a spray bar near the surface so the spray pattern and coverage rates are reasonably uniform to the satisfaction of the Engineer. Do not allow running or puddling of the sealer to occur. Apply the sealant at a minimum rate of 100 ft^2 / gal [9.3 m^2 / gal] and apply in two coats if running or puddling cannot be controlled. Apply a second treatment on very porous substrates.

Broadcast to refusal an oven-dried 30 grit or similar sand into the wet, uncured resin.

Allow the sealant to dry according to the Manufacturer's instructions. Do not allow vehicular traffic onto the treated areas until the sealer has dried and the treated surfaces provide safe skid resistance and traction.

D. Test Section

Apply the sealant to a test area of at least 50 ft^2 [4.6 m^2] on the shoulder of Bridge No _____. The selected test area must contain a crack that is visible from 5 ft. [1500 mm] above the deck (.007 inches [.2 mm]) but not be larger than .025 in [.60 mm]. The test section will be used to evaluate the application equipment, coverage rate, drying times, traffic control, etc. Propose the specific location and application time for the test section at least 5 days prior to applying the sealer. A technical representative from the sealer manufacturer must be present during application and drying of the test section.

Add a dissipating UV Dye to the sealant prior to placing it on the test area. This dye will help determine the crack penetration of the sealant. Within 30 days of placing the test panel, recover a core that is no greater than four inches in diameter and includes a sealed crack as determined above. Conduct independent certified laboratory tests for crack width and penetration depth of the sealer. Send results to Structural Concrete Engineer at the MnDOT Materials Lab (1400 Gervais Avenue; Maplewood, MN 55109). All the test results are for MnDOT informational purposes only.

Prior to application of the sealant, hold a meeting with the Manufacturer's Representative, the Engineer, and the Contractor to discuss all necessary safety precautions and application considerations.

SB- Method of Measurement

Measurement will be made to the nearest square foot of concrete area sealed based on surface area.

SB- Basis of Payment

Payment for Item No. 2433.618 "BRIDGE DECK CRACK SEALER" will be made at the Contract price per square foot and shall be compensation in full for all costs of furnishing and applying the sealer to the bridge decks, as described above, including surface preparation, and all incidentals thereto.

SB2014-2433.8

Use on all jobs requiring drilled-in reinforcement bar adhesive anchorages having an nominal (ultimate) pull-out tension greater than 5000 lbs [22 kN]

Engineer shall ensure that there is enough concrete to prevent the structural member from spalling out below or beyond the embedment depth (2" min. is recommended).

Adhesive anchorages are not permitted in sustained tensile-load applications.

CREATED 4/28/2008
REVISED 5/16/2013 (1)

SB- Reinforcement Bar Anchorage (Post-installed)

A. Description of Work

Furnish and install a drilled-in reinforcement bar anchorage system of the type, shape and size specified, and its satisfactory placement at the interface of _____ and _____ of Bridge No. _____.

Perform all work in accordance with the applicable provisions of 2433, "Structure Renovation," 2472, "Metal Reinforcement," and 3301, "Reinforcement Bars," the requirements of the plans, as directed by the Engineer, and the following:

Install anchorages with a chemical adhesive and test to the anchorage proof load as per this provision.

Submit for approval by the Engineer the following chemical adhesive supplier's product literature or calculations to establish embedment depth. This information will demonstrate compliance with the specification:

- Name of supplier
- Full product name as given in supplier's literature
- Embedment depth as determined from supplier's literature

B. Construction Requirements

Supply an anchorage system that meets the requirements of these special provisions and the plan, and install as per the manufacturer's recommendations.

Drill the holes for anchoring the reinforcement bars into 4000 psi. concrete with a maximum embedment depth of _____ at the following location(s).

C. Pullout Tests

Perform laboratory tests that include static load tests for ultimate (nominal) pullout strengths on anchorage systems that are subject to tensile loads. The tests, in accordance with ASTM E 488 (Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements), must be performed and certified by an independent testing laboratory. Furnish the Engineer with the test reports and the specification sheets that are prescribed by ASTM E 488.

Demonstrate the rebar anchorage system at the first site of field installation prior to actual use in the project. Include installation and static tension tests in the presence of the Engineer in accordance with test procedures prescribed in ASTM E 488. Do not allow any portion of the testing device to bear on the concrete surface within a distance equal to the anchorage embedment depth. Test three anchorages of each reinforcement bar size to not less than the anchorage proof load given in the following Table 1. Failure of any anchorage tested will require modification of installation procedures or use of a different anchorage system and be retested.

In addition to the three tests stated above the Engineer will require that each bridge have an additional 2% (not less than 1 test) of the remaining anchorages tested at a latter date. The Engineer will determine the locations of the additional anchors. If a failure occurs while testing the additional 2%, more testing will be required at the rate of an additional 1% per each failure at the Contractor's expense. Compensation for costs of testing is included in the payment for anchorage type reinforcement bars.

TABLE 1
REINFORCEMENT BAR PROOF LOADS

Rebar Size English [Metric]	**Minimum Ultimate Bond Strength pounds [kN]**	**Anchorage Proof Load pounds [kN]**	**Yield Strength of Rebar pounds [kN]**
3 [10]	11,000 [49]	5,300 [24]	6,600 [29]
4 [13]	20,000 [89]	9,600 [43]	12,000 [53]
5 [16]	31,000 [138]	14,900 [66]	18,600 [83]
6 [19]	44,000 [196]	21,100 [94]	26,400 [117]
7 [22]	60,000 [267]	28,800 [128]	36,000 [160]
8 [25]	79,000 [351]	38,000 [169]	47,400 [211]
9 [29]	100,000 [445]	48,000 [124]	60,000 [267]
10 [32]	127,000 [565]	61,000 [271]	76,200 [339]

D. Method of Measurement

Measurement will be by the single unit of each for furnishing and installing acceptable reinforcement bar anchorages complete in place. Anchorages installed that are not shown in the plans or ordered by the Engineer will not be measured for payment.

E. Basis of Payment

Payment will be made as Item 2433.516, "ANCHORAGES TYPE REINF BARS", at the Contract price per each and shall be compensation in full for all costs of furnishing, placing, and testing the reinforcement bar anchorages complete inplace.

SB2014-2433.10
Use when reconstructing paving bracket(s) is required.
CREATED 7/1/2014
REVISED 7/1/2014

SB- Reconstruct Paving Bracket

Reconstruct portions of the paving bracket(s) on the end diaphragms for Bridge No. _____ in accordance with 2401, "Concrete Bridge Construction," 2433, "Structure Renovation," and the following:

A. Concrete Removals

After portions of the inplace slab, end diaphragm, and approach panels are removed for reconstruction of the joint and new approach panels; remove deteriorated concrete on the paving bracket(s) using equipment and methods approved by the Project Engineer. Removals are to extend along the length of the abutments as designated by the Project Engineer for reconstruction.

Remove concrete beyond the back face vertical and longitudinal reinforcement so as to provide at least ¾" clearance around the periphery of the bar. Additional removal depth may be required until sound concrete is encountered, as directed by the Project Engineer.

After removal operations are complete, clean remaining loose concrete by sandblasting. Sandblast exposed reinforcing bars clean of all rust and concrete providing a tight surface but not necessarily to white metal, as directed by the Project Engineer.

B. Construction Requirements

Supplement exposed reinforcement that has 50 percent or more section loss due to rust, as determined by the Engineer, with a new bar of the same size.

Reconstruct areas of removed paving bracket by forming using concrete mix no. 3Y43.

Consolidate concrete with a “pencil thin” internal vibrator.

Keep exposed surfaces of newly placed concrete continuously moist for a minimum of 24 hours.

Apply a bonding grout consisting of Portland cement mixed with water to form a slurry with the consistency of paint to bond the new concrete to the remaining concrete surface. Coat the in-place concrete immediately before placing the new concrete against it.

C. Method of Measurement

Measure paving bracket reconstruction by length, in linear feet [meters], distance along the centerline of the bracket of removed and replaced paving bracket.

D. Basis of Payment

The contract unit price for Reconstruct Paving Bracket includes the cost of reconstructing the bridge paving bracket complete in place.

Payment for Item No. 2433.603, “RECONSTRUCT PAVING BRACKET”, will be made at the Contract price for the linear feet of paving bracket reconstructed, which shall be compensation in full for all work described above and needed to perform the repair described, complete inplace.

SB2014-2433.11

Use when reconstructing concrete end post is required.

CREATED 7/1/2014

REVISED 9/29/2014 (1)

SB- Reconstruct Concrete End Post

Reconstruct concrete end post(s) for Bridge No. _____ in accordance with 2401, "Concrete Bridge Construction," 2433, "Structure Renovation," and the following:

A. Removals

Disengage guardrail from end post, excavate, remove and dispose of the inplace end posts.

B. Construction Requirements

Supply reinforcement bar anchorages that conform to the requirements of SB-____.

C. Restoration of Turf

Restore the turf within the work area in accordance with the applicable requirements of 2575, “Establishing Turf and Controlling Erosion.” Meet the requirements of 2572.2.D, “Sandy Loam Topsoil,” for topsoil. Place erosion control blankets per 2575.3.K.2, “Rolled Erosion Control Products,” over newly seeded areas. Complete restoration work to the satisfaction of the Engineer.

Approximate quantities of material per end post are as follows: Topsoil – one cubic yard; Seed mixture – 1/4 pound; Erosion control blanket – five square yards.

D. Method of Measurement

Measurement of the concrete end post will be by the single unit of each.

E. Basis of Payment

The contract unit price for *Reconstruct Concrete End Post* includes the cost of reconstructing the post, complete in place.

Payment for Item No. 2433.602, "RECONSTRUCT CONCRETE END POSTS" will be made at the Contract price per each and shall be compensation in full for performing all work described above, including all other work incidental thereto. Reinforcement bar anchorages will be paid for under a separate item.

SB2014-2442

Use on all jobs requiring "Removal of Existing Bridges".

CREATED 5/14/1997

REVISED 5/16/2013 (8)

SB- **(2442) REMOVAL OF EXISTING BRIDGES**

Apply the provisions of 2442, "Removal of Existing Bridges," except as supplemented below.

Dispose of materials in accordance with 1506, "Supervision By Contractor," 2104.3.C, "Removal Operations," 2442, "Removal of Existing Bridges," MnDOT "Asbestos and Regulated Waste Manual for Structure Demolition or Relocations for Construction Projects" and the following:

Furnish written information to the Engineer as to disposal of steel bridge beams and other steel bridge components coated with lead paint. Include method of stabilization and disposal; name, address, and telephone number of disposal site; certification that Contractor has notified disposal site of presence of lead paint; acknowledgment by Contractor of OSHA requirements relating to lead; and certification that Contractor is familiar with proper handling and disposal of materials with lead-based paint systems. Stabilize all lead paint that has been identified as peeling by coating with an approved product, as listed on the MnDOT Approved Products website www.dot.state.mn.us/products under "Lead Paint Encasement Product". Prevent the peeling paint from flaking off during demolition, or scrape and contain the peeling paint. If the painting option is used apply 16 mils of the product. Applying more than 16 mils of the product on a bridge over any water will require that the bridge have a diaper apron be attached under the bridge to contain the drips. Complete all work as per the MnDOT Asbestos and Regulated Waste Manual for Structure Demolition or Relocations for Construction Projects. The form supplied in this special provision must include the signature of the authorized Superintendent verifying that the information is correct.

For the following section (Salvaged Materials), ONLY use on jobs requiring salvaging materials from bridge removals.

SB- **Salvaged Materials**

Salvage, load, and haul materials specified below, and unload them at the following location(s) in a manner satisfactory to the Engineer:

Bridge No.	Description of Materials	Delivery Location

Contact (Name) at (Address , telephone ( ) , prior to hauling the materials to arrange for their delivery.

Replace or repair materials damaged while being salvaged, loaded, or hauled, to the satisfaction of the Engineer and at the Contractor's expense.

Payment for Item No. 2442.502, "SALVAGE AND HAUL MATERIAL (BRIDGE)", at the Contract Lump Sum price, is payment in full for loading, hauling, and unloading the specified materials and all work incidentals thereto.

NOTIFICATION FORM ON DISPOSAL OF BRIDGE STEEL

The Contractor is required to provide certain information on disposal of bridge steel which has been painted with lead-based paint. By signing this document, the Contractor certifies that information supplied by the Contractor is correct and that the Contractor is familiar with proper handling and disposal of materials with lead-based paint. This information must be furnished to the Project Engineer a minimum of 30 days prior to removal of the bridge steel from the project site. Any change in method or location of disposal would require resubmittal and a 30 day notice.

MnDOT Project No. _____ **Bridge No.** _____

Description of Bridge Steel _____

Paint System is MnDOT Spec. _____, _____ _____
(Primer) **(Top Coat)**

Project Engineer: _____

Contractor/Subcontractor: _____
(Name, mailing address, telephone no.)

_____

I _____ certify that the following information is correct:
(print name of authorized representative)

The above bridge steel will be disposed of by the following method(s): _____
(list name,

_____
address and telephone no. of recipient, estimated delivery date, and intended use.)

_____

_____

I also certify that _____ is familiar with
(Contractor/Subcontractor name)
the requirements in OSHA 29 CFR 1926.62 relating to lead, precautions to be taken when working with lead, and proper handling and disposal of materials with lead-based paint systems and that _____ has been notified of the presence of lead-based paint.
(name of recipient)

_____ _____
(signature) **(date)**

Received by Project Engineer/Inspector: _____ _____
(date) **(signature)**

cc: Project File
Office of Environmental Services

SB2014-2451
CREATED 2/15/1978
REVISED 5/16/2013 (2)

SB- (2451) STRUCTURE EXCAVATIONS AND BACKFILLS

The provisions of 2451, "Structure Excavations and Backfills," are supplemented as follows:

SB2014-2451.1

Use where excavation is lump sum. Not to be used where rock excavation may be encountered.

CREATED 8/1/1994

REVISED 5/16/2013 (4)

SB- **Structure Excavation**

Excavate, sheet, shore and/or protect, prepare foundation, and place backfill necessary for construction of Bridge(s) No_____, which are not specifically included in the grading portion of the Contract. Dispose of surplus material.

Do not measure the excavated or backfill material. All work performed as specified above will be considered to be included in a single lump sum for which payment is made under Item No. 2401.601, "STRUCTURE EXCAVATION".

For purposes of partial payments, the portion of the lump sum Structure Excavation at each substructure unit will be defined as follows:

UAR

Bridge _____ Each Abutment_____%

Each Pier _____%

Bridge _____ Each Abutment _____%

Each Pier _____%

SB2014-2451.2

Use for all spread footings not on rock where plan specifies aggregate backfill, except in areas where aggregate material may trap and pocket water.

DESIGNER'S NOTE:

ITEM NO.	*ITEM*	*UNIT*
		Select ONE of the two following Items.
2451.505	*Aggregate Backfill (CV)*	*Cubic Yard*
2451.505	*Aggregate Backfill (CV)*	*Cubic Meter*

CREATED 8/28/1986
REVISED 5/16/2013 (1)

SB- Aggregate Backfill

Perform all labor and furnish all materials required to place the aggregate backfill material under spread footings.

After excavation to the bottom of footing elevation for each unit shown in the plans, excavate additional material until acceptable material, as determined by the Engineer, is encountered. Compact the upper 6 in [150 mm] of this material to not less than 100 percent of Maximum Density in accordance with 2105.3.F.1, "Specified Density," before placing the backfill material.

Performing the compaction, as specified above, will be considered an incidental expense for which no direct compensation will be made.

Use aggregate backfill material in accordance with 3l49.2.E, "Aggregate Backfill".

Compact aggregate backfill to 100 percent of Maximum Density in accordance with 2l05.3.F.1, "Specified Density". Perform sampling and testing on every 3 ft [1 m] depth of backfill at each footing location.

Excavation below the bottom of footing elevation for each unit shown in the plans is incidental to placing the backfill material.

The State reserves the right to eliminate all or part of the aggregate backfill.

Where aggregate backfill is eliminated, no excavation below the bottom of footing will be required. However, compact the upper 6 in [150 mm] of the material beneath the footing to not less than 100% of Maximum Density in accordance with 2105.3.F.1, "Specified Density".

SB2014-2451.3

Use for all spread footings not on rock where plan does not specify aggregate backfill, except in areas where aggregate material may trap and pocket water.

CREATED 2/16/1990

REVISED 5/16/2013 (1)

SB- Foundation Backfill

After the Contractor has excavated to the planned footing elevations for each unit shown in the plans, the Engineer will determine if aggregate backfill is necessary.

If the Engineer determines that aggregate backfill is not necessary, compact the upper 6 in [150 mm] of the excavation to not less than 100 percent of Maximum Density in accordance with 2105.3.F.1, "Specified Density".

If the Engineer determines that aggregate backfill is necessary, the Engineer will order additional excavation until acceptable material, as determined by the Engineer, is encountered. Compact the upper 6 in [150 mm] of this material to not less than 100 percent of Maximum Density in accordance with 2105.3.F.1, "Specified Density," before placing the backfill material.

Performing the compaction, as specified above, will be considered an incidental expense for which no direct compensation will be made.

Use aggregate backfill material in accordance with 3149.2.E, "Aggregate Backfill".

Compact aggregate backfill to 100 percent of Maximum Density in accordance with 2105.3.F.1, "Specified Density". Perform sampling and testing on every 3 ft [1 meter] depth of backfill at each footing location.

Excavation below the bottom of footing elevation for each unit shown in the plans is incidental to placing the backfill material.

When the proposal does not contain an estimated quantity or a lump sum item for aggregate backfill, any aggregate backfill required for the construction of the footings shall be considered to be Extra Work as provided for under 1403, "Notification for Contract Revisions".

SB2014-2451.4

Use when indicated on the Foundation and other Recommendations form. Use when seals are NOT shown in the plan.

CREATED 4/18/1994

REVISED 5/16/2013 (3)

SB- Foundation Preparation (Pier Nos. _____)

Furnish all material for and perform all work involved in the preparation of the foundation for each of the piers designated. Unless otherwise provided by separate Contract items, each item shall include, but not be limited to temporary work to access pier locations, earth excavation and all other work such as coffer dam construction, concrete seals, pumping, removal of the cofferdam and other temporary works, backfilling the excavation, and disposal of surplus excavated materials as may be necessary. If requested, partial payment for Foundation Preparation items may be made based on the Engineer's estimate of percent of work complete.

UAR

(Rock excavation) (Piling) will be paid for separately.

All costs for the work specified above for each of the piers will be paid for separately as Item No. 2401.601 "FOUNDATION PREPARATION PIER _____", at the contract lump sum price per each pier.

SB2014-2451.5

Use when indicated on the Foundation and other Recommendations form. Use when seals ARE shown in the plan.

CREATED 4/18/1994

REVISED 5/16/2013 (3)

SB- Foundation Preparation (Pier Nos. _____)

Furnish all material for and perform all work, except for construction of the concrete seals, involved in the preparation of the foundation for each of the piers designated. Unless otherwise provided by separate Contract items, each item shall include, but not be limited to temporary work to access pier locations, earth excavation and all other work such as cofferdam construction, pumping, removal of the cofferdam and other temporary works, backfilling the excavation, and disposal of surplus excavated materials as may be necessary. If requested, partial payment for Foundation Preparation items may be made based on the Engineer's estimate of percent of work complete.

UAR

(Rock excavation) (Piling) will be paid for separately.

UAR

Due to the concern for potential scour at the pier footings, elimination of the concrete seals is not permitted.

After seal courses are poured and before other concreting operations commence, make provisions for flooding of the cofferdams when the water surface elevation exceeds Elev. _____ in order to maintain stability against uplift. Should it become necessary to flood the cofferdams, take every precaution to prevent damage to temporary and permanent construction.

All costs for the work specified above for each of the piers will be paid for separately as Item No. 2401.601 "FOUNDATION PREPARATION PIER _____", at the contract lump sum price per each pier.

Select ONE of the two following paragraphs.

Payment for furnishing and placing of the concrete seals is under Item 2401.501 "STRUCTURAL CONCRETE (1X62)" by the yd^3.

Payment for furnishing and placing of the concrete seals is under Item 2401.501 "STRUCTURAL CONCRETE (1X62)" by the m^3.

SB2014-2451.6

Use when the Engineer would require Extra Work to provide exploratory drilling or soundings.

CREATED 2/15/1978

REVISED 5/16/2013 (1)

SB- Foundation Exploration

After the Contractor has excavated to the planned footing elevations for _____, the Engineer may perform or require that the Contractor perform certain exploratory operations such as drilling or rod sounding.

After the Contractor has excavated to and exposed ledge rock or to the planned footing elevation, whichever is higher, for _____, the Engineer may perform or require that the Contractor perform certain exploratory operations such as drilling or rod sounding.

The purpose of such exploratory operations will be to assist the Engineer in ascertaining the nature and extent of the underlying materials. The Engineer will then determine if it will be necessary to change the planned size, type, and elevation of the footings.

Any exploratory work that the Engineer orders the Contractor to perform will be paid for as Extra Work per 1403, "Notification for Contract Revisions". No compensation will be made for any delays resulting from the exploration operations or for delays caused by plan changes made because of the results of the exploration, except that extension of contract time may be given in accordance with 1806, "Determination and Extension of Contract Time".

SB2014-2451.7

Use when pile bent piers have concrete encasement walls.

CREATED 11/9/2001

REVISED 5/16/2013 (3)

SB- Foundation Preparation for Pile Bent Pier(s) – Bridge No(s). _____

In the following paragraph, fill in the blank. Elevation to be particularized by the Regional Construction Engineer.

Furnish all material for and perform all work involved in the preparation of the foundation for construction of the pile bent substructures and their encasement walls. The item shall include, but not be limited to, earth excavation and all other work such as pumping, constructing dikes, backfilling the excavation, and disposing of surplus excavated materials as may be necessary to build pier encasement walls in dry conditions above elevation _____. It is anticipated the Contractor will need to provide watertight forms.

Piling will be paid for separately.

All costs for the work specified above for all of the pile bent piers will be paid for as Item No. 2401.601, "FOUNDATION PREP PILE BENT PIERS", at the contract lump sum price.

SB2014-2452
Use on all jobs requiring piling.
CREATED 5/16/2013
REVISED 9/5/2014 (1)

SB- **(2452) PILING**

The provisions of 2452, "Piling," are supplemented as follows:

SB-__.1 Remove the entire contents of 2452.3.E.3, "MnDOT Pile Formula 2012 (MPF12) Used as Field Control Method," and substitute the following:

Determine the nominal pile bearing resistance using the following dynamic formula for CIP concrete piles and steel H piles driven with power-driven hammers:

$$R_n = 20\sqrt{\frac{WxH}{1000}} \times \log\left(\frac{10}{s}\right)$$

Where:

R_n = Nominal Pile Bearing Resistance in tons
W = Weight of the striking part of the hammer (ram) in pounds (see note below)
H = Height of fall in feet (see note below)
S = Average penetration in inches per blow for the last 10 blows or 20 blows, except if the pile may be damaged by this number of blows.

The MPF12 is not suitable for use in pile driving conditions where the average penetration during driving (S) is greater than 0.5 inches per blow (less than 24 blows per foot). The Contractor shall immediately notify the Engineer if the specified nominal pile bearing resistance shown in the plans is obtained with an average penetration greater than 0.5 inches per blow.

The Contractor may choose any of the following options to reduce the average penetration during driving to less than 0.5 inches per blow and achieve the specified nominal pile bearing resistance shown in the plans:

1. Reduce the fuel setting of the hammer for the test piles and foundation piles.
2. Perform redrives on the test piles and 10% of the foundation piles at a reduced fuel setting of the hammer. Perform redrives on the foundation piles that had the highest penetration at the end of initial drive or as determined by the Engineer.
3. Continue driving the pile until the average penetration is less than 0.5 inches per blow.
4. Use a qualified smaller hammer.

The above options will be performed at no additional cost to the Department, with the exception that additional driven and delivered length will be paid for by the Department up to the estimated length shown in the plans.

Regardless of the value measured during driving, the value of (S) used in the dynamic formula shall not be less than 0.066 inches per blow (more than 180 blows per foot). If the measured average penetration for the last 10 blows is less than 0.066 inches per blow, use 0.066 in the dynamic formula to determine the bearing resistance.

Note: (W x H) is measured during pile driving and is also commonly referred to as the "energy", E, hence E = W x H, for single acting power-driven hammers and is measured in foot-pounds. The value of (W x H) used in the dynamic formula shall not exceed 85 percent of the manufacturer's maximum rated energy for the hammer used.

In addition to the limits stated above, apply the dynamic formula only if:

(1) The hammer has a free fall,
(2) The head of the pile is free from damage,
(3) The penetration of the pile is at a uniform rate, and
(4) There is no bounce after the blow. If a bounce occurs, deduct twice the bounce height from H to determine the value of H in the formula.

For the requirements of this section, double-acting hammers include hammers utilizing a power source for acceleration of the down-stroke of the ram.

SB-__.2 The provisions of 2452.3.C.1.1, "Driving System Submittal," are supplemented as follows:

Add the following:

Include in the Driving System Submittal the penetration (blows/per foot) as calculated by the MPF12 at the nominal pile bearing resistance required for the test piles and at 85% of the manufacturer's maximum rated energy for the proposed hammer. When the MnDOT Pile Formula 2012 will be used as field control, the Engineer will only accept pile driving equipment capable of operating at 180 blows per ft or less at the above conditions.

FYI: The Spec Book chapter 2452.3.J now includes sections J.1 for "Painting Piles" and J.2 for "Galvanized Piles". Designer will be told by the Regional Construction Engineer or this info will typically be mentioned in the Foundation Rec. of what coating will be required. If a coating is required, which type? Select paint or galvanizing and then include language to eliminate the other. Select one of the following SB-___.3 paragraphs:

SB-__.3 The provisions of 2452.3.J, "Coating Steel H-Piles and Steel Pile Shells," are modified as follows:

Delete 2452.3.J.1, "Painted Piles," and supplement 2452.3.J.2, "Galvanized Piles," with the following:

Continuously coat the outside of steel H-piles and CIP steel pile shells from the cut-off elevation to an elevation extending a minimum of 10 feet [6 meters] below the defined ground surface or bottom of water channel with hot-dipped galvanizing. Do not hot-dip galvanize within 1 ft [600 mm] of a splice. Based on test pile length, if a splice is required, adjust location of splice so that it is not visible after driving is completed.

SB-__.3 The provisions of 2452.3.J, "Coating Steel H-Piles and Steel Pile Shells," are modified as follows:

Delete 2452.3.J.2, "Galvanized Piles."

SB2014-2452.1

Use when recommended by the Regional Engineer.

CREATED 6/20/2005

REVISED 2/11/2014 (4)

SB-

Commercial Drive Fit Splices for CIP Piling

Commercial drive fit splices will NOT be permitted (on this project) (on Bridge _____).

SB2014-2453
Use where drilled shaft foundations are required.
CREATED 9/13/1999
REVISED 5/16/2013 (5)

SB- (2453) DRILLED SHAFT CONSTRUCTION

SB- Scope of Work

Furnish all labor, equipment, material and other services necessary for construction of _____ inch (mm) and _____ inch (mm) diameter reinforced concrete drilled shafts in earth, rock, and water to serve as foundation supports for the piers and abutments as shown in the plans for Bridge No(s). _____ and _____. Perform work in accordance with the applicable provisions of 2401, "Concrete Bridge Construction," 2451, "Structure Excavations and Backfills," the plans, and these special provisions.

The work includes, but is not limited to:

- Obtaining all required Federal, State and local permits
- Exploratory borings as required
- Conformance with environmental regulations
- Dewatering of site as necessary for drilled shaft construction
- Earth and rock excavation for shafts
- Removal of obstructions
- Furnishing and placing temporary or permanent casing
- Disposal of drilling fluids, excavated material, waste concrete and reinforcement
- Roughening of the sides of the rock portion of the shafts
- Furnishing and placing reinforcement and concrete
- Correction to acceptable tolerances

SB- Geotechnical Information

A. Geotechnical Data

UAR

Geotechnical borings were taken at this site for design purposes. (copies of the boring logs are included in this document) Cored samples of the rock formations are stored at the Material & Research Lab, 1400 Gervais Ave., Maplewood, MN. It is the responsibility of the drilled shaft contractor to inspect this geotechnical data and core samples, and to visit the job site prior to submitting a proposal for this work. Arrangements for viewing the rock core can be made through the Foundations Engineering Unit, phone (651) 366-5598.

B. Site Geology

(Insert relevant geologic information from Foundation Engineer's report or contact the Foundations Unit.)

SB- Definitions

A. Rock

Rock is defined as ... (use geologic definition – rock definition should be site-specific for the project. See Foundations Report or contact Foundations Unit.)

The top of rock will be at the contact of the overlying unconsolidated materials and the underlying bedrock as determined by the Engineer. Rock which has weathered to the degree to be classified as "residual soil" (see MnDOT Geotechnical and Pavement Manual) will not be considered to be bedrock, and top of rock will then be the contact between "residual soil" and weathered bedrock.

Excavation in bedrock will likely require the use of special rock augers, core barrels, air hammers and combination thereof, and/or other methods commonly used for shaft construction in rock. All soft seams, rock fragments, and voids encountered after commencing drilling of rock in a shaft will be included in the quantity of rock excavation.

B. Earth

Earth is defined as all material between the top of the rock (as defined above) and the bottom of footing. It may also contain highly weathered rock ("residual soil").

C. Obstructions

An obstruction will be classified by the Engineer as material and/or objects that cannot be efficiently removed from a shaft during normal excavation operations with the drilling equipment adequate to excavate earth and rock materials found on the project, and which necessitate the use of other methods and/or equipment to remove. Such obstructions may be rock fragments, boulders, waterlogged timbers, or any material, natural or man-made which requires use of special tools or procedures not otherwise required for excavation of rock or earth materials on the project.

For this project the following are *not* classified as obstructions and, if present, must be removed by the Contractor with no additional compensation.

- Material present above rock elevation which is (1) required to be removed by the Contract; or (2) known to the Contractor or readily visible upon site investigation and which can be removed by conventional surface excavation methods.
- Any material below the elevation of the top of the rock.
- Boulders that are one-fourth, or less, of the shaft diameter.

SB- Qualifications of Drilled Shaft Contractor

The drilled shaft contractor must have a minimum of five years experience in drilled shaft installations and have successfully completed construction of shafts with similar site and subsurface conditions, shaft diameter and shaft depths.

The supervisor in charge of this work must have a minimum of three years of experience in the construction of similar types of drilled shafts.

SB- Submittals

Submit the following information to the Engineer at the preconstruction conference:

A. Proof that the above-noted drilled shaft contractor qualifications have been met, including a list of similar projects completed within the last three years with names and phone numbers of owner’s representatives who can verify the contractor’s participation in those projects.

B. Name and experience record of the supervisor in charge of the drilled shaft construction.

C. A preliminary installation plan that contains, but is not limited to, the following data:

- A description of the proposed drilling machine and down-hole tools to be used for the drilled shaft construction

- Procedures for exploratory borings, if required
- Means of access to the drilling site
- Proposed construction methods; include procedures for exploration, excavation, cleaning, inspection, placement of temporary and permanent casings, removal of temporary casings, placement of reinforcement, placement of concrete, filing of voids between permanent casing and earth or rock, and containment and disposal of excavated materials and drilling fluids
- A description of spacers and supports to be used for the reinforcement
- Proposed schedule and sequence of construction operations
- A written contingency plan for containment and clean-up of any spill or discharge of material which might contaminate public waters

D. Status of permits obtained or necessary for the work.

The Engineer will review the plan within 14 calendar days of submittal and provide written instructions if changes are necessary to meet Contract requirements. Submit a final drilling plan which meets all Contract requirements. If revisions in the plan are required to accommodate site conditions, or for other reasons, obtain the Engineer's approval prior to implementation.

The Engineer's approval of the installation plan does not relieve the Contractor of full responsibility for the safe and successful completion of construction of the drilled shafts.

SB- Methods and Equipment

A. Drilling and Excavation Equipment

Drilling equipment used to perform the drilled shaft work on this project must have the capability of providing sufficient torque and down-thrust for drilling and excavating shafts in the geologic strata described herein that is 20% greater in diameter than the largest shaft diameter and at least 6.5 feet [two meters] below the deepest shaft required for this project.

Ensure excavation equipment is capable of excavating the drilled shaft to the dimensions required in the plan with a level bottom. The cutting edges of the excavation tools must be normal to the vertical axis of the equipment within a tolerance of ± 0.42 inches per foot [35 mm per meter] of shaft diameter.

B. Concrete Placement Equipment

Tremie – Use rigid tremie pipe to place concrete underwater that is watertight and of sufficient length, weight, and diameter to discharge concrete at the shaft base elevation. The tremie must not contain aluminum parts that will have contact with the concrete. The tremie inside diameter must not be less than 10 inches [250 mm] unless a smaller inside diameter is approved by the Engineer. The inside and outside surfaces of the tremie must be clean and smooth to permit both flow of concrete and unimpeded withdrawal during concrete placement. The discharge end of the tremie must be constructed to permit the free radial flow of concrete. Wall thickness of the tremie must be adequate to prevent crimping or sharp bends that may restrict concrete placement. Use a plug, valve, or bottom plate to separate the concrete from the water until the concrete is flowing through the orifice. Plugs, if left in the shaft concrete, must be of a material approved by the Engineer.

SB- Data Reports

Complete the initial data report supplied in this special provision for *each* drilled shaft constructed. Give the report to the Engineer within 24 hours after concreting has been completed for that shaft. Upon the Engineer's completion and acceptance of all shafts, give a final report for each shaft – in the same standard format – containing any additional data to the Engineer. Include the following data in the final report:

- Date and time excavation started
- Shaft location and identification

- Shaft diameter per plans and as constructed
- River pool elevation if appropriate
- Description of soil and rock types encountered while drilling
- Variation of shaft as constructed from plumb and from its plan location
- Location and extent of rock cavities
- Comments on water condition within a shaft, if applicable; i.e. flow volume, hydrostatic head, elevation encountered
- Date and time excavation completed and method of cleaning bottom if applicable
- Date concrete is placed, placement method(s) and Mix No(s)
- Diameter and depth of permanent casings used
- Other comments as deemed necessary for the work including any non-standard methods of construction which may have been required and which affected the shaft configuration and/or construction
- Details of any obstructions encountered and removed including removal methods

SB- Materials

A. Permanent casings must conform to the requirements of ASTM A 252 or A 36, welded and seamless, and may be of unit or sectional construction with welded seams. The casings must be of ample strength to withstand handling stresses, internal pressure of fluid concrete, external pressure of surrounding earth and water, and be watertight. Minimum wall thickness of permanent casing must be 3/8 in [10 mm]. The outside diameter of the casings must not be less than _____ inches (_____mm). Casings must be non-corrugated and the surface smooth, clean and free from hardened concrete.

Used material in like-new condition with no section loss may be used for the permanent casings with approval of the Engineer.

B. Temporary casings must conform to the requirements of permanent casings, except that the diameters shall be as required for the particular usage.

UAR

C. Concrete must conform to the requirements of Mix No. 3X46 unless otherwise specified in the plans (designer note: if top of drilled shaft is completely below the frost line use 1X62 mix). Increase slump to 7-8 inches [175-200 mm] using MnDOT approved super plasticizers.

D. Slurry:

Mineral slurries may be made with sodium bentonite or attapulgite mixed with fresh water and must meet the requirements given in the following table:

MINERAL SLURRY			
Acceptable Range of Values			
Property (Units)	**At Time of Slurry Introduction**	**In Hole at Time of Concreting**	**Test Method**
Density lb/ft^3 (k/m^3)	64.3-69.1 (1030-1107)	64.3-75.0 (1030-1201)	Density Balance
Viscosity seconds/quart (seconds/liter)	28-45 (30-48)	28-45 (30-48)	Marsh Cone
pH	8-11	8-11	pH Paper or Meter

SB- Acceptable Construction Methods

A. Casing or Wet Construction Method - The casing method may be used in earth and rock strata to prevent hole caving and/or excessive deformation of the hole.

Advance the casing through the earth by twisting, driving, or vibrating before cleaning it out. For rock strata, place the casing in a predrilled hole. No extra compensation will be allowed for concrete required to fill an oversized casing, or an oversized excavation required to place the casing.

1. Temporary Casing - All casing is considered temporary (unless the drilled shaft contractor chooses to provide a permanent casing at the top of the shafts as a form). Remove any temporary casing within the excavated shaft during concrete placement operations while the concrete is in a fluid state. If the Contractor elects to remove a casing and substitute a longer and/or larger diameter casing through caving soils, the excavation must be stabilized, as approved by the Engineer, before the new casing is installed.

Temporary casings which become bound or fouled during shaft construction and cannot be practically removed constitute a defect in the drilled shaft. The Contractor is responsible for improving such defective shafts to the satisfaction of the Engineer. Such improvement may consist of, but is not limited to, removing the shaft concrete and extending the shaft deeper to compensate for loss of frictional capacity in the cased zone. The Contractor will perform all corrective measures to the satisfaction of the Engineer. No additional compensation and extension of Contract time will be made for corrective measures, or for casing left in place.

2. Permanent Casing - Permanent steel casing may be used at the Contractor's option to form the top of the shaft within the earth strata only. The casing may be set in place prior to start of shaft drilling or a temporary casing may be used for drilling and excavation, with the permanent casing placed prior to placement of reinforcement and concrete. Permanent casing may be larger than minimum shaft diameter to allow withdrawal of the temporary casing. Cut off the permanent casing at the top of finished shaft elevation, as given in the plans before or after concrete and reinforcement placement, at the Contractor's option.

When temporary casings are deemed necessary in conjunction with permanent casings, the drilled shaft contractor must maintain alignment of both casings on the axis of the shaft.

B. Slurry Displacement Construction Method

The slurry displacement method may only be used in earth strata. All slurry must be removed from the excavation prior to beginning rock excavation unless written approval has been obtained from the Engineer. Employ mineral slurries in the drilling process unless other drilling fluids are approved by the Engineer.

During construction, maintain the level of the slurry at a height sufficient to prevent caving of the hole at a level not less than 4 ft [1.2 meters] above the highest expected piezometric pressure head along the depth of the shaft. In the event of a sudden significant loss of slurry such that the slurry level cannot practically be maintained by adding slurry to the hole, or the slurry construction method fails for any other reason, delay construction until an alternate construction procedure has been approved by the Engineer.

Ensure that heavily contaminated slurry suspension, which could impair the free flow of concrete, has not accumulated in the bottom of the shaft.

SB- Construction Requirements

A. General

Do not begin construction of drilled shafts until the installation plan has been approved by the Engineer.

Do not place reinforcement or concrete in the drilled shafts without approval of the Engineer.

B. Protection of Existing Structures

If drilled shaft excavation is required within close proximity to inplace structures or utilities, take all reasonable precautions to prevent damage to those utilities and structures. Adverse effects of shaft drilling operations may include loss of ground support, lowering of water table, or vibrations detrimental to utilities and structures. If not otherwise provided in the plans and/or special provisions, the Contractor is solely responsible for evaluating the need for, design of, and installation of all reasonable precautionary features to prevent damage. These measures include, but are not limited to, selecting construction methods and procedures that will prevent damage and monitoring and controlling the vibrations from construction activities. Use vibration monitoring equipment capable of detecting velocities of 0.1 inch/second [2.50 mm/second] or less.

C. Excavation of Shafts

Shaft diameter(s) given are the minimum required for this project. The drilled shaft contractor may increase diameters to conform to his equipment or to expedite drilling operations, but no additional compensation will be paid unless the increased diameter is ordered by the Engineer.

For the following paragraph, use for shafts in rock designed for side friction.

The permanent steel casing may be set in place prior to start of shaft drilling or a temporary casing may be used for drilling and excavation, with the permanent casing placed prior to placement of reinforcement and concrete. The base of either casing must be in full contact with rock around its perimeter. In order to accomplish this, precore a casing socket into the rock or use the casing as a core barrel to penetrate the rock.

If drilling and excavation operations are performed with permanent casing in place, take care to prevent damage such as dents to the casing.

Excavate shafts occurring in strata subject to caving only after adjacent shafts are filled with concrete and the concrete has reached a minimum strength of 1450 psi [10 megapascals].

D. Cleaning and Inspection

Remove loose material from drilled shafts prior to placement of reinforcement. After the shafts have been cleaned, the Engineer will inspect the shafts for conformance to plan dimensions and construction tolerances. If permanent casing is damaged and unacceptable for inclusion in the finished shaft, the casing must be replaced at the Contractor's expense. If a portion of a shaft is underwater, demonstrate that the shaft is clean to the satisfaction of the Engineer. This includes inspection by a diver at no cost to the Department if considered necessary by the Engineer. Dewatering of the drilled shafts for cleaning, inspection and placement of reinforcement and concrete is not required. If the drilled shaft contractor chooses to dewater the shafts for convenience of construction, this work will be done at the contractor's expense.

E. Construction Tolerances

Tops of the finished shafts must be at the elevations given in the plans with a tolerance of plus ½ in [13 mm] or minus 2 in [50 mm]. The base elevations given in the plans are estimates only and may be revised by the Engineer.

Do not let rock projections extend inside the plan diameter of the shaft by more than 2 inches [50 mm].

The maximum permissible variation of the center axis at the top of any finished shaft is 3 inches [75 mm] from its plan location. No finished shaft may be out of plumb by more than 2.0% of its depth. If the center axis of the rock portion of any shaft varies by more than 3 in [75 mm] from its plan location, ream or re-drill the holes as required to bring them into the proper alignment. In the event that the above-noted tolerances are exceeded, additional reinforcing steel must be added at the direction of the Engineer. All remedial work and materials required to restore or reconstruct a shaft for final acceptance by the Engineer must be provided at no additional cost to the department.

F. Reinforcement

Completely assemble the shaft reinforcement cage and place as a unit in accordance with the installation plan. Do not weld reinforcement.

When lifting the cage for placement in the shaft, provide sufficient pick points to prevent bending of the cage that will cause deformation of the reinforcement bars. Damaged bars must be replaced at the Contractor's expense.

Laterally support the reinforcement cage at the top during placement of the concrete. The support system must be concentric to prevent racking and displacement of the cage. Provide approved spacers at intervals not exceeding 10 ft [3 m] along the cage to ensure concentric positioning for the entire depth of the cage. Provide a minimum of three perimeter spacers at each spacing interval. Add additional reinforcement to stiffen the cage at the Contractor's option and expense. Extension of the top of the cage above the elevation of the top of each finished shaft must be no less than that given in the plans.

If after placement of the reinforcement the Engineer determines that the condition of the shaft is unsuitable or if concrete placement does not immediately follow the reinforcing steel placement, the Engineer may order the cage removed from the shaft so that the integrity of the excavation, including accumulation of loose material in the bottom of the shaft and the condition of the sides of the shaft, can be determined by inspection. If the reinforcement cage moves up or down from its original position by more than 6 inches [150 mm], the Engineer may consider the work to be defective and require both reinforcement and concrete to be removed.

G. Concrete

Within 24 hours after placement of the reinforcement, place concrete in the shaft in accordance with the applicable requirements of these special provisions. The minimum placing rate for concrete in the shafts is 40 yd^3 [30 m^3] per hour.

Place concrete in water or slurry-filled shafts with a tremie or by pumping. Do not begin concrete placement until the tremie or pump line is placed to within one tremie or line diameter of the shaft base. Remove plugs if not specifically approved to remain in the shaft. Do not raise the discharge end until it becomes immersed at least 5 ft [1.5 meters] in the concrete. Immersion must remain at a minimum of 5 ft [1.5 meters] at all times after starting the flow of concrete until the shaft has been filled. If, at any time during concrete placement in water, the discharge end is raised to the top of the fluid concrete and concrete is discharged above the rising concrete level, the Engineer may consider the shaft defective and require removal of both reinforcement and concrete. Maintain a positive pressure differential in the tremie or pump line to prevent water intrusion into the concrete.

Place concrete continuously to the top of the shaft once placement has begun. Continue concrete placement until good quality concrete is evident at the top of the shaft. Vibrate the top 5 ft [1.5 meters] of concrete to assure compaction at the top of the shaft.

Remove concrete within 6 inches [150 mm] of the top of the shaft and water diluted concrete remaining to the depth ordered by the Engineer and wasted. Only concrete that meets specification requirements must remain as part of the finished shaft.

Place concrete in a dry shaft either by free-fall, by a tremie, or by a concrete pump. Free-fall placement is only permitted for dry construction where the depth of water does not exceed 3 inches [75 mm] immediately prior to commencement of the concrete pour. Let concrete fall directly to the base without contacting the rebar cage or the shaft sidewall. Use a hopper and/or dropchute to direct the concrete. If concrete placement causes the shaft sidewall to cave or slough, or if the concrete strikes the reinforcement cage or sidewall, the drilled shaft contractor must reduce the height of free-fall or reduce the rate of concrete flow into the excavation. If placement cannot be satisfactorily accomplished by free-fall, the Contractor must place the remaining concrete with a tremie or pump.

Before temporary casing is withdrawn, ensure the level of fresh concrete in the casing is at least 3 ft [1 m] above the bottom of the casing. As the casing is withdrawn, take care to maintain an adequate level of concrete within the casing so that water behind the casing is displaced upward without contaminating or displacing the shaft concrete.

Following concrete placement, thoroughly clean the projecting reinforcing steel to remove accumulations of splashed mortar. Complete this work before the concrete takes its initial set. Take care when cleaning the reinforcing steel to prevent damage to the epoxy coating or breakage of the concrete-steel bond.

SB- Method of Measurement

A. Excavation for Drilled Shafts (Earth) will be measured by length in ft [m] along the axis of each shaft from the bottom of footing to the elevation of the top of the rock or tip of the shaft. Portions in water above the ground surface are not included as excavation is not required.

B. Excavation for Drilled Shaft (Rock) will be measured by length in ft [m] along the axis of the shaft from the top of rock to the final tip of the shaft.

C. Permanent Casing will be measured by length in ft [m] along the axis of the shaft from top of installed casing to the final approved elevation of the bottom of the casing.

D. Shaft reinforcement, including spirals, will be measured by weight in pounds [kilograms] for the amount of reinforcement bars required for constructing the drilled shafts excluding reinforcement placed to facilitate construction. Additional splices due to shaft lengths exceeding plan lengths will be measured at 40 bar diameters for each splice required.

E. Shaft concrete will be measured by volume in yd^3 [m^3] for the amount of concrete required for constructing the drilled shafts based on nominal diameters and approved lengths. Concrete placed to facilitate construction or because of over-excavation will not be measured for payment.

F. Obstruction removal will be measured by volume in yd^3 [m^3] based on nominal shaft diameter and elevation of initial contact with the obstruction to the elevation where the shaft is free from the obstruction and normal drilling operations are resumed.

G. Exploratory boring will be measured by length in ft [m] from the ground surface to the tip of the boring.

SB- Basis of Payment

Payment for constructing drilled shafts will be made under separate pay items for 1) shaft excavation in rock and disposal of waste materials, 2) furnishing and placing permanent casing, 3) furnishing and placing reinforcement bars, and 4) furnishing and placing concrete as follows:

UAR

A. Payment for Item No. 2453.603 "(_____) " DIA DRILLED SHAFTS (EARTH)", will be made at the Contract price per ft [m] and shall be compensation in full for all costs of drilling, excavating, cleaning, and inspecting the shafts in earth as described herein including temporary casings.

UAR

B. Payment for Item No. 2453.603 "(_____) " DIA DRILLED SHAFTS (ROCK)", will be made at the Contract price per ft [m] and shall be compensation in full for all costs of drilling, excavating, cleaning, and inspecting the shafts in rock as described herein, including temporary casings.

UAR

C. Payment for Item No. 2453.603 "(_____) " DIA CASED SHAFTS", will be made at the Contract price per ft [m] of shaft depth and shall be compensation in full for furnishing and installing permanent casing as described herein.

UAR

D. Payment for Item No. 2401.608 "SHAFT REINFORCEMENT", will be made at the Contract price per pound [kilogram] and shall be compensation in full for all costs of furnishing and placing vertical reinforcement bars for the drilled shafts.

UAR

E. Payment for Item No. 2401.543 "SPIRAL REINFORCEMENT" will be made at the Contract price per pound [kilogram] and shall be compensation in full for all costs of furnishing and placing spiral reinforcement for the drilled shafts.

UAR

F. Payment for Item No. 2401.501 "STRUCTURAL CONCRETE (_____)", will be made at the Contract price per yd^3 [m^3] and shall be compensation in full for all costs of furnishing and placing concrete for the drilled shafts.

UAR

G. Payment for Item No. 2453.607 "OBSTRUCTION REMOVAL", will be made at the Contract price per yd^3 [m^3] and shall be compensation in full for all additional costs of excavation and disposal of materials or objects classified by the Engineer as obstructions.

UAR

H. Payment for item 2453.603 "EXPLORATORY BORINGS", will be made at the contract price per ft [m] for each boring authorized by the Engineer and shall be compensation in full for all costs of drilling, sampling, casing, filling and restoration and documenting.

No additional compensation will be paid for increased dimensions of shafts due to Contractor’s method of construction, oversized casing, caving of earth or rock, or corrective action necessitated to meet Contract requirements.

MINNESOTA DEPARTMENT OF TRANSPORTATION

DRILLED SHAFT REPORT

Bridge No. _____ S.P. No. _____ Pier No. _____ Shaft No. _____

Prime Contractor _____

Drilled Shaft Contractor _____ MnDOT Inspector _____

GENERAL INFORMATION

Date Shaft Construction Started _____

Date Shaft Construction Completed _____

River Pool Elev. _____ Water Temp. _____

Construction Method: Wet _____ Dry _____

SHAFT INFORMATION

Permanent Casing Dia.: Plan _____ in

As-built _____ in

Date Permanent Casing Set _____

Bottom Elev. of Permanent Casing _____

Top Elev. of Finished Shaft: Plan _____

As-built _____

Elev. of Initial Contact of Rock _____

Bottom Elev. of Drilled Shaft _____

Rock Shaft Dia. Plan _____ in, As-built in _____

DRILLING INFORMATION

Drill Rig Make and Mdl. _____

_____

Drilling Tools Used: _____

_____

_____

Excavation Tools Used: _____

_____

_____

Earth Drilling Start Date _____ , Finish Date _____

Rock Drilling Start Date _____ , Finish Date _____

Excavation Finished Date _____

Location and Extent of Rock Cavities or Shaft Caving:

_____

_____

_____

_____

OBSTRUCTIONS

Description of Obstructions Encountered in Earth Shaft

_____

_____

Removal Methods and Tools Used _____

_____

_____

ROCK SHAFT CLEANOUT PROCEDURE

Method _____

_____

Estimated Thickness of Sediment at Bottom of Shaft at Time of Concreting _____

CONCRETE PLACEMENT OBSERVATIONS

Concrete Mix No. _____

Placement Date _____

Ambient Temperature _____

Placement Method _____

Total Placement Time _____

Water Elev. in Shaft at Time of Conc. Placement _____

VARIATION OF SHAFT FROM PLUMB AND PLAN LOCATIONS

Plumb _____

Lateral _____

REMARKS/COMMENTS/NOTES

_____

_____

_____

_____

_____

SB2014-2471
Use on all jobs.
CREATED 9/28/1999
REVISED 6/26/2014 (20)

SB- (2471) STRUCTURAL METALS

The provisions of 2471, "Structural Metals," are supplemented as follows:

Delete the fourth paragraph of 2471.3.A.2, "Certification Requirements," and substitute the following:

The Contractor/Fabricator performing coating application must demonstrate qualification by obtaining the AISC Sophisticated Paint Endorsement (SPE), the SSPC QP Certification, or a Quality Control Plan (QCP) that is acceptable to the Engineer.

Add the following to 2471.3.F.1, "General":

Provide a minimum weld size per AASHTO/AWS D1.5 and 2471, "Structural Metal," when a weld symbol is void of a weld size.

Add the following to 2471.3.F.1, "General":

For the purpose of this specification, a weld repair is defined as any area of the welded product not in compliance with the WPS, approved Quality Manual or current edition of AASHTO AWS D1.5 Bridge Welding Code.

Delete the first paragraph of 2471.3.H.1, "Bolt Holes," and substitute the following:

Hole forming operations other than drilling will require a written procedure in the suppliers Quality Control Plan and a verification test for each hole forming process. Produce holes after any required bending, cambering, curving, or heat-treating of member. Sub-punching or sub-drilling of holes is permitted only where specifically allowed by this specification.

Delete the third paragraph of 2471.3.H.1, "Bolt Holes," and substitute the following:

All holes and slots produced will have hole quality that is free of sharp, torn, or jagged edges with walls square to the surface. Surface roughness of holes shall not exceed 1000 micro inches. As built holes shall have a size tolerance of -0/+1/32" when compared to as detailed.

Delete the fourth paragraph of 2471.3.L.1, "Galvanizing," and substitute the following:

Prior to pickling and galvanizing, abrasive blast clean galvanized surfaces to achieve a SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning". The following products are exempt from this requirement:

(1) Bearings,
(2) Channel, Bent Plate, or Bolt assembled Diaphragms,
(3) Sole Plates,
(4) Expansion Devices,
(5) Shear Connectors,
(6) Ballast Plates,
(7) Piling,
(8) Drainage Systems,
(9) Conduit,
(10) Protection Angles, and
(11) Other systems or components designated by the Engineer.

Use all of the following ONLY when the structure has a STEEL superstructure.

Delete the title of 2471.3.H.1.a, "Special Assembly," and substitute the following:

H.1.a Line Assembly

Delete the first sentence of 2471.3.H.1.a, "Special Assembly," and substitute the following:

If the contract requires line assembly, drill the connection holes in flange and web splices full size in the assembled position.

Delete the entire contents of 2471.3.H.1.b, "Full Assembly," and substitute the following:

If the contract requires full assembly, ensure the fabricator drills bolt holes for field connections, in all members and all components of each structural unit, from the solid to the specified size while assembled with the following exceptions:

1) Two sub-sized holes may be used to attach each diaphragm to stiffeners and field splice plates to webs and flanges to facilitate assembly.
2) The fabricator has the option to drill one ply of a field connection with full size holes providing it is used as a template only once.

Delete the contents of 2471.3.J, "Shop Assembly," and substitute the following:

Ensure the fabricator performs the following:

Complete fabrication, weld inspection, nondestructive testing, and any repairs, before placing any component in the assembly.

Adjust each assembly unit to the true field position with respect to alignment, camber, grade and skew, as shown on the plans, prior to drilling field connection. The fabricator may angularly rotate the assembly from true field position, with respect to grade, providing the fabricator supplies shop drawings showing elevations at all points of bearing and the relative position of webs of main members, with respect to true field position. Provide calculations to support the information shown in the drawings. Rotation is not allowed on hold over members.

For multiple span continuous structures, both straight and curved, progressive assembly is allowed providing a length no shorter than the length supported by three adjacent points of bearing is used as a minimum length of each structural sub-assembly. For these progressive assemblies, hold over pieces between adjoining assemblies shall be held to the following tolerances in relation to their documented position prior to removal:

(1) At point of support: Vertical +1/16", -0, Horizontal and Tilt +/-1/32"

(2) At member ends: Vertical, Horizontal and Tilt +/-1/32"

Clean metal surfaces in contact with each other before assembling. Assemble, pin, and draw together the parts of a member before drilling or bolting.

Assemble all structures that contain secondary connections utilizing full size holes in accordance with 2471.J.2, "Full Assembly".

In the assembly plan, identify maximum deviations of differential camber and sweep between girder lines.

Provide a written record of each shop assembly set-up. The inspection of the assembly and the written report shall be completed by a competent individual with experience in structural assemblies. If a total station or similar device is used to check the assemblies the operator shall be certified to a National Standard or the equipment manufacture. If a progressive assembly is used the written report shall contain all the required information for each assembly and a final written report for the full length and width of the structure. Include the following assembly dimensions, theoretical (as shown on a blocking diagram) and actual measurements with the written record:

(1) X, Y, and Z dimensions (horizontal offset, elevations, and tilt) at bearing points, ¼ span points, field splice locations, Plan ordinates closest to mid span and any other connection points.
(2) Span lengths.

Temporary bolts shall be drawn sufficiently tight to bring the required parts into bearing and to preclude loosening of the nut. The permanent bolt assembly shall be in accordance with 2402.3.G.2, "Connections Using High Strength Bolts".

Take apart assembled pieces, if necessary, to remove burrs, shavings, or other irregularities produced by the operation. Adjust the members if they have any twists, bends, and other deformations.

Delete the title and the contents of 2471.3.J.1, "Special Assembly," and substitute the following:

J.1 Line Assembly

Assemble, major structural components, pedestrian truss bridges, overhead sign trusses, and modular and finger expansion joint devices at the fabrication shop, unless otherwise required by the contract. Line assemble principal members [such as but not limited to beams, girders, arches, trusses, etc.] full length with all components completely assembled.

Delete the contents of 2471.3.J.2, "Full Assembly," and substitute the following:

J.2 Full Assembly

Performs full assembly as required by the Contract in accordance with the following:

(1) Assemble, in totality, the main members for the complete length as required by the Contract and assemble to the full width of the structural unit,

(2) Block all members in the "no load" or "zero gravity" position unless other requirements are specified in the Contract. This shall include at a minimum, five points of support for each individual main member: ends, ¼ points and midpoint, and

(3) Include components such as diaphragms, brackets, laterals, wind frames, links, and transverse floor systems. The Department will not require components such as expansion and deflection devices and bearings to be assembled.

Delete the first sentence in 2471.3.M.1, "Nondestructive Testing (NDT)," and substitute the following:

Performs NDT in areas designated in the Contract and/or the applicable welding code with the exceptions of all CJP horizontal web splices shall be Radiograph Tested (RT) 100%, all other CJP welds subject to a design load shall be Ultrasonic Tested (UT) 100% and backer bars, when used and left in place, shall be tested 100% using either RT or UT. Computed Radiography (CR) may be used in lieu of conventional radiography providing the CR procedure is approved by the Engineer.

Delete (1) and (2) in the second paragraph of 2471.3.M.1, "Nondestructive testing (NDT)," and replace with the following:

(1) Any location in a rolled beam or girder where
   a. the superstructure curvature is greater than 4 degrees, and/or
   b. members are designed as an interactive 2-D structure where members are sharing or distributing load to one another, and/or
   c. that requires full assembly in fabrication.
(2) Any other tension area as shown in the Project Plan.

Delete the third paragraph, (1), (2), and (3) of 2471.3.M.1, "Nondestructive testing (NDT)," and replace with the following:

Perform NDT at locations and frequencies in accordance with AASHTO/AWS D1.5, with the following modifications to the exceptions of Clause 6.7.1.2 (1):

(1) One-sixth of the web depth beginning at the point(s) of maximum tension,
(2) Also test 50 percent of the remainder of the web depth, and
(3) If the tests for (1) and (2) above find unacceptable discontinuities, test the remainder of the weld.

SB2014-2472
Use on all jobs requiring reinforcement.
CREATED 5/16/2013
REVISED 8/1/2014 (4)

SB- (2472) METAL REINFORCEMENT

The provisions of 2472, "Metal Reinforcement," are supplemented as follows:

Designer note: use only when applicable.

Add the following to the end of 2472.3.C.1, "General Requirements":

Carefully place the beam seat/pedestal reinforcement to avoid interference with drilling holes for fixed bearing anchor rods. Provide a template demonstrating that the anchor rods have a 2 inch [50 mm] clear distance to all reinforcement for the entire embedment at all bearing anchor rod locations. Confirm the proper clearance to the reinforcement with the Engineer prior to placing the affected substructure concrete. Place the beam or girder in its final position prior to drilling or coring holes for the anchor rods. If reinforcement steel is encountered during the drilling or coring process, contact the Engineer, and the Engineer will determine how to proceed. Verify the depth of the holes in the presence of the Engineer prior to inserting the anchor rods.

Delete Table 2472-1, "Maximum Spacing of Supports and Ties for Bridge Slabs," and substitute the following:

Table 2472-1
Maximum Spacing of Supports and Ties for Bridge Slabs

Bar Size Number ***English [metric]***	**Maximum Spacing for Slab Bolsters and Continuous Type High Chairs, *ft [mm]***
3 [10] and 4 [13]	3.00 [900]
5 [16], 6 [19], and 7 [22]	4.00 [1,200]

Delete the first paragraph of 2472.3.D.1, "Lap Splices," and substitute the following:

Provide lap splices as shown on the plans. If not shown on the plans, provide bar reinforcement lap lengths equal to at least 36 diameters for No. 7 [22] bar and smaller and at least 40 diameters for No. 8 [25] bar through No. 11 [36] bar. Lap bar reinforcement for No. 14 [43] bar through No. 18 [57] bar as approved by the Engineer in writing.

Delete Table 2472-2, "Reinforcement Bars Theoretical Weights Nominal Dimensions," and substitute the following:

Reinforcement bars may be marked in either U.S. Customary or metric sizes. Make conversions per the following table:

Table 2472-2
Reinforcement Bars
Theoretical Weights
Nominal Dimensions

Bar Size, Designation Number		**Diameter, *in [mm]***	**Weight, *lb/ft [kg/m]***
U.S. Customary Bar Size	**Metric Bar Size***		
3	10	0.375 [9.5]	0.376 [0.560]
4	13	0.500 [12.7]	0.668 [0.994]
5	16	0.625 [15.9]	1.043 [1.552]
6	19	0.750 [19.1]	1.502 [2.235]
7	22	0.875 [22.2]	2.044 [3.042]
8	25	1.000 [25.4]	2.670 [3.973]
9	29	1.128 [28.7]	3.400 [5.060]
10	32	1.270 [32.3]	4.303 [6.404]
11	36	1.410 [35.8]	5.313 [7.907]
14	43	1.693 [43.0]	7.650 [11.380]
18	57	2.257 [57.3]	13.600 [20.240]

* Bar designation numbers approximate the nominal diameter of the bar in millimeters

SB2014-2472.1

Use on jobs with grade 60 ksi stainless steel used as dowels or to connect approach panels to back of integral/semi-integral abutment.

CREATED 6/10/2011

REVISED 10/29/2014 (6)

SB- **Stainless Steel Reinforcement Bars (Bridge No. _____)**

UAR

Furnish and place stainless steel reinforcement bars to connect the approach panel to the bridge abutment, *and pier dowels, end blocks on the abutments, etc.…*. Stainless steel reinforcement bars are marked with the suffix "S" in the bridge plans. (Example: A504S.)

A. Materials

The requirements of 2472.2, "Materials," are modified to include the following:

Grade and Type: The material shall conform to ASTM A 955 and to one of the following Unified Numbering System (UNS) designations: S24000, S24100, S32205, S32304, S20910, S30400, S31603, S31803, or S31653.

Supply Grade 60 bars, all of the same UNS designation.

Evaluation of Corrosion Resistance: Prior to fabrication, supply test results from an independent testing agency certifying that stainless steel reinforcement from the selected UNS designation meets the requirements of Annex A1 of ASTM A955. Corrosion performance for the selected UNS designation shall be redemonstrated if the processing method is significantly altered. Removal of mill scale or pickling processes used for stainless steel reinforcement supplied under this contract shall be the same as those used to prepare the samples tested per Annex A1 of ASTM A955.

Chemical composition of the material shall conform to that specified in ASTM A 276, Table 1, Chemical Requirements, for the given UNS designation.

Heat Treatment: Bars may be furnished in one of the heat treatment conditions listed in ASTM A 955, and as needed to meet the requirements of this specification.

Finish: Supply bars that are free of dirt, mill scale, oil and debris by pickling to a bright or uniform light finish. Fabricate and bend bars using equipment that has been thoroughly cleaned or otherwise modified to prohibit contamination of the stainless steel from fragments of carbon steel or other contaminants. Bars displaying rust/oxidation, questionable blemishes, or lack of a bright or uniform pickled surface are subject to rejection.

Bending and Cutting: Bend bars in accordance with 2472, "Metal Reinforcement," and ASTM A 955. Use fabrication equipment and tools that will not contaminate the stainless steel with black iron particles. To prevent such contamination, equipment and tools used for fabrication, including bending and cutting, shall be solely used for working with stainless steel. Do not use carbon steel tools, chains, slings, etc. when fabricating or handling stainless steel reinforcement bars.

Manufacturers/Suppliers: The following manufacturers/suppliers are capable of providing material meeting this specification. Other suitable manufacturers/suppliers may also exist. Ensure that all materials supplied meet the Contract requirements.

SUPPLIERS:	CONTACT	PHONE NO.
Altec Steel, Inc. 5515 Meadow Crest Drive Dallas, TX 75229	Ross Paulson	425-823-1913

American Arminox 1230 Avenue of the Americas 7th Floor New York, NY 10020	Jean-Pierre Belmont	646-283-3837
Contractors Materials Co. 10320 S. Medallion Drive Cincinnati, OH 45241	David Friedman	513-719-0112
Dunkirk Specialty Steel 88 Howard Ave Dunkirk, NY 14048	Gary Zaffalon	800-916-9133 716-366-1000 Ext 323
North American Stainless 6870 Highway 42 East Ghent, KY 41045	Jason Sharp	800-499-7833 Ext 6360
Salit Specialty Rebar 3235 Lockport Road Niagara Falls, NY 14305	Kevin Cornell	877-299-1700 716-299-1990
Talley Metals P.O. Box 2498 Hartsville, SC 29551	Melba Deese	800-334-8324 Ext 712-2356

Control of Material: All reinforcement bars or bar bundles delivered to the project site shall be clearly identified with tags bearing the identification symbols used in the Plans. The tags shall also include the UNS designation, heat treat condition, heat number, grade (corresponding to minimum yield strength level), and sufficient identification to track each bar bundle to the appropriate Mill Test Report.

In accordance with 1603.2, "Sampling and Testing," supply samples to the MnDOT Materials Laboratory for testing. Supply one three foot long sample per heat, per bar size. Each sample shall include one complete set of bar markings. Individually tag each sample with the same information listed above per "Control of Material" and include a copy of the associated Mill Test Report (MTR). Straighten the test specimen if sample comes from a coil.

Provide MTRs for the Project that:

1. Are from the supplying mill verifying that the stainless reinforcement provided has been sampled and tested and the test results meet ASTM A 955, ASTM A 276, Table 1 and the Contract requirements;

2. Include a copy of the chemical analysis of the steel provided, with the UNS designation, the heat lot identification, and the source of the metal if obtained as ingots from another mill;

3. Include a copy of tensile strength, yield strength and elongation tests per ASTM A 955 on each of the bar sizes of stainless steel reinforcement provided;

4. Permit positive determination that the reinforcement provided is that which the test results cover;

5. Include a statement certifying that the materials meet 1601, "Source of Supply and Quality," regarding material being melted and manufactured in the United States; and

6. Certify that the bars have been pickled to a bright or uniform light finish.

B. Construction

Conform to the construction methods in 2401, "Concrete Bridge Construction," and 2472, "Metal Reinforcement," except as modified below:

Ship, handle, store, and place the stainless steel reinforcement bars according to the applicable provisions with the following additions and exceptions:

1. Prior to shipping, ensure that all chains and steel bands will not come into direct contact with the stainless steel reinforcement bars. Place wood or other soft materials (i.e., thick cardboard) under the tie-downs. Alternatively, use nylon or polypropylene straps to secure the stainless steel reinforcement bars.

2. When bundles of reinforcement steel and stainless steel reinforcement bars must be shipped one on top of the other, load the stainless steel reinforcement bars on top. Use wooden spacers to separate the two materials.

3. Outside storage of stainless steel reinforcement bars is acceptable. Cover the stainless steel reinforcement bars with tarpaulins.

4. Store stainless steel reinforcement bars off the ground or shop floor on wooden supports.

5. Do not use carbon steel tools, chains, slings, etc. when fabricating or handling stainless steel reinforcement bars. Only use nylon or polypropylene slings. Protect stainless steel from contamination during construction operations including any cutting, grinding, or welding above or in the vicinity of stainless steel.

6. Alternatively, epoxy coated bars may be substituted for stainless steel bars where the Plans indicate that the bars are immediately adjacent to (touching) galvanized expansion joint device anchorages, but only for the bars that run parallel to the length of the expansion device and that are completely within 12 inches [305 mm] of the device.

7. Place all stainless steel reinforcement on bar chairs that are solid plastic, stainless steel, or epoxy coated steel. Fabricate stainless steel metal chairs and continuous metal stainless steel supports from stainless steel conforming to the same requirements and UNS designations as stainless steel bar reinforcement as listed in section A, “Materials”. Use stainless steel chairs with plastic-coated feet above steel beams as per 2472, "Metal Reinforcement".

Use one of the listed tie wires to tie stainless steel reinforcement:

- 16 gauge or heavier plastic or nylon coated soft iron wire; or
- Fabricated from stainless steel conforming to the same requirements as stainless steel bar reinforcement as listed in section A, “Materials”, dead soft annealed, annealed at size. The tie wire does not need to be of the same UNS designation as the bar reinforcement.

Do not tie stainless steel reinforcing to, or allow contact with uncoated reinforcement, bare metal forming hardware, or to galvanized attachments or galvanized conduits. Direct contact with these materials is *not* acceptable. When stainless steel reinforcing or dowels must be near uncoated steel reinforcing, bare metal forming hardware or galvanized metals, maintain a minimum 1 in [25 mm] clearance between the two metals. Where insufficient space exists to maintain this minimum, sleeve the bars with a continuous 1/8 in [3 mm] minimum thickness polyethylene or nylon tube extending at least 1 in [25 mm] in each direction past the point of closest contact between the two dissimilar bars and bind them with nylon or polypropylene cable ties. Stainless steel reinforcing bars are allowed to be in direct contact with undamaged epoxy coated reinforcing bars. Stainless steel reinforcing is permitted to contact or be tied to shear studs on steel girders.

Uncoated fasteners (such as used for static safety lines on beams), anchors, lifting loops, etc., that extend from the top flange of prestressed beams into the bridge deck shall be completely removed or cut off flush with the top flange of the beam prior to casting the deck.

Splices: Splices shall generally be of the lap type. Stainless steel mechanical splices may be used in certain situations, subject to the approval of the Engineer.

If it is necessary to increase the number of bar laps from those indicated in the Plans, provide copies of plan sheets to the Engineer showing the revised reinforcement layout with length and location of laps. The Engineer must approve the location of new lap splices prior to fabrication. New lap splices must be at least as long as those shown in the plans. No additional compensation or changes in the reinforcement bar quantities will be made for such splices.

Provide mechanical splices for stainless steel reinforcement made of stainless steel conforming to one of the UNS designations listed in section A, "Materials", above.

Approval: Stainless steel reinforcement placed in any member must be inspected and approved by the Engineer before placing concrete. Concrete placed in violation of this specification may be rejected and removal required, as directed by the Engineer.

C. Method of Measurement

Measurement of the stainless steel reinforcement will be by weight in pounds (kg) based on Table 5.2.2.1 of the MnDOT LRFD Bridge Design Manual, regardless of the actual unit weight of the material supplied.

D. Basis of Payment

Payment for Item No. 2401.541 "REINFORCEMENT BARS (STAINLESS-60KSI)" will be made at the Contract price per pound [kilogram] and shall be compensation in full for all costs of furnishing and installing the stainless steel reinforcement with all component materials as described above, including fabricating and shipping.

SB2014-2472.2

Use on jobs with grade 75 ksi stainless steel deck and barrier reinforcement.

CREATED 6/10/2011

REVISED 10/29/2014 (4)

SB- **Stainless Steel Reinforcement Bars (Bridge No. _____)**

UAR

Furnish and place stainless steel reinforcement bars in the concrete deck slab, barriers, *and end blocks on the abutments, etc.*…. Stainless steel reinforcement bars are marked with the suffix "S" in the bridge plans. (Example: A504S.)

A. Materials

The requirements of 2472.2, "Materials," are modified to include the following:

Grade and Type: The material shall conform to ASTM A 955 and to one of the following Unified Numbering System (UNS) designations: S24000, S24100, S32205, S32304, S20910, S30400, S31603, S31803, or S31653.

Supply Grade 75 bars, all of the same UNS designation.

Evaluation of Corrosion Resistance: Prior to fabrication, supply test results from an independent testing agency certifying that stainless steel reinforcement from the selected UNS designation meets the requirements of Annex A1 of ASTM A955. Corrosion performance for the selected UNS designation shall be redemonstrated if the processing method is significantly altered. Removal of mill scale or pickling processes used for stainless steel reinforcement supplied under this contract shall be the same as those used to prepare the samples tested per Annex A1 of ASTM A955.

Chemical composition of the material shall conform to that specified in ASTM A 276, Table 1, Chemical Requirements, for the given UNS designation.

Heat Treatment: Bars may be furnished in one of the heat treatment conditions listed in ASTM A 955, and as needed to meet the requirements of this specification.

Finish: Supply bars that are free of dirt, mill scale, oil and debris by pickling to a bright or uniform light finish. Fabricate and bend bars using equipment that has been thoroughly cleaned or otherwise modified to prohibit contamination of the stainless steel from fragments of carbon steel or other contaminants. Bars displaying rust/oxidation, questionable blemishes, or lack of a bright or uniform pickled surface are subject to rejection.

Bending and Cutting: Bend bars in accordance with 2472, "Metal Reinforcement," and ASTM A 955. Use fabrication equipment and tools that will not contaminate the stainless steel with black iron particles. To prevent such contamination, equipment and tools used for fabrication, including bending and cutting, shall be solely used for working with stainless steel. Do not use carbon steel tools, chains, slings, etc. when fabricating or handling stainless steel reinforcement bars.

Manufacturers/Suppliers: The following manufacturers/suppliers are capable of providing material meeting this specification. Other suitable manufacturers/suppliers may also exist. Ensure that all materials supplied meet the Contract requirements.

SUPPLIERS:	CONTACT	PHONE NO.
Altec Steel, Inc. 5515 Meadow Crest Drive Dallas, TX 75229	Ross Paulson	425-823-1913

American Arminox 1230 Avenue of the Americas 7th Floor New York, NY 10020	Jean-Pierre Belmont	646-283-3837
Contractors Materials Co. 10320 S. Medallion Drive Cincinnati, OH 45241	David Friedman	513-719-0112
Dunkirk Specialty Steel 88 Howard Ave Dunkirk, NY 14048	Gary Zaffalon	800-916-9133 716-366-1000 Ext 323
North American Stainless 6870 Highway 42 East Ghent, KY 41045	Jason Sharp	800-499-7833 Ext 6360
Salit Specialty Rebar 3235 Lockport Road Niagara Falls, NY 14305	Kevin Cornell	877-299-1700 716-299-1990
Talley Metals P.O. Box 2498 Hartsville, SC 29551	Melba Deese	800-334-8324 Ext 712-2356

Control of Material: All reinforcement bars or bar bundles delivered to the project site shall be clearly identified with tags bearing the identification symbols used in the Plans. The tags shall also include the UNS designation, heat treat condition, heat number, grade (corresponding to minimum yield strength level), and sufficient identification to track each bar bundle to the appropriate Mill Test Report.

In accordance with 1603.2, "Sampling and Testing," supply samples to the MnDOT Materials Laboratory for testing. Supply one 3 ft [900 mm] long sample per heat, per bar size. Each sample shall include one complete set of bar markings. Individually tag each sample with the same information listed above per "Control of Material" and include a copy of the associated Mill Test Report (MTR). If material is from a coil, the test specimen shall be straightened by the supplier.

Provide MTRs for the Project that:

1. Are from the supplying mill verifying that the stainless reinforcement provided has been sampled and tested and the test results meet ASTM A 955, ASTM A 276, Table 1 and the Contract requirements;

2. Include a copy of the chemical analysis of the steel provided, with the UNS designation, the heat lot identification, and the source of the metal if obtained as ingots from another mill;

3. Include a copy of tensile strength, yield strength and elongation tests per ASTM A 955 on each of the bar sizes of stainless steel reinforcement provided;

4. Permit positive determination that the reinforcement provided is that which the test results cover;

5. Include a statement certifying that the materials meet 1601, "Source of Supply and Quality," regarding material being melted and manufactured in the United States; and

6. Certify that the bars have been pickled to a bright or uniform light finish.

B. Construction

Conform to the construction methods in 2401, "Concrete Bridge Construction," and 2472, "Metal Reinforcement," except as modified below:

Ship, handle, store, and place the stainless steel reinforcement bars according to the applicable provisions with the following additions and exceptions:

1. Prior to shipping, ensure that all chains and steel bands will not come into direct contact with the stainless steel reinforcement bars. Place wood or other soft materials (i.e., thick cardboard) under the tie-downs. Alternatively, use nylon or polypropylene straps to secure the stainless steel reinforcement bars.

2. When bundles of reinforcement steel and stainless steel reinforcement bars must be shipped one on top of the other, load the stainless steel reinforcement bars on top. Use wooden spacers to separate the two materials.

3. Outside storage of stainless steel reinforcement bars is acceptable. Cover the stainless steel reinforcement bars with tarpaulins.

4. Store stainless steel reinforcement bars off the ground or shop floor on wooden supports.

5. Do not use carbon steel tools, chains, slings, etc. when fabricating or handling stainless steel reinforcement bars. Only use nylon or polypropylene slings. Protect stainless steel from contamination during construction operations including any cutting, grinding, or welding above or in the vicinity of stainless steel.

6. Alternatively, epoxy coated bars may be substituted for stainless steel bars where the Plans indicate that the bars are immediately adjacent to (touching) galvanized expansion joint device anchorages, but only for the bars that run parallel to the length of the expansion device and that are completely within 12 inches [305 mm] of the device.

7. Place all stainless steel reinforcement on bar chairs that are solid plastic, stainless steel, or epoxy coated steel. Fabricate stainless steel metal chairs and continuous metal stainless steel supports from stainless steel conforming to the same requirements and UNS designations as stainless steel bar reinforcement as listed in section A, "Materials". Use stainless steel chairs with plastic-coated feet above steel beams, as per 2472, "Metal Reinforcement".

Use one of the listed tie wires to tie stainless steel reinforcement:

- 16 gauge or heavier plastic or nylon coated soft iron wire; or
- Fabricated from stainless steel conforming to the same requirements as stainless steel bar reinforcement as listed in section A, “Materials”, dead soft annealed, annealed at size. The tie wire does not need to be of the same UNS designation as the bar reinforcement.

Do not tie stainless steel reinforcing to, or allow contact with uncoated reinforcement, bare metal forming hardware, or to galvanized attachments or galvanized conduits. Direct contact with these materials is *not* acceptable. When stainless steel reinforcing or dowels must be near uncoated steel reinforcing, bare metal forming hardware or galvanized metals, maintain a minimum 1 in [25 mm] clearance between the two metals. Where insufficient space exists to maintain this minimum, sleeve the bars with a continuous 1/8 in [3 mm] minimum thickness polyethylene or nylon tube extending at least 1 in [25 mm] in each direction past the point of closest contact between the two dissimilar bars and bind them with nylon or polypropylene cable ties. Stainless steel reinforcing bars are allowed to be in direct contact with undamaged epoxy coated reinforcing bars. Stainless steel reinforcing is permitted to contact or be tied to shear studs on steel girders.

Uncoated fasteners (such as used for static safety lines on beams), anchors, lifting loops, etc., that extend from the top flange of prestressed beams into the bridge deck shall be completely removed or cut off flush with the top flange of the beam prior to casting the deck.

Splices: Splices shall generally be of the lap type. Stainless steel mechanical splices may be used in certain situations, subject to the approval of the Engineer.

If it is necessary to increase the number of bar laps from those indicated in the Plans, provide copies of plan sheets to the Engineer showing the revised reinforcement layout with length and location of laps. The Engineer must approve the location of new lap splices prior to fabrication. New lap splices must be at least as long as those shown in the plans. No additional compensation or changes in the reinforcement bar quantities will be made for such splices.

Provide mechanical splices for stainless steel reinforcement made of stainless steel conforming to one of the UNS designations listed in section A, "Materials", above.

Approval: Stainless steel reinforcement placed in any member must be inspected and approved by the Engineer before placing concrete. Concrete placed in violation of this specification may be rejected and removal required, as directed by the Engineer.

C. Method of Measurement

Measurement of the stainless steel reinforcement will be by weight in pounds (kg) based on Table 5.2.2.1 of the MnDOT LRFD Bridge Design Manual, regardless of the actual unit weight of the material supplied.

D. Basis of Payment

Payment for Item No. 2401.541 "REINFORCEMENT BARS (STAINLESS-75KSI)" will be made at the Contract price per pound [kilogram] and shall be compensation in full for all costs of furnishing and installing the stainless steel reinforcement with all component materials as described above, including fabricating and shipping.

SB2014-2476.1

Use for Repainting Projects with Non-Lead Paints Inplace.

CREATED 9/13/1999

REVISED 5/16/2013 (7)

SB- METHODS FOR PAINT REMOVAL AND WASTE DISPOSAL OF NON-LEAD PAINT

Any method of paint removal which meets the requirements for surface preparation and complies with Contract requirements can be used by the Contractor. Owner responsibility for recording the Contractor's testing, waste transport and disposal processes are described in MnDOT's manual for "MnDOT Steel Structure Paint Removal Program for Contractors" available on the Web at http://www.dot.state.mn.us/environment/regulatedmaterials/paintremoval.html.

SB- Disposal of Waste Materials

A. Information Requirements on Hazardous Wastes

Subject to penalty under 1807, "Failure to Complete the Work on Time," no later than 30 calendar days after any hazardous waste is transported off site, the Contractor will provide the following information to the Engineer:

1. Type of waste shipped;
2. Quantity of waste shipped;
3. Date of waste shipment;
4. Name and address of transporter;
5. Name and location of disposal site;
6. Final signed copies of the hazardous waste manifest and Land Disposal Restriction (LDR) form for all hazardous waste.

B. Handling and Disposal of Non-hazardous Residue

The Contractor shall notify the Project Engineer of each waste disposal site. Subject to penalty under MnDOT 1807, "Failure to Complete the Work on Time," within 30 calendar days of transportation of waste off site, the Contractor shall furnish to the Engineer records of disposal including, but not limited to, waste manifests which have been signed by the receiving approved landfill, scale tickets, invoices and any laboratory analysis.

Unless otherwise required in these special provisions, disposal of non-hazardous residue in a MnDOT approved landfill is acceptable.

As the surface preparation work progresses, the Contractor may dispose of non-hazardous blasting residue, and other residue that may prove to be non-hazardous, in all MPCA permitted lined Sanitary/Industrial landfills in Minnesota.

Disposal of waste material, such as paint pails, rags, clothing, waste oil, spent cleaning solvents, brushes, etc., with the blasting residue is prohibited.

Hauling and placement of blast-residue in accordance with appropriate specifications for designated usage will be the responsibility of the Contractor. The material must be covered with tarps if hauled in an open truck to prevent loss of blast residue.

SB- **Method of measurement**

Containment, collection and disposal of waste material and blasting residue will be measured by a single lump sum.

SB- **Basis of Payment**

A. Payment for Item No. 2476.601 "WASTE COLLECTION AND DISPOSAL", will be made at the Contract price per lump sum and shall be compensation in full for all costs of containing, collecting, transporting and disposing of the abrasive blasting residue, as described above, including all work incidental thereto.

B. Except for payment for "WASTE COLLECTION AND DISPOSAL", compliance with all of the requirements of 1717 and those described herein shall be considered an incidental expense for which no direct compensation will be made.

SB2014-2476.2

Use for Class I, II, III, or IV Projects when generating lead paint residue.
Designers: You are required to call 651-366-3630 of the office of Environmental Services (MS 620) of the location(s) of bridges with lead residues scheduled to be re-painted, and a letting date for the contract.

CREATED 6/6/1997
REVISED 5/16/2013 (8)

SB- CONTAINMENT AND DISPOSAL OF WASTE MATERIALS

The provisions of 1717, "Air, Land, and Water Pollution," are supplemented as follows:

SB- Handling and Disposal of Waste Materials

Contain waste materials on site and provide for their transportation and disposal in accordance with Minnesota Pollution Control Agency (MPCA) regulation under Minnesota Rules 7045 and MnDOT criteria. Waste materials, which include but are not limited to, blasting residue (spent abrasives or paint chips), waste paint solvents, cleaning solutions, and unusable paint must be managed as hazardous waste except as described below for blasting residue. Waste disposable Personnel Protection Equipment (PPE) from blasting operations must be treated as a hazardous waste unless the Contractor provides proof that the waste is nonhazardous.

Owner responsibility for recording the Contractor's testing, waste transport and disposal processes are described in MnDOT's manual for "MnDOT Steel Structure Paint Removal Program for Contractors" available on the web at http://www.dot.state.mn.us/environment/regulatedmaterials/paintremoval.html.

SB- Storage of Materials

At all times during cleaning and painting operations, provide locked storage of cleaning and painting materials to prevent access by unauthorized persons.

SB- Loss of Paint Materials into Public Waters

In the event of accidental loss of paint, cleaning materials or debris into public waters, take immediate action to recover the lost materials and report the incident immediately by telephone to the State Duty Officer (1-800-422-0798) followed by a written report addressed to MPCA, Water Quality Division, Compliance and Enforcement Section, 520 Lafayette Road, St. Paul, Minnesota 55155.

SB- Lead Paint Removal

The original paint system on Bridge No. _____ contains lead. Precautions to protect worker health and safety are necessary since operations will result in removal or detachment of paint from metal surfaces.

A. Lead Exposure Plan

OSHA rules and regulations pertaining to Lead Exposure in Construction – 29 CFR 1926.62 – require a written plan to minimize worker exposure to lead. Furnish two copies of this plan to the Engineer.

Compliance with provisions of MPCA Rule 7025.0230-7025.0380, which are applicable to abrasive blasting and lead paint removal, is required on this project.

B. Safety Equipment for Department Paint System Inspectors

Provide the following items, services and information for use by each of the Department inspectors assigned to the project.

1. Protective clothing to be worn within the enclosure(s) during abrasive blasting operations. This clothing must be available at the job site and daily laundering or disposal provided for by the Contractor.

2. Unrestricted use of cleaning and washing facilities, including vacuums, showers, sinks, lockers, soaps or cleansers that are available for use by the Contractor's personnel.

3. A copy of all information supplied to workers about hazards and safe working practices in lead removal areas, including all information on lead concentrations measured by the Contractor for the duration of lead removal and clean-up operations.

C. Notification to MPCA and Owner/Occupants of Nearby Buildings

Provide written notice to the residents of each dwelling unit and the owner or administrator of each occupied building within 200 ft [60 m] of the bridge with lead paint removal exceeding 500 ft^2 [50 m^2]. State in the notice that lead paint removal will occur, and specify the days and hours during which lead paint removal and clean-up is anticipated. The notice must advise that children under the age of ten are not permitted to enter the outdoor area within 100 ft [30 m] of the bridge during the daily paint removal and clean-up operations.

In addition, for buildings within 100 ft [30 m] of the bridge, the building owner or administrator and residents must be advised in the notice that during lead removal and clean-up (a) all doors, windows, and storm windows should be closed on the walls facing the bridge and the adjoining walls; and (b) all air conditioning units on walls facing the bridge and the adjoining walls should be turned off; and (c) take inside or remove from the exterior property all pets, pet houses, pet food and water bowls, children's toys and play equipment within 100 ft [30 m] of the bridge should be removed or tightly covered with an impermeable material.

Provide written notice to the Commissioner of the Minnesota Pollution Control Agency of the scheduled starting and completion days and times for lead paint removal. Include in the notice (a) the bridge location, (b) a copy of Contract requirements pertaining to lead paint removal and disposal, (c) the name, business address, and telephone number of the Contractor and the Project Engineer, (d) the distances to all occupied buildings within 200 ft [60 m] of the bridge, (e) a list of owners, administrators and residents notified with examples of written notices, (f) the proposed waste disposal methods for all materials containing lead paint residues, (g) a brief description of the proposed methods of lead paint removal, and (h) any other information required by law or MPCA regulation.

Give all required notices a minimum of 10 working days prior to beginning paint removal. If beginning of removal is delayed by more than five working days from the date stated in the notices, provide revised written notices prior to the original starting date for paint removal.

Restrict access to work areas during paint removal and provide warning signs at logical access points sufficiently remote from the work area to minimize possibility of accidental exposure to lead.

D. Methods for Paint Removal

As removal of the lead-based paint system is required, follow special procedures to ensure that the material, when removed from the bridge, does not contaminate the surrounding air, water and land.

Any method of paint removal which meets the requirements for surface preparation and complies with Contract requirements can be used by the Contractor. Since the removal method is selected by the Contractor, all costs of compliance with these specifications are incidental except as may be provided under payment provisions in the proposal.

If paint is removed by use of dry abrasive blasting, the following materials are acceptable:

1. Mineral aggregate abrasive mixed with BLASTOX approximately 15% by weight, or in proportion as recommended by the manufacturer. The residue resulting from the use of BLASTOX will not be removed off site until the Toxicity Characteristic Leaching Procedure (TCLP) for Resource Conservation Recovery Act (RCRA) metals renders it non-hazardous. The testing of PH shall also be included for indication of presence of BLASTOX.

NOTE: The Contractor must manage residue resulting from the following abrasives, regardless of the TCLP test, as hazardous waste.

1. Mineral aggregate abrasive.

2. Steel grit or steel shot abrasives.

If recyclable steel grit or shot is used as an abrasive blasting material, provide a recovery system that is self-contained for abrasive blasting and recovery. It must be a recovery system which does not allow fugitive emissions from the recovery operation. The recovery equipment must be such that the amount of contaminants in the clean recycle abrasive is less than one percent by weight.

3. Other abrasive mixtures approved by the Engineer.

E. Containment

Prior to the start of surface preparation operations, submit to the Engineer detailed plans of the proposed containment and blasting residue collection system. The submittal must also identify the method proposed for paint removal, the composition of the blast medium, and the details of the means of attachment of the containment system and painting platform to the bridge. In the event that the system is in contact with the bridge barrier railing or previously painted structural steel, the submittal must indicate the method of protecting those surfaces from any visible marring. No system which will produce stresses exceeding the allowable stresses on bridge members is allowed. Furnish calculations showing loads and stresses if requested by the Engineer. Review of the Contractor's submittal does not relieve the Contractor of responsibility for repairing damage to the bridge and for providing containment which prevents contamination of air, water and land.

In the event any marring or structural damage is observed, immediately modify the method of suspension and bridge protection system to the Engineer's satisfaction and at the Contractor's expense. Additionally, any damage must be corrected as directed by the Engineer at no cost to the State.

Use the following paragraph IF WORK IS ALL CLASS I OR II

Enclose each area where abrasive blasting is being performed over land using tarpaulins weighted or securely fastened on the bottom edges so as to maintain the position of this edge over ground cover or paved surfaces. Where a complete bottom enclosure is not provided, ensure side enclosures extend from the bottom of the bridge deck to the ground surface, and adjacent tarpaulins overlap by at least 3 ft [1 m]. Determine the lengths by the work area (as necessary to confine the blasting residue) and ensure the width of ground cover is a minimum of 30 ft [9 m] beyond the outside edges of side enclosures. Ground cover is not required for unbroken paved surfaces. Tip up all edges of the ground cover to prevent spent material from spilling over the edges. Overlap adjacent edges a minimum of 1.5 ft [one-half m].

Use the following paragraph IF WORK IS ALL CLASS III OR IV

Provide containment that will completely enclose the work area on the bridge. If dry abrasive blasting is used to remove lead-based paints, provide exhaust ventilation with a dust collector for the enclosures. Exhaust ventilation must be sufficient to maintain negative air pressure (inside air pressure must be slightly less than outside ambient air pressure) within the enclosures.

Use the following TWO paragraphs IF SOME BRIDGES ARE CLASS I OR II AND OTHERS ARE III OR IV

For bridges _____ and _____, provide containment that will completely enclose the work area on the bridge and, if dry abrasive blasting is used to remove lead-based paints, provide exhaust ventilation with a dust collector for the enclosures. Exhaust ventilation must be sufficient to maintain negative air pressure (inside air pressure must be slightly less than outside ambient air pressure) within the enclosures.

For all other bridges, enclose each area where abrasive blasting is being performed over land using tarpaulins weighted or securely fastened on the bottom edges so as to maintain the position of this edge over ground cover or paved surfaces. Where a complete bottom enclosure is not provided, extend side enclosures from the bottom of the bridge deck to the ground surface, and ensure adjacent tarpaulins overlap by at least 3 ft [1 m]. Determine the lengths by the work area (as necessary to confine the blasting residue) and ensure the width of ground cover is a minimum of 30 ft [9 m] beyond the outside edges of side enclosures. Ground cover is not required for unbroken paved surfaces. Tip up all edges of the ground cover to prevent spent material from spilling over the edges. Ensure adjacent edges overlap a minimum of 1.5 ft [one-half m].

Construct enclosures to minimize the escape of blasting residue during adverse weather conditions. Provide tarpaulins composed of canvas, heavy-gauge nylon, or heavy-gauge nylon-reinforced vinyl. The tarpaulins must be free of holes and tears, be suitable for holding blasting residue and be 100% impermeable to blasting residue as rated by the manufacturer.

F. Dust Emissions

The Contractor's operations and containment must be modified if any significant dust emissions are observed by the Engineer during removal of lead based paints. Suspend abrasive blasting operations if significant dust emissions are observed and during times when adverse weather conditions prevent the enclosures from effectively containing the blasting residue.

SB- Waste Management, Testing and Disposal of Blasting Residue

A. Storage

Provide containers intended to hold hazardous waste which meet the requirements in CFR 49, subp. 178.502. The containers must meet the requirements of the identification codes 1A2 (steel drum with removable head) or 1H2 (plastic drum with removable head.) The Contractor has the option to store blasting residue for transportation in roll-offs supplied by the MnDOT hazardous waste contractor.

If spent abrasive is stored temporarily, it must be stored in closed drums or roll-offs. The materials from the bridge are to remain in storage until the results of testing, as described in SB-____.5B, have been reviewed by the Engineer and the Contractor is notified by the Engineer that s/he can proceed with disposal of the materials representing the test. Materials must be covered at all times during storage. Use methods for handling of materials during loading, unloading and transport that minimize dust emissions.

B. Disposal of Blasting Residue

Blasting residue resulting from the use of mineral aggregate abrasives mixed with Blastox must be treated as hazardous waste until the residue has been tested and determined not to be hazardous waste. The Department will sample the blasting residue and will deliver samples from the bridge to a laboratory selected by the Contractor. The Contractor shall engage the services of a qualified independent laboratory to have the samples **"priority"** analyzed for the Resource Conservation Recovery Act (RCRA) metals by the **"priority"** Toxicity Characteristic Leaching Procedure (TCLP). Manage these residues according to test results. Furnish copies of all test results to the Engineer. **Regardless of "priority" TCLP testing results, all blasting residues resulting from the use of any abrasive mixture, other than BLASTOX mixtures that test non-hazardous, must be managed as a hazardous waste.**

C. Hazardous Wastes

Classify all blasting residue as a hazardous waste, and transport and dispose of through the MnDOT hazardous waste contractor. Call (651) 366-3630 for present hazardous waste contract and prices.

Subject to penalty under MnDOT 1807, "Failure to Complete the Work on Time," no later than 30 calendar days after any waste is transported off site, the Contractor shall provide the following information to the Project Engineer:

1. Type of waste shipped;
2. Quantity of waste shipped;
3. Date of waste shipment;
4. Name and address of transporter;
5. Name and location of disposal site;
6. Final signed copies of the hazardous waste manifest and Land Disposal Restriction (LDR) form.

Disposal of waste material, such as paint pails, rags, clothing, waste oil, spent cleaning solvents, brushes, etc., with the blasting residue is prohibited.

SB- Handling and Disposal of Non-hazardous Residue

The Contractor shall notify the Project Engineer of each waste disposal site. Subject to penalty under 1807, "Failure to Complete the Work on Time," within 30 calendar days of transportation of waste off site, the Contractor shall furnish to the Engineer records of disposal including, but not limited to, waste manifests which have been signed by the receiving approved landfill, scale tickets, invoices and any laboratory analysis.

Unless otherwise required in these special provisions, disposal of non-hazardous residue in a MnDOT approved landfill is acceptable.

As the surface preparation work progresses, dispose of non-hazardous blasting residue, and other residue that may prove to be non-hazardous, in all MPCA permitted, lined Sanitary/Industrial landfills in Minnesota.

Hauling and placement of blast-residue in accordance with appropriate specifications for designated usage is the responsibility of the Contractor.

SB- Method of Measurement

A. TCLP tests will be measured by each test performed.

B. Containment, collection and disposal of waste material and blasting residue will be measured by a single lump sum.

SB- Basis of Payment

A. Payment for Item No. 2013.602 “TCLP TEST”, will be made at the Contract price per each and shall be compensation in full for all costs of collecting, transporting and testing the blast residue samples as described above.

B. Payment for Item No. 2476.601 “LEAD SUBSTANCES COLLECTION & DISPOSAL”, will be made at the Contract price per lump sum and shall be compensation in full for all costs of containing, collecting, transporting and disposing of the abrasive blasting residue whether hazardous or non-hazardous, as described above, including all work incidental thereto.

C. Except for payment for “LEAD SUBSTANCES COLLECTION & DISPOSAL” and “TCLP TEST”, compliance with all of the requirements described herein shall be considered an incidental expense for which no direct compensation will be made.

SB2014-2478

Use on all jobs requiring 2478 paint system, or on repainting of inplace bridges.

CREATED 11/25/1997

REVISED 2/12/2014 (15)

SB- **(2478) ORGANIC ZINC-RICH PAINT SYSTEM**

Add the following as a new second paragraph of 2478.3A:

For the preparation and application of field applied coatings, Contractors must perform work with staff meeting the requirements of The Society of Protective Coatings Certified Application Specialist (SSPS CAS) Level 2. One CAS Level 2 is required on sight overseeing the work in each work area up to a crew of 10 workers. Multiple work areas will require an additional CAS for each area.

Add the following to 2478.3.C.1, "Quality Control Plan (QCP) Requirements" supplementing Table 2478-1 requirement, "Blast profile inspection per ASTM D 4417":

- Steel Girders – minimum of three readings per each blasted
- Diaphragms – three readings minimum per each lot blasted*****
- Sole Plates – three readings minimum per each lot blasted*****
- Pedestrian Bridges – minimum of three readings on each truss and a minimum of three readings on the floor beam
- Railing – three readings minimum for each 100 lineal feet [30 m] of rail
- Bridge Truss – three readings minimum for each 1000 sq. ft. [93 sq. m] or the amount of truss blasted in an eight hour shift (whichever is less)

*****The amount of diaphragms or sole plates going through an automated blast machine at one time or the amount blasted in an eight hour shift

Items not covered by this list shall have three documented profile readings for every 1000 sq. ft. [93 sq. m] blasted.

For the following paragraph, use where beams are 3309, "High-Strength Low-Alloy Structural Steel," steel and are partially painted at bridge joints (this is typical).

Paint in accordance with the provisions of 2478 all structural steel and steel bearing assemblies for Br. No. _____ that are within 7 ft [2 m] of the end of the beams or girders as measured along the centerline of the beams or girders. In addition, paint the fascia beams their full length from end to end of bridge on the following designated surfaces: the outboard surfaces of the bottom of the top flange, the web, the top of bottom flange, and the edge of the bottom flange; the bottom of the bottom flange; and the inboard edge of the bottom flange.

For the following paragraph, use where beams are 3310, "High-Strength Low-Alloy Collumbium-Vanadium Steel," steel or when the District requires that a full paint system be applied.

Paint all structural steel members _____ of Bridge No. _____.

For the following paragraph, specify color.

Add the following to 2478.3.F.5, "Finish Coats":

The color must match Federal Standard 595 C No. _____ and have a semi-gloss finish.

SB2014-2478.1

Use when required for Historic Bridges or a higher level of aesthetics where overspray is NOT acceptable.

CREATED 5/16/2013

REVISED 5/16/2013

SB- **Protection of Non-Painted Surfaces**

Delete the sixth paragraph of 2478.3.B, "General," and substitute the following:

Fill in the blank with the reason for this aesthetic sensitivity. (Historic, high visibility to the public, etc.)

The structure is aesthetically sensitive because of _____. Protect non-painted surfaces that are adjacent to the painted surfaces from overspray. The Engineer will not allow overspray. The Engineer will visually inspect the non-painted surfaces. If the Engineer determines that there is overspray on the non-painted surfaces, then the Engineer will deem the materials as non-conforming in accordance with 1503, "Conformity with Contract Documents," and 1512, "Unacceptable and Unauthorized Work". The Engineer will direct the contractor to immediately correct the oversprayed surface and submit a written non-conformance report, containing data required by the Engineer to ensure compliance with the contract. Perform additional work as required by the Engineer at no additional cost to the Department.

SB2014-2478.2

Use when required by the Regional Engineer and when preexisting structures are to be repainted with 2478, 2479, and MC.

CREATED 1/16/2003

REVISED 5/16/2013 (2)

SB- Removal of Soluble Salts

Description of Work

Remove soluble salts and test for soluble salt contamination prior to painting as detailed in this provision. Test surfaces for soluble salt contamination (e.g. chlorides and nitrates) using a prescribed procedure outlined in part A.

A. Procedure for Testing for Soluble Salt Contamination

1. Perform the tests for soluble salt contamination after the steel surfaces have been blasted to SSPC - SP 10/NACE No. 2 "Near-White Blast Cleaning".

2. Perform tests of the prepared surfaces at intervals defined, and in the presence of the Engineer.

a. When requested by the Engineer, provide evidence that personnel who perform tests for soluble salts have been trained by the manufacturer's technical representative in the use of soluble salt test kits. They must also be able to interpret the results.

b. Defined intervals consist of testing all surfaces at a rate of one test for each 3000 ft^2 [300 m^2], or any part thereof. Testing must be concentrated in areas where there was coating failure, corrosion, pitting, and/or loss of section. All areas to be tested must be approved by the Engineer.

3. Test methods and equipment used in the procedure must be selected at the contractor's discretion. All equipment and materials chosen must be reviewed and approved by the Engineer.

4. Evaluate approval of test methods and equipment on the following basis. The method used should:

- be a completely self-contained test kit with all materials, supplies, tools and instructions to take tests and identify results. The contractor may purchase the following test kits or an approved equal:
  CHLOR-RID - "Chlor*Test"
- use identifiable, consistent, factory pre-measures test extract solution.
- be dated, or otherwise marked to provide evidence of a 1 year/12 month verifiable shelf-life of the measurement components.
- provide for any steel surfaces, regardless of orientation.
- provide for testing on smooth, pitted, and rough surfaces.
- provide for taking measurements of the chloride ion in micrograms per square centimeter without using conversion charts or tables.
- be environmentally friendly and not contain any form of mercury.
- provide all new forms for extraction and titration for each test.
- provide an encapsulated environment while extracting chlorides.
- provide a factory sealed titration device for each test.
- use the extract sampling container as the titration container.
- allow the test results to be presented in readings in ppm and ug/cm^2. A ratio of 1:1 would provide a direct correlation (eg: 7ppm = $7ug/cm^2$)

5. Readings greater than 7 parts per million (ppm) and/or micrograms per centimeter squared (ug/cm^2) of chlorides, and 7 parts per million (ppm) and/or micrograms per centimeter squared (ug/cm^2) of nitrates, per test area, require that the contaminated surfaces represented by the test be cleaned. Repeat the cleaning and retesting as necessary until satisfactory test results are obtained. All tests are to be properly labeled and retained for future test verification by the Engineer.

B. Procedure for Cleaning the Contaminated Surface

Surfaces, which have unacceptable levels of soluble salts may be cleaned by the use of sand blasting, high-pressure water washing with a soluble salt remover product, or another method acceptable to the Engineer.

Basis of Payment

Payment for removal of soluble salts and testing shall be considered an incidental expense to Item No. 2478._____ for which no direct compensation will be made.

SB2014-2479

Use on new work only (shop prime and field paint). (See Structural Metals Engineer for paint system selection if unique conditions or applications are present).

CREATED 6/8/2005

REVISED 2/12/2014 (13)

SB- **(2479) INORGANIC ZINC-RICH PAINT SYSTEM**

Add the following as a new second paragraph of 2478.3A:

For the preparation and application of field applied coatings, Contractors must perform work with staff meeting the requirements of The Society of Protective Coatings Certified Application Specialist (SSPS CAS) Level 2. One CAS Level 2 is required on sight overseeing the work in each work area up to a crew of 10 workers. Multiple work areas will require an additional CAS for each area.

Add the following to 2479.3.C.1, "Quality Control Plan (QCP) Requirements" supplementing Table 2479-1 requirement, "Blast profile inspection per ASTM D 4417":

- Steel Girders – minimum of three readings per each blasted
- Diaphragms – three readings minimum per each lot blasted*****
- Sole Plates – three readings minimum per each lot blasted*****
- Pedestrian Bridges – minimum of three readings on each truss and a minimum of three readings on the floor beam
- Railing – three readings minimum for each 100 lineal feet [30 m] of rail
- Bridge Truss – three readings minimum for each 1000 sq. ft. [93 sq. m] or the amount of truss blasted in an eight hour shift (whichever is less)

*****The amount of diaphragms or sole plates going through an automated blast machine at one time or the amount blasted in an eight hour shift

Items not covered by this list shall have three documented profile readings for every 1000 sq. ft. [93 sq. m] blasted.

The provisions of 2479, "Inorganic Zinc-Rich Paint System," are supplemented as follows:

Paint in accordance with provisions of 2479, "Inorganic Zinc-Rich Paint System," all structural steel and steel bearing assemblies for Br. No. _____ that are within 7 ft [2 m] of the end of the beams or girders as measured along the centerline of the beams or girders. The fascia beams must be painted for their full length from end to end of bridge on the following designated surfaces:

- the outboard surfaces of the bottom of the top flange,
- the web,
- the top of bottom flange,
- the edge of the bottom flange,
- the bottom of the bottom flange,
- the inboard edge of the bottom flange.

For the following paragraph, use only when the District requires that all structural steel receive a full paint system (typical for 3309 steel is a partial paint system -- see memo by Gary Peterson dated 5/1/2006)

The work to be performed under this contract consists of painting all structural steel members, _____ of Bridge No. _____.

For the following TWO paragraphs, specify color.

Add the following to the first paragraph of 2479.3.F.5, "Finish Coats":

Apply the finish coat as per 2479.2B(1) of this special provision. The color must match Federal Standard 595 C No. _____ and have a semi-gloss finish.

SB2014-2479.1

Use when required for Historic Bridges or a higher level of aesthetics where overspray is NOT acceptable.

CREATED 5/16/2013

REVISED 5/16/2013

SB- **Protection of Non-Painted Surfaces**

Delete the sixth paragraph of 2479.3.B, "General," and substitute the following:

Fill in the blank with the reason for this aesthetic sensitivity. (Historic, high visibility to the public, etc.)

The structure is aesthetically sensitive because of _____. Protect non-painted surfaces that are adjacent to the painted surfaces from overspray. The Engineer will not allow overspray. The Engineer will visually inspect the non-painted surfaces. If the Engineer determines that there is overspray on the non-painted surfaces, then the Engineer will deem the materials as non-conforming in accordance with 1503, "Conformity with Contract Documents," and 1512, "Unacceptable and Unauthorized Work". The Engineer will direct the contractor to immediately correct the oversprayed surface and submit a written non-conformance report, containing data required by the Engineer to ensure compliance with the contract. Perform additional work as required by the Engineer at no additional cost to the Department.

SB2014-2506

Use when "2506 - Manholes and Catch Basins" are required on a job.

CREATED 4/15/2015

REVISED 4/15/2015

SB- **(2506) MANHOLES AND CATCH BASINS**

The entire 1st paragraph of 2506.3.G is replaced with the following:

Provide vertical adjustment of access castings made to the planned elevation on the structure. Meet the criteria that full support for the casting is obtained above the cone section and ensure that structure construction above the cone does not exceed 6 in [150 mm], not including the frame. Use no more than 3 adjusting rings. Limit thickness of each adjusting ring to 6 in or less. If these criteria cannot be met by vertical adjustment work, reconstruct the structure.

SB2014-2514

Use when slope paving repair is required. This may be concrete or bituminous aggregate. See Regional Bridge Engineer.

CREATED 8/1/1994

REVISED 5/16/2013 (1)

SB-_____ (2514) SLOPE PAVING

Remove and dispose of concrete panel, furnish and install granular fill, construct new reinforced concrete panels, and furnish and install joint filler and joint sealer. Perform work in accordance with 2514, "Slope Paving," the plans, and the following:

Joint filler and joint sealer at designated joints must be in accordance with SB-_____.

The Engineer will designate the slope paving areas where the above work is to be performed.

Dispose of excavated materials in accordance with 2104.3.C.3, "Concrete and Masonry Structures".

The Engineer will separately measure slope paving by area of top surface in yd^2 [m^2].

UAR

Payment will be made as Item No. 2514.501 "CONCRETE SLOPE PAVING," at the Contract price per square yard [square meter] and shall be compensation in full for all costs of construction complete in place.

UAR

Payment will be made as Item No. 2514.503 "AGGREGATE SLOPE PAVING," at the Contract price per square yard [square meter] and shall be compensation in full for all costs of construction complete in place.

SB2014-2545

Use on jobs where conduit systems are required.

CREATED 7/25/1991

REVISED 5/16/2013 (1)

SB- **CONDUIT SYSTEMS**

Furnish and install each Conduit System in accordance with the plans, approved erection drawing, the applicable requirements of 2545, "Electrical Lighting Systems," 2550, "Traffic Management System," 2565, "Traffic Control Systems," and the following:

All conduit runs must be straight and true and all offsets and bends uniform and symmetrical. Adjust the elevations of the conduit assembly, for its full length, to approximately the same gradient as the finished roadway, and furnish and install in the approaches such suitable spacers and framing as may be necessary to maintain the correct grade and alignment.

Ferrous components of fittings must be hot dip galvanized as per 3394, "Galvanized Structural Shapes". Carefully install all fittings according to the manufacturer's recommendations and at the locations shown in the plans. At time of installation, adjacent conduit sections to be coupled by fittings must be in true alignment.

Ensure fabrication and inspection of structural metals used for each Conduit System are in accordance with the applicable requirements of 2471, "Structural Metals".

Identify the ends of conduits as lighting, signals, telephone, telegraph, power, etc. by the use of embossed metallic tags or other equally durable identification.

Conform non-metallic conduit and fittings to the requirements of the NEMA Standards Publication No. TC 14, titled "Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings."

Furnish three sets of erection drawings of each Conduit System to the Engineer for preliminary review. Two sets will be forwarded to the Bridge Construction and Maintenance Engineer for review and one set will be returned to the Contractor showing any necessary corrections.

The drawings must be to a scale of not less than 1/4" = 1'-0" [50:1] and show the locations of the diaphragms and inserts, a conduit placement scheme, and detailed views of the placement of the sleeves through the parapets, end webs, and diaphragms. Define the locations of the sleeves from established reference points or lines and elevations, such as working points or centerlines and bridge seat elevations. Show the locations and manufacturer of expansion fittings in the drawings.

Space concrete inserts for hanger assemblies in such a manner that the assemblies will not interfere with conduit couplings. Hanger spacing must not exceed 10 ft [3 m]. Conduit must be installed in 10 ft [3 m] lengths where practicable.

For the following paragraph, use with suspended systems where linear expansion is greater than 4" [100 mm] and vertical movement would not be detrimental to the systems.

Each expansion fitting must be in accordance with 3839, "Conduit Expansion Fittings," and the plan, except that the fitting must provide for greater than 4 in [100 mm] linear movement when required by the plans.

For the following paragraph, use with concrete encased systems where movement will not exceed 3/4" [20 mm] in any direction.

Each expansion/deflection fitting must be an approved watertight unit which can accommodate 3/4 in [20 mm] of linear expansion or contraction of conduit, 3/4 in [20 mm] of parallel misalignment of adjacent conduit sections, and up to 30° of angular misalignment of the axes of adjacent conduit sections. To prevent damage to internal bonding jumper, fittings should not be twisted during installation.

For the following paragraph, use where expansion and expansion-deflection fittings are joined together to provide for expansion greater than 3/4" [20 mm] in the longitudinal direction and for misalignment.

A combination expansion/deflection fitting must consist of an expansion fitting and an expansion/deflection fitting connected by a nipple. The expansion fitting must be in accordance with 3839, "Conduit Expansion Fittings," except that the fitting must provide for greater than 4 in [100 mm] linear movement when required by the plans. Each expansion/deflection fitting must be an approved watertight unit which can accommodate 20 mm (**3/4 inch**) of linear expansion or contraction of conduit, 3/4 in [20 mm] of parallel misalignment of adjacent conduit sections, and up to 30° of angular misalignment of the axes of adjacent conduit sections. To prevent damage to internal bonding jumper, do not twist fittings during installation.

Furnish and seal any remaining conduit opening at the back face of each abutment with one of the materials listed on the Department's "Approved/Qualified Product Lists of Bridge Silicone Joint Sealants" www.dot.state.mn.us/products/Bridge, after the conduit is in place.

All sidewalk or flush mounted junction boxes must be removable flange (NEMA 5) galvanized cast iron with checkered cast iron covers. Equip these junction boxes with 1/2 in [13 mm] diameter pipe drains. Each conduit entrance and the pipe drain entrance must be bossed and threaded to provide five full threads. Fasten the cover and flange with stainless steel screws. Equip the cover with pry bar slots and a neoprene gasket.

Include in each junction box conduit entrance an insulating bushing of the appropriate size.

SB2014-2557.1

Use with all bridges requiring fencing, except pedestrian bridges. See Figs. 5-397.119, .120, .205.

CREATED 9/17/1990

REVISED 5/16/2013 (5)

SB- (2557) FENCING

Furnish and install the complete wire fence (including its frame work, anchorages, and electrical grounds) on the bridge in accordance with the applicable provisions of 2471, "Structural Metals," 2557, "Fencing," 2402.3.H, "Setting Anchor Bolts," and the following:

SB- Materials

A. All 2 in [50 mm] and 2½ in [65 mm] pipe for posts must be Standard Weight (ANSI B36.10, Schedule 40) and a grade of steel pipe intended by the manufacturer to meet all the following requirements, and which actually meets all of the following requirements when inspected in accordance with 2471.3.M, "Fabricator Inspection".

1. Tensile Properties: Tensile strength, min., 58,000 psi [400 MPa]; Yield point, min., 35,000 psi [241 MPa].

2. Bending Properties: The pipe must withstand being cold bent through 90 degrees to the radius specified in the plans, without developing cracks and without opening the weld.

3. Welding Properties: All pipe used for members which require welding must be a grade of steel pipe which is easily welded.

4. Coating Properties: The pipe must be galvanized per 3394, "Galvanized Structural Shapes," after all welding and bending are completed.

B. All other pipe for members not included in (A) above must be Standard Weight (ANSI B36.10, Schedule 40) and a grade of steel pipe meeting ASTM A 53 requirements or better. The pipe must be galvanized per 3394, "Galvanized Structural Shapes". Factory galvanized pipe which conforms to the above requirements will be accepted for members that do not require welding for fabrication.

Inspect pipe to ensure compliance with the above requirements according to 2471.3.M, "Fabricator Inspection".

C. Chain link fabric must be 9 gauge [3.8 mm] wire, 2 in [50 mm] mesh, Type II fabric complying with 3376, "Fence Wire," except that the fabric must be Type IV when vinyl coating is specified.

D. Hardware, including bolts, nuts, washers and lock washers, must be galvanized per 3392, "Galvanized Hardware". Galvanize all other material per 3394, "Galvanized Structural Shapes".

E. All standard hardware (clamps, caps, and couplings) must be size and type which are compatible with the members and which result in a detail with a workman-like appearance.

For the following paragraph (F.), USE AS REQUIRED.

F. Epoxy mortar for post bases must consist of one part of an approved epoxy to not more than four parts of an approved silica sand measured by bulk volume. In lieu of the epoxy mortar, an approved latex modified mortar may be substituted.

For the following paragraph (G.), INSERT COLOR.

G. After being galvanized, all fence fabric, pipes, posts, fittings, and hardware must be _____ vinyl coated. The minimum thickness of vinyl coating for pipes, posts, fittings, and hardware is 10 mils.

For the following 6 paragraphs, (Anchorages Section), use this section when Detail B905, "Fence Post Anchorage," is included in the plans.

SB- Anchorages

Furnish and install each anchorage in accordance with the applicable requirements of 2433, "Structure Renovation," and the following:

Except when part of an approved proprietary anchorage assembly, threaded rods and bolts must meet the requirements of 3385, "Anchor Rods," and 3391, "Fasteners," respectively.

Galvanize threaded rods, nuts, bolts, and washers in accordance with 3392, "Galvanized Hardware," or electroplated in accordance with ASTM B 633, Type III, SC 4. As an alternate to galvanizing or electroplating, threaded rods, nuts, bolts, and washers which are part of an approved proprietary anchorage may be fabricated from stainless steel in accordance with 3391, "Fasteners".

Anchorages for fastening fence post anchorages must have an ultimate pull out strength as specified in the plan and be installed in sound concrete to a depth equal to at least six times the rod or bolt diameter, unless a different depth is specified elsewhere in the Contract. Bolt heads and/or nuts must be in contact with the adjacent surface and torqued to approximately 80 ft-lbs [108 N·m] unless a different torque is recommended by the manufacturer. Adhesive anchorages must consist of a continuously threaded rod secured by an adhesive or mortar. Install anchorages in accordance with the manufacturer's recommendations and as specified in the plans.

Perform laboratory tests that include static load tests for ultimate pullout strengths on anchorage systems that are subject to tensile loads. The tests, in accordance with ASTM E 488, must be performed and certified by an independent testing laboratory. Furnish the Engineer with the test reports and the specification sheets that are prescribed by ASTM E 488.

If anchorages are installed vertically and are not encased in concrete after project completion, fill any voids occurring between the top of the anchorages and the concrete in which it is embedded with approved caulk.

For the following 3 paragraphs, including TABLE 1, use if anchorages have a strength greater than 5000 lbs [22kN].

Submit, for approval by the Engineer, the following anchorage supplier's product literature or calculations to establish embedment depth. This information will demonstrate compliance with the specification:

- Name of supplier
- Full product name as given in supplier's literature
- Embedment depth as determined from supplier's literature

Demonstrate the anchorage system for drilled-in anchorage systems at the first site of field installation prior to actual use in the project. The demonstration must include installation and static tension tests in the presence of the Engineer in accordance with test procedures prescribed in ASTM E 488. No portion of the testing device shall bear on the concrete surface within a distance equal to the anchorage embedment depth. Test three anchorages to not less than 1/2 the required minimum ultimate pull out strength or the value given in Table 1, whichever is less. Failure of any anchorage tested will require modification of installation procedures or use of a different anchorage system.

In addition to the three tests stated above, the Engineer will require that each bridge have an additional 2% (not less than 1 test) of the remaining anchorages tested at a latter date. The Engineer will determine the locations of the additional anchors. If a failure occurs while testing the additional 2%, more testing will be required at the rate of an additional 1% per each failure at the Contractor's expense. Compensation for costs of testing is included in the payment for anchorage type reinforcement bars.

TABLE 1

ANCHOR ROD PROOF LOADS, kips [KN]
TYPE OF ROD, FROM SPEC. 3385

DIA., in [mm]	TYPE A	TYPE B	TYPE C	TYPE D
1/2" [13]	4.75 [21.0]	5.7 [25.0]	10.1 [45.0]	4.9 [22.0]
5/8" [16]	7.4 [33.0]	8.9 [39.5]	15.8 [70.0]	7.6 [34.0]
3/4" [19]	10.6 [47.0]	12.6 [56.0]	22.8 [101.0]	11.0 [49.0]
7/8" [22]	14.5 [65.0]	17.4 [77.0]	31.0 [138.0]	15.0 [67.0]
1" [25]	19.0 [85.0]	22.6 [100.0]	40.5 [180.0]	19.5 [86.0]

SB- Construction Requirements

A. Delete the requirements for shop detail drawings per 2471.3.B, "Shop Detail Drawings". However, supply the Materials Engineer with a complete list of fence components. Include in the list the names of all suppliers and fabricators for the various components. Do not install the fence until the Materials Engineer and the Project Engineer have approved the required information.

B. Ensure all rods or bolts have lock washers.

C. Ensure chain link fabric is continuous between stretcher bars.

D. Ground all metal railings. Install all electrical grounding in accordance with the applicable provisions of 2557, "Fencing," and the National Electrical Code. Clamp or braze the ground wires to the grounding device, then practicably route and attach to the nearest rail by clamping, brazing, or any other approved means that will provide a permanent positive connection. If rail has non-continuous sections, use a #6 AWG solid copper wire to connect adjacent railing panels.

If the bridge does not include exposed electrical equipment, then ground the rails at points directly below or adjacent to the railing at all abutment corners. The grounding system must consist of a #6 AWG solid copper wire connected to the railing which in turn is connected to a copper coated steel rod having a nominal diameter of 5/8 in [15 mm] or more and a minimum length of 8 ft [2.4 m] installed to an elevation approximately flush with the ground surface.

If the bridge includes exposed electrical equipment, such as roadway lighting, traffic signals, variable message signs, surveillance cameras, or ramp metering, then bond the railing grounding system to the exposed electrical equipment grounding system. Refer to the electrical plans and electrical special provisions for details regarding bonding multiple electrical grounding systems.

E. Coat pipe surfaces which have the galvanizing removed during field fabrication (cut or drilled edges) with an approved zinc rich coating. Prior to the application of the coating, clean the pipe in accordance with the manufacturer's recommendations.

SB- **Method of Measurement**

The length of wire fence for payment will be the horizontal dimension along the centerline of each fence between the centers of end posts. Suspended lengths at end posts will not be included in the length for payment.

SB- **Basis of Payment**

Furnishing and installing the Wire Fence, as specified above, will be paid for as Item No. 2557.501 "WIRE FENCE DESIGN ___ VINYL COATED", at the Contract price per linear foot [meter].

SB2014-2557.2

Use with pedestrian bridges requiring fencing. See Figs. 5-397.202 and .205.

CREATED 9/17/1990

REVISED 5/16/2013 (5)

SB- (2557) FENCING

Furnish and install the complete wire fence (including its frame work, handrails, anchorages, fastenings, fittings, and electrical grounds) on the bridge and its ramps or stairways in accordance with the applicable provisions of 2471, "Structural Metals," 2557, "Fencing," 2402.3.H, "Setting Anchor Bolts," and the following:

SB- Materials

A. All 1½ in [40 mm] pipe for frame members, 1½ in [40 mm] pipe for handrails, and 2 in [50 mm] pipe for posts must be Standard Weight (ANSI B36.10, Schedule 40). The pipe must be a grade of steel pipe intended by the manufacturer to meet all the following requirements, and which actually meets all of the following requirements when inspected in accordance with 2471.3.M, "Fabricator Inspection".

1. Tensile Properties: Minimum tensile strength, 58,000 psi [400 MPa]; minimum yield point, 35,000 psi [241 MPa].

2. Bending Properties: The pipe must withstand being cold bent through 90 degrees to the radius specified in the plans, without developing cracks and without opening the weld.

3. Welding Properties: All pipe used for members which require welding must be a grade of steel pipe which is easily welded.

4. Coating Properties: The pipe must be galvanized per 3394, "Galvanized Structural Shapes," after all welding and bending is completed.

B. All other pipe for members not included in (A) above must be Standard Weight (ANSI B36.10, Schedule 40) and a grade of steel pipe meeting ASTM A 53 requirements or better. Galvanize the pipe per 3394, "Galvanized Structural Shapes". Factory galvanized pipe which conforms to the above requirements will be accepted for members that do not require welding for fabrication.

Inspect the pipe to ensure compliance with the above requirements according to 2741.3.M, "Fabricator Inspection".

C. Chain link fabric must be 9 gauge [3.8 mm] wire, 2 in [50 mm] mesh, Type II fabric complying with 3376, "Fence Wiring," except that the fabric must be Type IV when vinyl coating is specified.

D. Galvanize hardware, including bolts, nuts, washers and lock washers per 3392, "Galvanized Hardware". Galvanize all other material per 3394, "Galvanized Structural Shapes".

E. All standard hardware (clamps, caps, and couplings) must be of a size and type compatible with the members and which result in a detail with a workman-like appearance.

F. In lieu of the single grooved washer detailed in the plans for the handrail connection, two individual grooved washers may be used.

For the following paragraph (G.), USE AS REQUIRED.

G. Epoxy mortar for post bases must consist of one part of an approved epoxy to not more than four parts of an approved silica sand measured by bulk volume. In lieu of the epoxy mortar, an approved latex modified mortar may be substituted.

For the following paragraph (H.), USE AS REQUIRED.
For the following paragraph (H.), INSERT COLOR.

H. After being galvanized, all fence fabric, pipes, posts, fittings, and hardware must be ____ vinyl coated. The minimum thickness of vinyl coating for pipes, posts, fittings, and hardware is 10 mils.

For the following 7 paragraphs, use this section when Detail B905, "Fence Post Anchorage," is included in the plans.

SB- Anchorages

Furnish and install each anchorage in accordance with the applicable requirements of 2433, "Structure Renovation," and the following:

Except when part of an approved proprietary anchorage assembly, threaded rods and bolts must meet the requirements of 3385, "Anchor Rods," and 3391, "Fasteners," respectively.

Galvanize threaded rods, nuts, bolts, and washers in accordance with 3392, "Galvanized Hardware," or electroplate in accordance with ASTM B 633, Type III, SC 4. As an alternate to galvanizing or electroplating, threaded rods, nuts, bolts, and washers which are part of an approved proprietary anchorage may be fabricated from stainless steel in accordance with 3391, "Fasteners".

Anchorages for fastening fence post anchorages must have an ultimate pull out strength as specified in the plan and be installed in sound concrete to a depth equal to at least six times the rod or bolt diameter, unless a different depth is specified elsewhere in the Contract. Bolt heads and/or nuts must be in contact with the adjacent surface and torqued to approximately 80 ft-lbs [108 N·m] unless a different torque is recommended by the manufacturer. Adhesive anchorages must consist of a continuously threaded rod secured by an approved adhesive or mortar.

Install anchorages in accordance with the manufacturer's recommendations and as specified in the plans.

Perform laboratory tests that include static load tests for ultimate pullout strengths on anchorage systems that are subject to tensile loads. The tests, in accordance with ASTM E 488, must be performed and certified by an independent testing laboratory. Furnish the Engineer with the test reports and the specification sheets that are prescribed by ASTM E 488.

If anchorages are installed vertically and are not encased in concrete after project completion, fill any voids occurring between the top of the anchorages and the concrete in which it is embedded with approved caulk.

For the following 3 paragraphs, including TABLE 1, use if anchorages have a strength greater than 5000 lbs [22 kN].

Submit for approval by the Engineer the following anchorage supplier's product literature or calculations to establish embedment depth. This information will demonstrate compliance with the specification:

- Name of supplier
- Full product name as given in supplier's literature
- Embedment depth as determined from supplier's literature

Demonstrate the anchorage system for drilled-in anchorage systems at the first site of field installation prior to actual use in the project. Include in the demonstration static tension tests in the presence of the Engineer in accordance with test procedures prescribed in ASTM E 488. No portion of the testing device shall bear on the concrete surface within a distance equal to the anchorage embedment depth. Test three anchorages to not less than 1/2 the required minimum ultimate pull out strength or the value given in Table 1, whichever is less. Failure of any anchorage tested will require modification of installation procedures or use of a different anchorage system.

In addition to the three tests stated above, the Engineer will require that each bridge have an additional 2% (not less than 1 test) of the remaining anchorages tested at a latter date. The Engineer will determine the locations of the additional anchors. If a failure occurs while testing the additional 2%, more testing will be required at the rate of an additional 1% per each failure at the Contractor's expense. Compensation for costs of testing is included in the payment for anchorage type reinforcement bars.

TABLE 1

ANCHOR ROD PROOF LOADS, kips [KN]
TYPE OF ROD, FROM SPEC. 3385

DIA., inches [mm]	TYPE A	TYPE B	TYPE C	TYPE D
1/2" [13]	4.75 [21.0]	5.7 [25.0]	10.1 [45.0]	4.9 [22.0]
5/8" [16]	7.4 [33.0]	8.9 [39.5]	15.8 [70.0]	7.6 [34.0]
3/4" [19]	10.6 [47.0]	12.6 [56.0]	22.8 [101.0]	11.0 [49.0]
7/8" [22]	14.5 [65.0]	17.4 [77.0]	31.0 [138.0]	15.0 [67.0]
1" [25]	19.0 [85.0]	22.6 [100.0]	40.5 [180.0]	19.5 [86.0]

SB- Construction Requirements

A. Delete the requirements for shop detail drawings per 2471.3.B, "Shop Detail Drawings". However, supply the Materials Engineer with a complete list of fence components. Include in the list the names of all suppliers and fabricators for the various components. Do not install the fence until the Materials Engineer and the Project Engineer have approved the required information.

B. Ensure all rods or bolts have lock washers.

C. Ensure chain link fabric is continuous between stretcher bars.

D. Ground all metal railings. Install all electrical grounding in accordance with the applicable provisions of 2557, "Fencing," and the National Electrical Code. Clamp or braze the ground wires to the grounding device, then practicably route and attach to the nearest rail by clamping, brazing, or any other approved means that will provide a permanent positive connection. If rail has non-continuous sections, use a #6 AWG solid copper wire to connect adjacent railing panels.

If the bridge does not include exposed electrical equipment, then ground the rails at points directly below or adjacent to the railing at all abutment corners. The grounding system must consist of a #6 AWG solid copper wire connected to the railing which in turn is connected to a copper coated steel rod having a nominal diameter of 5/8 in [15 mm] or more and a minimum length of 8 ft [2.4 m] installed to an elevation approximately flush with the ground surface.

If the bridge includes exposed electrical equipment, such as roadway lighting, traffic signals, variable message signs, surveillance cameras, or ramp metering, then bond the railing grounding system to the exposed electrical equipment grounding system. Refer to the electrical plans and electrical special provisions for details regarding bonding multiple electrical grounding systems.

E. Coat pipe surfaces which have the galvanizing removed during field fabrication (cut or drilled edges) with an approved zinc rich coating. Prior to the application of the coating, clean the pipe in accordance with the manufacturer's recommendations.

F. Fabricate all longitudinal pipes for the chain link fence on the spiral ramp to follow the curvature of the ramp, and do not fabricate chords between interior posts.

SB- Method of Measurement

The length of chain link enclosure for payment will be the horizontal dimension along the centerline of the pedestrian bridge between end pipe frames. The length of wire fence for payment will be the horizontal dimension along the centerline of each fence between the centers of end posts. Suspended lengths at end posts are not included in the length for payment.

SB- Basis of Payment

Furnishing and installing the chain link enclosure, specified above, will be paid for as Item 2557.603, "CHAIN LINK ENCLOSURE", at the Contract price per linear foot [meter]. Furnishing and installing the Wire Fence, as specified above, will be paid for as Item No. 2557.501 "WIRE FENCE DESIGN ___ VINYL COATED", at the Contract price per linear foot [meter].

SB2014-3348
Use on all jobs.
CREATED 5/16/2013
REVISED 5/16/2013

SB- **(3348) SEVEN-WIRE STRAND FOR PRESTRESSED CONCRETE**

Delete the first sentence of 3348.1, "Scope," and substitute the following:

Provide one of two grades of seven-wire, uncoated, low-relaxation steel strand for pretensioned and post tensioned prestressed concrete construction.

SB2014-3371
Use on all bridges requiring steel shells for piling.
CREATED 3/5/2001
REVISED 5/16/2013 (4)

SB- (3371) STEEL SHELLS FOR CONCRETE PILING

The provisions of 3371, "Steel Shells for Concrete Piling," are supplemented as follows:

Only use the following paragraphs when Bridge Aesthetics require a "Level A or B" attention.

Supplement the fourth paragraph of 3371.2, "Requirements," with the following:

Pipe containing an as described defect must be given one of the following dispositions:

a. Remove the visible welds, "flash" of trimmed welds or other defects by grinding in such a way that the ground area blends in smoothly with the contour of the pipe. Verify complete removal of the defect by visual inspection of the ground area and ensure the wall thickness in the ground area is not adversely affected.
b. Cut off the section of pipe containing the defect.
c. Reject the entire pipe.

Only use the following paragraphs when Bridge Aesthetics require a "Level C" attention and after an evaluation of the site or location of the bridge has been made.

Supplement the fourth paragraph of 3371.2, "Requirements," with the following:

Give pipe containing a non-permissible irregularity as described above one of the following dispositions:

a. Remove the non-permissible irregularity by grinding in such a way that the ground area blends in smoothly with the contour of the pipe. Ensure the wall thickness in the ground area is not adversely affected. Smoothly contoured welds with a clean appearance need not be ground flush. The only permissible irregularity will be one caused from the original manufacturing of the pipe (e.g. weld seam of a Double Submerge Arc Weld process), or a field weld that has a clean appearance.
b. Cut off the section of pipe containing the non-permissible irregularity.
c. The entire pipe containing a non-permissible irregularity may be rejected at the Engineer's discretion.

SB2014-3601
Use on all jobs requiring Riprap.
CREATED 7/15/2014
REVISED 7/15/2014

SB- **(3601) RIPRAP MATERIAL**

Supplement 3601.2.A.1, "Quality," with the following:

(5) If using carbonate quarry/bedrock materials in total or in part for riprap materials, ensure the portion of the insoluble residue passing the #200 [75 µm] sieve is no greater than 10 percent.

SB2014-3741

Use on all jobs requiring Elastomeric Bearing Pads (cotton duck pads fall under this spec).

CREATED 3/22/2002

REVISED 4/21/2015 (13)

SB- (3741) ELASTOMERIC BEARING PADS

Delete the entire contents of 3741, "Elastomeric Bearing Pads," and substitute the following:

3741.1 SCOPE

Provide elastomeric bearing pads for use in bridges and other structures.

3741.2 REQUIREMENTS

A General

The basis of design for all bearing pads is in conformance with Method A of the *AASHTO LRFD Bridge Design Specifications.*

Use a bearing pad supplier listed on the "Approved/Qualified Products List for Bridge Products, Elastomeric Bearing Pads" (http://www.dot.state.us/products). Test and manufacture elastomeric bearing pads in accordance with AASHTO M 251 except as modified in this special provision.

Provide bearing pads no greater than ½ in [13 mm] thick, fabricated of all elastomer. Plain elastomer pads may be cut from larger sheets cast to the thickness shown on the plans. Avoid heating or damaging the material when cutting. Ensure the cutting produces smooth edges at least meeting the requirements of ANSI 250 finish.

Provide bearings of laminated construction when pads are greater than ½ in [13 mm] thick. Refer to AASHTO M 251 for tolerances, dimensions, and configurations, except provide elastomer to a thickness of ¼ in [6 mm] within a range from $+^{1}/_{8}$ in to $-^{1}/_{16}$ in [+3 mm to –2 mm] to cover the top and bottom steel plates.

Provide laminated pads meeting the following requirements or characteristics:

(1) Consisting of alternate layers of elastomer and metal reinforcement integrally bonded together,
(2) Containing reinforcement spaced as shown on the plans, and parallel to the top and bottom surfaces of the pad, and
(3) Including the manufacturer's name or trademark molded into the edge of the pad.

Do not expose the finished laminated pad to temperatures greater than 400°F [205°C].

Cover the edges of metal reinforcement with ¼ in [6 mm] of elastomer.

B Physical Properties

Substitute the requirements of sections 4.1 and 4.2 of AASHTO M 251; comply with B.1 & B.2 in this special provision.

B.1 Elastomer

Use elastomer compound containing only virgin crystallization resistant polychloroprene (neoprene) or virgin natural polyisoprene (natural rubber) as the raw polymer. Use only new material with no reclaimed material incorporated in the finished bearing.

Provide elastomer for bearing pads meeting the requirements of AASHTO M 251 with durometer hardness of 60 on the Shore "A" scale. Provide elastomer compounds classified as Low-Temperature Zone D, Grade 4 or 5 meeting the requirements of AASHTO *LRFD Bridge Design Specifications*, Table 14.7.5.2-1, "Low-Temperature Zones and Minimum Grades of Elastomer".

For the following paragraph, include it when using any of standard details B310, B311, B354, or B355.

Utilize cotton duck bearing pads (CDP) where standard details B310 and B354 are included in the plans or when standard details B311 or B355 utilize plain (non-steel reinforced) elastomeric bearing pads. Test and manufacture CDP in accordance with Military Specification MIL-C-882E. For CDP, waive additional sampling and testing requirements listed in this special provision.

B.2 Properties

Test and accept sampled bearings in accordance with the following:

	Natural Polyisoprene (Natural Rubber)	Polychloroprene (Neoprene)
Durometer	60±5	60±5
Physical properties Hardness (ASTM D 2240)	60±5	60±5
Tensile strength (ASTM D 412)	2250 psi [15.5 MPa]	2250 psi [15.5 MPa]
Ultimate elongation (ASTM D 412), minimum	400%	400%
Heat resistance (ASTM D 573) Temperature / Aging Time	158°F [70°C]/168hrs	212°F [100°C]/70hrs
Hardness, maximum Shore "A" points change	+10	+15
Tensile strength, maximum percent change	–25%	–15%
Ultimate elongation, maximum percent change	–25%	–40%
Compression set (ASTM D 395, method B) 22 hrs. at 158°F [70°C], maximum percent	25	N.A.
22 hrs. at 212°F [100°C], maximum percent	N.A.	35
Low Temperature Test (ASTM D 746, procedure B) Brittleness at –54.4°F [–48°C]	No Failure	No Failure
Laminated Pad Adhesion Test (ASTM D 429, method B) Bond Strength (Peel Test)	40 psi [0.276 MPa]	40 psi [0.276 MPa]

Compressive Strain of Laminated Bearings

Test each sampled laminated pad for compressive strain. The compressive strain in any layer of a laminated pad shall not exceed 9 percent at 1250 pounds per in^2 [8.62 MPa] average unit pressure for the full size laminated pad.

Proof Load Testing

Proof load each bearing pad per AASHTO M 251, Section 8.8.2. Use a compressive load of 1800 pounds per in^2 [12.41 MPa] for laminated pads and 1200 pounds per in^2 [8.27 MPa] for plain elastomeric pads. Reject bearing pads if bulging patterns imply laminate placement does not satisfy design criteria and manufacturing tolerances, or if bulging suggests inadequate laminate bond. Also reject bearing pads if there are three separate surface cracks greater than $^1/_{16}$ in [1.5 mm] wide by $^1/_{16}$ in [1.5 mm] deep.

B.3 Metal Reinforcement

Provide mild steel plates at least $^1/_8$ in [3 mm] thick for use as metal reinforcement.

C Certification

Submit to the Engineer a manufacturer's Certificate of Compliance.

3741.3 SAMPLING AND TESTING

A Manufacturer Sampling and Testing

Sample and test in accordance with AASHTO M 251, Section 8 except as modified in this special provision. Destructive test finished laminated and plain bearing pads at a rate of two full size bearing pads per lot (produced from the same raw material utilizing the same processes and procedures). A lot shall not exceed 100 pads and is not limited to finished sizes or thickness. Destructive testing is defined as any test that renders the product not usable for its intended purpose.

Provide bearing pad test data and certification prior to shipping. Test results of samples must verify compliance to product specifications. Any bearing tested that does not meet the specifications will result in the rejection of the entire lot. When applicable, the supplier shall retain a copy of the passing test results for one year and supply the document with subsequent jobs.

The cost of all bearing pad testing is incidental to the bearing pads.

Use the following paragraph on rehabilitation jobs when a replacement product is needed between steel masonry plate and concrete surface in place of lead sheets (lead is no longer environmentally allowed). Add this paragraph as a "NOTE" on the plan sheet that shows the detail. Reminder: This is not intended to remain in this special provision, but that it be incorporated into the plan.

Provide $^{1}/_{8}$ in 60 durometer plain elastomeric pad or preformed fabric pad meeting AASHTO *LRFD Bridge Construction Specification Section 18.10*. Waive the sampling and testing requirements under 3741, "Elastomeric Bearing Pads," and AASHTO M 251.