

INDEX TO DIVISION SB

DIVISION SB

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BRIDGE PLANS

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

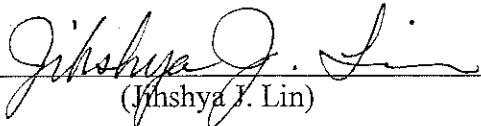
<u>BRIDGE NO.</u>	<u>TOTAL SHEETS</u>	<u>SHEET NO.</u>	<u>DATE OF APPROVAL</u>
25024	54	1-54	12/3/2010

S.P. 2513-25024 (T.H. 61 = 003)
December 8, 2010

New or revised sheets were approved as listed below:

<u>BRIDGE</u> <u>NO.</u>	<u>SHEET</u> <u>NO.</u>	<u>DATE OF</u> <u>APPROVAL</u>
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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.


(Jinsya J. Lin)

Date: 12/8/10 Lic. No. 19115

December 8, 2010

SB-1 BRIDGE PLANS

Plans of existing structures are available at the Minnesota Dept. of Transportation, Bridge Office, 3485 Hadley Avenue N., Oakdale, MN, 55128, for review and inspection by Bidders; or electronic copies are available for viewing, printing, and downloading on the Mn/DOT Consumer Access EDMS (Electronic Document Management System). Go to: http://dotapp3.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.

SB-2 SCOPE OF PROJECT

SB-2.1 Description of Work

Bridge No. 25024 utilizes precast concrete abutment elements, precast pier elements, and precast inverted T-beams to facilitate the development of Accelerated Bridge Construction (ABC) in the State of Minnesota.

The precast concrete abutment elements, precast pier cap and bottom elements, and intermediate precast pier panels are placed on the cast-in-place piles with through holes in these panels. These elements and panels, some with architectural surface finish patterns, shall be placed at the design elevations with strictly limited tolerance. The piles shall be located and driven within the defined tolerances so these precast abutment elements, pier elements and pier panels can be placed within the design locations. The construction staging will require concrete closure pours between precast elements and panels from two construction stages with matching architectural surface finish.

SB-2.2 Coordination

Bidders are advised that significant coordination and cooperation will be required between the Contractor, Subcontractors, Mn/DOT and other associated parties during the execution of this Project. In addition to typical project coordination, the Contractor will be required to coordinate his/her activities closely with the work of the precast concrete abutment and pier manufacturer, the precast inverted T-beam manufacturer, Mn/DOT and other situations that may arise during the course of the Project. It is a project requirement, and in the best interest of the Contractor, that the precast elements and panels shall be ready before beginning pile driving for the bridge construction. The required curing time for these precast members will be critical for this bridge construction. A Quality Management Plan shall be submitted for the Engineer's review prior to the start of construction as specified in Division S of the special provisions. A CPM schedule for the entire bridge construction shall be submitted for Engineer's review prior to the start of bridge construction as specified in Division S of the special provisions.

SB-2.3 Special Provisions

Detailed special provisions for the construction of components of Bridge No. 25024 are contained in the remainder of Division SB of this Proposal.

SB-2.4 Submittals

As part of the contract, the Contractor is required to provide several submittals. It is the Contractor's responsibility to provide all submittals required in the contract documents (plans, specifications, special provisions). The following is a list of bridge related submittals and is not all inclusive:

- A. Plan to provide OSHA required safety equipment (SB-3)
- B. Plan & specifications for sheeting & shoring if required (SB-4)
- C. Contractor Concrete Mix Design – 3Y33AHP (SB-9.7)
- D. Contractor Concrete Mix Design – Self Consolidating Concrete (SB-9.8)
- E. Precast concrete inverted T-beam shop drawings (SB-11.2.C)
- F. Precast concrete abutment, wingwall and pier element shop drawings (SB-12.2A.1)
- G. Precast concrete abutment, wingwall and pier element erection plan (SB-12.2.A.2)
- H. Test data and certified test results (SB-12.2.B)
- I. Repair procedures (SB-12.4.C)

Submittals identified in items F through I shall be submitted as a combined "Fabrication, Assembly and Installation Plan".

The dates for submittals shall be outlined in the CPM scheduling submittal at the beginning of the bridge construction.

SB-3 (1706) EMPLOYEE HEALTH AND WELFARE

The provisions of Mn/DOT 1706 are supplemented as follows:

The Contractor shall submit a plan, at the preconstruction conference, for providing all OSHA required safety equipment (safety nets, static lines, false decks, etc.) for all work areas whose working surface is 1.8 meters (6 feet) or more above the ground, water, or other surfaces. 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 in place and operable in adequate time to allow Mn/DOT personnel to perform their required inspection duties at the appropriate time. No concrete shall be placed 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; however, if the Contractor desires to use an anchorage system which requires modification of structural members, s/he shall request approval, in writing, for plan modification as provided in Mn/DOT 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 1.8 meters (6 feet) or more above the ground, the Contractor shall install an insert or other suitable anchorage to which safety lines can be attached. Any portion of said device extending outside the finished lines of the pier cap shall be removed unless otherwise approved by the Engineer. Any void or cavity resulting from the installation or removal of this device shall be repaired or sealed to prevent the ponding or entry of water as directed by the Engineer.

Approved anchorage systems shall be furnished, installed, and removed at no increased cost to the State for materials, fabrication, erection, or removal of the bridge component or anchorage system.

SB-4 CONSTRUCTION OPERATIONS ADJACENT TO ROADWAYS

This work shall be performed in accordance with the provisions of Mn/DOT 1404, 1502, and 1707 except as modified below:

The Contractor shall, 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 sheeting and shoring shall remain in place until the excavated area has been properly backfilled.

At least six weeks before starting construction of Br. No. 25024, 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 during staging construction. 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, be it 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.

SB-5 (1717) AIR, LAND AND WATER POLLUTION

The provisions of 1717 are supplemented as follows:

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

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.

SB-6 (1803) PROSECUTION OF WORK

The work under this Contract shall be prosecuted in accordance with the provisions of Mn/DOT 1803, except as modified below:

The provisions of Mn/DOT 1803.3 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.

SB-7 (2104) REMOVAL OF ASBESTOS AND REGULATED WASTE (BRIDGE)

This work shall consist of the removal and disposal of any regulated waste found on existing bridges or from the utilities located on the bridge, in accordance with the applicable Mn/DOT Standard Specifications and the following:

SB-7.1 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, the Contractor shall notify the Mn/DOT Project Engineer who shall suspend work and the Contractor shall furnish a documented inspection and evaluation by a Mn/DOT approved certified MDH contractor prior to the resumption of work. The work, as outlined in this paragraph, will be paid for as Extra Work.

SB-7.2 All asbestos and/or regulated waste shall be disposed of in accordance with Mn/DOT'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. The Contractor shall use Mn/DOT approved companies for testing, waste transport and disposal as provided and described in Mn/DOT'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/regulated-materials/index.html>. Contact Mark Vogel, Mn/DOT Office of Environmental Services, 651-366-3630 with any questions regarding the manual.

SB-7.3 All material shall be removed, identified, and disposed of in accordance with Section S-1701 (LAWS TO BE OBSERVED (BRIDGE)) of these Special Provisions. The Contractor will not receive permission to begin the regulated waste removals, with the exception of material needed for hazardous and regulated waste assessment or testing, until the Engineer has copies of all required notices.

SB-7.4 The Contractor will not be allowed to proceed with the demolition or renovation of bridges 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.

The Contractor shall be responsible to 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-7.5 See the attached "Asbestos and Regulated Waste Assessment Summary" for information on whether or not asbestos or regulated waste was detected in the bridge(s) to be removed or renovated.

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

SB-7.6 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)).

SB-8 BRIDGE ABUTMENT CONSTRUCTION

Stage 1 construction of each abutment shall not be started until one month after the approach fill at that abutment has been constructed to the full height and cross section. The approach fill construction shall extend a distance of at least **30 feet** behind the abutment as measured along the centerline of the roadway. The settlement time period may be reduced if it can be demonstrated through the use of settlement plates that settlement has occurred in less time. The Division S special provisions contain requirements for settlement plates. The approach embankment fill may be placed prior to spring 2010 road restrictions being lifted as long as traffic is not restricted.

SB-9 (2401) CONCRETE BRIDGE CONSTRUCTION

The provisions of Mn/DOT 2401 are modified and/or supplemented with the following:

Delete the first sentence of the first paragraph of 2401.3G:

Cure newly placed concrete by providing protection against rapid loss of moisture, freezing temperatures, high temperatures, abrupt temperature changes, vibration exceeding a normal or reasonable limit as described in the Bridge Construction Manual chapter .362, shock waves, and prematurely applied loads.

Add the following to the end of the second paragraph of 2401.3G:

All sections not included in superstructures.....45

SB-9.1 Concrete Aggregate for Bridges

The provisions of 2401.2A shall apply except as modified herein:

Delete the second paragraph of 2401.2A and substitute the following therefor:

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Class A Coarse Aggregate, as defined in 3137.2B, shall be used in all concrete for bridge superstructures, except that coarse aggregate requirements for precast concrete members fabricated under 2405 shall be as specified in 2461.2D and Contractor Concrete Mix Design – 3Y33AHP as specified in SB-9.7.

SB-9.2 Joint Filler and Sealing

The provisions of 2401.3J1 are supplemented as follows:

Prior to installation of sealing materials, concrete curing shall be completed. A minimum of 7 days drying is required prior to application of sealers. Sawcut joints shall be sandblasted, blown clean, and the concrete surfaces shall be dry at the time sealer is installed.

Preformed joint shall be as detailed in the Plans and in conformance with the following requirements.

1. Bituminous felt shall comply with AASHTO M33, modified to the extent that the load required to compress the test specimen to 50 percent of its thickness before test shall be not more than 8274 kPa (**1200 psi**).
2. Cork shall comply with Mn/DOT 3702 and AASHTO M153 Type II.
3. Polystyrene shall comply with the following:

Type	Minimum Compressive Strength (5 percent deflection)	Characteristics
A	207 kPa (30 psi)	losed Cell Expanded Polystyrene
B	69 kPa (10 psi)	Molded Polystyrene

Testing for compressive strength of polystyrene shall be in accordance with ASTM D 1621. The Contractor shall, if requested by the Engineer, furnish evidence that the material meets these requirements.

The quantity of preformed cork joint filler material given in the Plans is for the Contractor's convenience only. Any additional joint filler required shall be furnished by the Contractor with no additional compensation.

SB-9.3 Finish of Concrete Surfaces

Cure concrete for a minimum of 28 days (preferred) or as recommended by the manufacturer (in lieu of the 28 day cure if late in the construction season and cold weather conditions are eminent) 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 2401.3F2c apply except as modified herein:

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Apply SSF on the exposed concrete surfaces as designated below for Bridge No. 25024.

1. Barrier Railings
2. Outside surfaces of barrier railing (excluding areas receiving Architectural Concrete Texture)
3. Wing walls
4. Copings
5. Edges of slabs
6. Bottom of two (2) inverted "Tees" at each edge of deck
7. Abutments
8. Piers/pier cap (excluding areas receiving Architectural Concrete Texture)

Provide a finish color for all SSF matching Mn/DOT standard color "Gray-Modified" on file in the Mn/DOT Chemical Laboratory (651-366-5548). Provide paint free of toxic metals and toxic pigments.

Apply a top coat of 100% acrylic paint (Mn/DOT Spec. 3584) in the color specified.

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

Add the following sentence after the fourth sentence in the second paragraph of 2401.3F2c:

Furnish only one approved system of mortar, bonding agent, water, and 100% acrylic paint (meeting MnDOT 3584) from the "Approved/Qualified Product Lists of Special Surface Finish" (<http://www.dot.state.mn.us/products/index.html>) to produce the color(s) specified in this special provision.

B. Finishing Roadway Faces and Tops of Barrier Railing

1. Finish conventionally formed roadway faces, tops of barrier railings (and medians), as per 2401.3F2d 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.
 - b) After completion of the curing period, paint the roadway faces and tops of the parapet/barrier railings (excluding areas receiving architectural concrete texture) with an approved acrylic paint conforming to 3584. The color of the acrylic paint shall conform to Mn/DOT standard color "Gray-Modified" on file in the Mn/DOT Chemical Laboratory (651-366-5548). Apply the paint at a rate of 7.4 m² per L (**300 ft² per gallon**). Commence or suspend the painting operation when the air and surface temperature meet or exceed the manufacturer's recommendations.

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

- a) Lightly broom the railing surface immediately after passage of the slipformer.
- b) Coat the roadway face and top of the barrier railing as described above for the conventionally formed railing.

C. 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.

SB-9.4 Architectural Concrete Texture (Ashlar Stone)

A. Description of Work

This work consists of constructing simulated natural (split) and smooth cut stone masonry textured surfaces on all areas so designated on the plans for Bridge 25024. The work shall be performed in accordance with the applicable provisions of Mn/DOT 2401, the Plans and the following:

Architectural Concrete Texture (Ashlar Stone) shall be a random ashlar stone pattern resembling stone masonry applied to the surface areas of the bridge abutment and wing walls so designated on the plans. The maximum relief of the simulated stone shall be a maximum of 2 inches in depth.

The ashlar pattern shall match the appearance and characteristics which result when using Pattern 11003, Rustic Ashlar, by Customrock International, Inc.

B. Formed Textured Surfaces

When simulated ashlar stone is designated, concrete surfaces shall be formed using a form lining system made of high-strength urethane elastomer materials capable of withstanding anticipated concrete pour pressures without leakage or causing physical defects. Form liners shall attach easily to forms and be removable without causing concrete surface damage. The liners shall be designed to form surfaces conforming to the design intent including the shape, lines and dimensions described herein and in the plans. Match pattern features at form liner joints to minimize visible pattern repeats and make the formed concrete surface appear uniform and continuous without visible seams and form marks. When joints are unavoidable, make joints along main features of the pattern.

Form liners shall produce the textured effect of a highly realistic, random ashlar stone masonry surface. Simulated stones should exhibit the rough, natural (split) finish of real limestone laid in place with hand tooled mortar joints. Simulated stone surfaces having a smooth, slick or shiny surface will be rejected. Acceptable form liners shall provide a maximum pattern relief of 2 inches. Individual stones shall be formed with crisp, sharp edges and a rough (split), natural relief to the shape and dimensions described herein and shown on approved shop drawings.

Subject to compliance with requirements, provide form liner materials from the following manufacturers:

1. Custom Rock International, Inc.
2. Milestones, Inc.
3. Scott System
4. Other approved manufacturers

Form ties shall be made of non-corrosive materials when the portion permanently embedded in the concrete is less than 1-1/2 inches from the finished surface.

Form release agents shall be fully compatible with the form liner material and the special surface finish to be applied to the textured surfaces.

C. Submittals

Within 60 calendar days of execution and approval of the Contract, the Contractor shall submit the following to the Engineer for approval:

1. Product data including manufacturer's technical information and use instructions for form liner placement and release.
2. Actual samples of form ties that will be permanently embedded in the concrete.
3. Qualification data for firms and person specified below under Quality Assurance to demonstrate their capabilities and experience. Include a list of completed projects with project names, addresses, and names of architects, engineers and owners, plus any other pertinent information.
4. Shop drawings indicating form liner layout and termination details. Indicate backup, rustication, reveal, and chamfer strip locations. Include jointing, form tie location, pattern placement, pattern match details, and end, edge and other special conditions. Indicate tolerances and procedure of installation and separation.

D. Quality Assurance

1. Manufacturer's Qualifications: The form liner manufacturer must have five years minimum experience making liners used to create formed concrete surfaces matching natural stone shapes and textures.
2. Installer Qualifications: The form liner installer shall have had a minimum of five consecutive years of experience in textured formed concrete construction.
3. Test Panel Mock-ups and Test Panels (Stone Patterns Only): Construct test panel mock-ups of textured formed surfaces of the approved Architectural Surface Treatment for quality control comparison of surface texture and pattern characteristics between the approved sample mock-up and the actual work as it is installed. The test panel mock-ups shall be constructed using urethane foam or other suitable lightweight material to produce a surface that simulates that produced when casting concrete. The test panel mock-ups may also be used as a finished surface for mock-ups of the Architectural Surface Finish (Multi-color) as specified under Section SB-9.5 of these special provisions. The test panel mock-ups shall be a minimum of 3 inches thick, 4 feet wide and 3 feet high. They must be lightweight and easily moved or transported by one person.

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Upon approval of the test panel mock-up, concrete test panels shall also be constructed. At a minimum, the concrete test panels shall be the same size as the test panel mock-ups. Materials used in the construction of the concrete test panels shall comply with the applicable requirements of 2401 for formwork and concrete. Concrete mix for the concrete test panels shall be Mix No. 3Y43. The form liners used for the concrete test panels shall produce the same pattern that is intended for use on the structures. Cast unreinforced panels vertically simulating as many phases of the actual construction as possible. Additional concrete test panels will be required if results of the initial test panel do not meet the requirements of these special provisions.

Following completion of the structure, remove and dispose of the test panels in accordance with 2104.3C3.

Test panels shall be considered incidental to the work and no direct compensation will be made therefore.

E. Construction Requirements

Match pattern features at form liner joints to make the formed concrete surface appear uniform and continuous without grout leakage at the joints. When concrete vertical construction joints are required, place form liner joints in the valley of the grooves, or as approved by the Engineer. Following removal of forms, finish minor defects to blend with the balance of the pattern surface texture. Filling of "bug holes" or other similar deformities in the texture surface that are 1/2 inch or less in diameter or depth is not required. No visible vertical and horizontal seams or conspicuous form marks created by butt-joining form liners will be allowed. Where it is not possible to locate a vertical groove at a construction joint, the concrete surface shall be finished to reduce visibility of the construction joints.

Strip formwork in accordance with the form liner manufacturer's recommendations to avoid concrete surface deterioration or weakness planes in the substrate. Finish form tie holes in accordance with 2401.3F2a using approved patching materials.

Surface Preparation: All conventionally formed concrete surfaces receiving architectural concrete texture shall be water blasted to break the surface film and to remove all laitance detrimental to the finish coating system performance. Sandblasting will not be allowed for cleaning concrete surfaces, as it will reduce the architectural concrete texture specified in this Special Provision. Pressure washing with water at a pressure of **3000 psi** at a rate of **3 to 4 gallons** per minute using a fan nozzle held perpendicular to the surface at a distance of **one to two feet** shall be used.

Clean and repair surfaces of form liners to be re-used. Split, frayed, delaminated or otherwise damaged form liner material will not be acceptable for exposed surfaces. Form liners shall be cleaned and free of concrete buildup prior to each pour. Do not use "patched" forms for exposed concrete surfaces unless acceptable to the Engineer.

F. Method of Measurement

Measurement for Architectural Concrete Texture (Ashlar Stone) will be made by area in square feet of the finished surface constructed to the limits shown and noted in the Plans.

G. Basis of Payment

Payment for **Item 2411.618, "ARCH CONC TEXTURE (Ashlar Stone)"**, shall be made at the Contract price per square foot and shall be compensation in full for all costs of constructing the textured surfaces including the test panel mock-ups, concrete test panels, and the additional concrete required to achieve the specified treatment relief.

SB-9.5 Architectural Surface Finish (Multi-color)

A. Description of Work

This work consists of applying an architectural surface finish to all exposed concrete surfaces of the Architectural Concrete Texture (Ashlar Stone). The work shall be performed in accordance with the applicable provisions of Mn/DOT 2401, the Plans, and the following:

Architectural Surface Finish (Multi-color) shall be applied to the areas designated in the plans to receive Architectural Concrete Texture (Ashlar Stone).

Architectural Surface Finish (Multi-color) shall be a multi-colored application using approved stains. Simulated stone formed concrete surfaces shall be stained with a base color matching Federal Standard 595B, Color No. 33522 (tan) and highlighted with a color matching Federal Standard 595B, Color No. 37056 (Dark Brown). Architectural Surface Finish shall also include an anti-graffiti coating applied to the stained surface as specified in SB-9.6.

B. Surface Color

The surface coloring for the Architectural Surface Finish described above shall be performed using approved stains or paint systems applied in a manner consistent with the aesthetic design requirements of the Project.

For Architectural Surface Finish (Multi-color), the color shall be provided by a colored stain application emulating the dominant color (base color) of the natural limestone found in the Minnesota River Valley. The desired finish color effect shall be achieved through the application of a base coat and then applying an accent color to highlight the voids, blemishes, and imperfections in the simulated stone surface. Highlight coloration shall be by hand staining or other suitable antiquing methods. An application of the two stain colors mentioned above shall be required.

Grout pattern joints shall have the appearance of natural mortared joints.

Cork joints shown in the Plans shall be finished to visually continue the stonework pattern across the joint uninterrupted. A sample of the colored cork for approval shall be included in the concrete test panel described in SB-9.4.

Color samples will be developed by the Contractor using the test panel mock-ups described in SB-9.4 and the color information contained herein. Colors shall be derived from real rock samples of the natural stone provided by the Contractor. These color samples shall remain the property of the Department.

C. Stain Materials

Stain shall be a 100 percent acrylic; water-repellant, semi-opaque, tinted emulsion sealer designed for concrete and masonry surfaces. Acceptable products shall allow moisture and vapor transmission, be formulated for exterior application with resistance to freeze/thaw, moisture, alkali, acid and mildew, mold or fungus, discoloration or degradation and meet the following requirements:

1. Physical or performance properties:

Volume Solids	29-31 percent (Calculated Lab Value)
Weight Solids	44-46 percent (Calculated Lab Value)
Viscosity	65-85 KU (Calculated Lab Value)
Accelerated Weathering	1,000 Hours Minimum (ASTM G-26)

2. Color pigments for tinted products shall be derived from synthetic mineral oxides.

3. Subject to compliance with requirements, provide colored concrete finishing products from one of the following manufacturers:

- The Sherwin-Williams Company
- Tamms Industries
- TK Products
- Chem-Rex
- Other approved sources

To the greatest practical extent, all concrete finishing products shall be obtained from a single source.

All materials shall be furnished, prepared, applied, cured and stored according to the product manufacturer's directions and as specified herein. Special attention shall be given to the recommended temperature range for application.

D. Submittals by Contractor

Within 60 calendar days of execution and approval of the Contract, the Contractor shall submit the following to the Engineer for approval:

1. Product data including manufacturer=s technical information, label analysis, and application instructions for each material proposed for use.
2. Laboratory test reports showing that materials proposed for use meet physical or performance property requirements.

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3. 1 foot x 1 foot square samples of the Architectural Surface Finish (Multi-color) to be used on the stone textured surface patterns. Final color selections will be based upon completion of the test panel specified below.
4. Proof that the applicator has had five years experience finishing simulated stone masonry textured concrete. Include list of completed projects with project name and location and architect/engineer/owner of record.

E. Quality Assurance

1. The Contractor shall finish the test panel mock-up for Architectural Concrete Texture fabricated under Section SB-9.4 to satisfy the criteria specified herein.
2. Approved mock-up panels will be used for quality control comparison of color characteristics between the approved mock-up panels and the actual work as it is completed. The Contractor and/or his agents shall be responsible for maintaining these panels at individual work sites while the work is in progress for this purpose.
3. The Contractor shall demonstrate his workmanship by completely finishing the architectural surface treatment concrete test panels, described in SB-9.4, using approved concrete stain products, materials, methods and workmanship and the specified surface preparation method. Test panels shall be considered incidental to the work and no direct compensation will be made therefore.

F. Surface Preparation

Following removal of forms, all exposed textured concrete surfaces shall receive an ordinary surface finish in accordance with Mn/DOT 2401.3F2a prior to the surface preparation described below. Minor defects shall be finished to blend with the balance of the textured surfaces. On heavily textured surfaces (i.e. ashlar stone, cut stone, fractured granite, etc.) only minor defects greater than 1/2" in diameter shall be finished to blend with the balance of the textured surface. The Contractor shall make every effort to match the surface texture of patched surfaces with the surrounding textured surface. Visible vertical or horizontal seams or conspicuous form marks shall be repaired to the satisfaction of the Engineer and at the Contractor's expense.

All formed concrete surfaces to receive Architectural Surface Finish (Multi-color) shall be water-blasted to break the surface film and to remove all laitance detrimental to the color system performance. Sandblasting will not be allowed for cleaning concrete surfaces, as it will reduce the architectural concrete texture. Pressure washing with water at a pressure of 3000 lbs. Per Square Inch at a rate of 3 to 4 gallons per minute using a fan nozzle held perpendicular to the surface at a distance of 12 inches to 24 inches shall be used.

G. Application

The concrete to which the architectural surface finish is to be applied must be a minimum of 28 days old. All surfaces that are to receive architectural surface finish shall be thoroughly flushed with clean water not more than 24 hours before commencing with the finishing.

The finish color effect for the bridges and structures involves an application of a base coat, uniformly applied over the entire simulated stone textured surface (both individual stones and joints between stones). Subsequent coats are applied by placing one color over another or by inter-mixing several colors of stain to achieve the characteristics of the approved sample panel. The base color application shall meet the requirements of the product manufacturer for both thickness and coverage. All stain products used to tint and highlight the work shall not be diluted with water or other solvents in any way.

H. Method of Measurement

Measurement for the Architectural Surface Finish (Multi-color) applied to the architectural concrete texture (stone pattern) will be by area based on the Plan dimensions of the finished colored plane surface area in square feet.

I. Basis of Payment

Payment for **Item No. 2411.618, "ARCH SURFACE FINISH, (Multi-color)"**, shall be at the Contract price per square foot and shall be compensation in full for all costs of furnishing and applying finishing materials to the areas of Architectural Concrete Texture (Stone Pattern).

Application of the architectural surface finish to the test panels for quality assurance purposes shall be considered incidental and no direct compensation will be made therefore.

SB-9.6 Anti-Graffiti Coating

A. Description of Work

This work consists of applying an anti-graffiti coating to all areas of Bridge 25024 which receive Architectural Surface Finish (Multi-color) and the smooth concrete surfaces on the pier, the non-traffic face of the "F" Barriers, and the entire P-1 Parapet. The work shall be performed in accordance with the Plans and the following:

B. Materials

Anti-graffiti coatings shall be a clear, multi-component, multi-coat system designed as a permanent, non-destructive coating system for exterior architectural aesthetics. Product shall be compatible with any surface sealer and/or special surface finish that may have been previously applied to the concrete surfaces. It shall be non-yellowing, non-chalking and UV-resistant, available in a flat, matte or semi-gloss finish and shall not require re-application after graffiti removal. Coating shall not contain paraffin (wax) or elastomeric silicones. Acceptable products shall demonstrate protection from graffiti defacement, chemical staining, ghosting, shadowing and normal environmental effects without yellowing, color change, increased dirt pick-up or damage to the coating or substrate for a minimum ten-year period.

Acceptable anti-graffiti coating products are as follows:

- Invisi Shield as manufactured by Sherwin Williams
- Permaclean as manufactured by TK Products
- Graffiti Guard as manufactured by Tex-Cote
- Other products submitted for approval by the Mn/DOT Office of Materials – Analytical Lab

Graffiti removal agents shall be non-toxic, non-flammable, biodegradable and have a pH of 7 - 8.5. After graffiti removal, no evidence of graffiti shall be present. The product(s) shall not cause a change in the appearance to the treated surface, including shadowing, ghosting or staining of the coating or substrate.

C. Submittals

Submittals may be made at any time prior to being incorporated in the work. Allow sufficient time so that construction will not be delayed as a result of the time required to approve the submittals, including time for re-submittal as necessary. An extension of time will not be authorized because of failure to transmit submittals sufficiently in advance of the work.

The Contractor shall submit the following items to the Engineer:

- a) Manufacturer's product data sheets indicating technical information, label analysis and application instructions for each material proposed.
- b) For the purpose of future maintenance, a list of manufacturer-approved products for cleaning of the surface of the anti-graffiti coating product(s) used on the Project
- c) Certified test reports indicating compliance with requirements.
- d) A one-quart sample of each anti-graffiti coating product and a compatible graffiti removal agent for verification purposes.
- e) Test panel in accordance with the requirements of SB-9.4.
- f) Applicator qualifications demonstrating experience in coating applications. Include a list of recently completed graffiti-resistant coating projects. Supply name and location of project, name and telephone number of owner, and a description of products used, substrates, applicable local environmental regulations and application procedures.

D. Quality Assurance

All products applied under this Project shall be supplied by the same manufacturer. Coating and removal products shall demonstrate a history of successful use on transportation, commercial or industrial projects.

The approved coating manufacturer shall conduct a training seminar for the purpose of training applicators on anti-graffiti product technology, substrates and application methods. Applicator trainers shall be approved by and shall be in good standing with the manufacturer.

E. Application

Anti-graffiti coating shall be applied after all components of the Architectural Surface Finish have been applied to the areas of architectural concrete texture.

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The substrate shall be prepared and the anti-graffiti coating product(s) shall be applied in accordance with the manufacturer=s directions.

Prior to full application of the anti-graffiti coating to the designated surfaces, the applicator shall apply the anti-graffiti coating to the test panel containing Architectural Concrete Texture and Architectural Surface Finish (Multi-color) as described in SB-9.5 to confirm compatibility, coverage and possible color change. Any problems or damage to the color system as a direct result of the anti-graffiti products or surface preparation methods, shall be corrected to the satisfaction of the Engineer and at the Contractor=s expense.

F. Method of Measurement

Measurement for the Anti-graffiti Coating applied to the architectural concrete texture will be by area based on the Plan dimensions of the finished colored plane surface area in square feet.

G. Basis of Payment

Payment for **Item No. 2411.618, "ANTI-GRAFFITI COATING"**, shall be at the Contract price per square foot and shall be compensation in full for all costs of furnishing and applying finishing materials to the areas describes above.

Application of the anti-graffiti coating to the test panels for quality assurance purposes shall be considered incidental and no direct compensation will be made therefore.

SB-9.7 Contractor Concrete Mix Design – 3Y33AHP

For Bridge No. 25024, the Contractor shall design a 3Y33AHP concrete mixture that will minimize cracking. The work shall be performed in accordance with the requirements of Mn/DOT 2461 and the following:

The Contractor shall be responsible for determining the appropriate concrete mix design proportions based on a volume of 1.000 cubic yard and testing the mixes in accordance with the requirements. All submittals shall be sealed by a register Professional Engineer.

Any Mn/DOT approved admixture including water reducers, super-plasticizers, retarders, accelerators, and any Viscosity Modifying Admixture (VMA) or a combination thereof may be used at the discretion of the Contractor. The approved list is on file in the Mn/DOT Concrete Unit or can be found at the following web site: www.dot.state.mn.us/products

The Contractor shall obtain a written statement from the manufacturer of the admixtures verifying the compatibility of the combination of materials and the sequence in which they are combined. The manufacturer will further designate a technical representative from the concrete supplier or his company to be in charge of the dispensing of 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 by the representative as being detrimental to the integrity of the placement. The manufacturer’s technical representative will be present during the concrete placement unless the Engineer waives his presence.

A. Specific requirements for **3Y33AHP** concrete:

1. Cement complying with ASTM C 150 Type I or I/II or ASTM C595 blended cement currently on the MN/DOT approved list shall be used. Up to a total of 30 percent replacement by mass (weight) with fly ash conforming to ASTM C618, ground granulated blast furnace slag conforming to ASTM C 989, and/or Silica Fume conforming to ASTM C 1240 may be used. Replacement with Silica Fume shall not exceed 5 percent of the total cementitious material.
2. The Contractor shall designate a 3" slump range. The slump shall be kept consistent during the entire placement. If a spread range is specified a Visual Stability Index (VSI) of 1 or less is required according to ASTM C1610.
3. The coarse aggregate shall be class A.
4. The Contractor shall 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.
5. The mixture shall be designed and produced at a water/cementitious ratio of not greater than 0.45.
6. The air content shall be 6.5 percent plus 2.0 percent or minus 1.5 percent at the point of placement.
7. The shrinkage of the concrete when performed in accordance with ASTM C157 shall not be greater than 0.040 percent at 28 days.
8. The concrete shall obtain a rapid chloride permeability of not more than 2500 Coulombs at 28 days and not more than 1500 Coulombs at 56 days. The 28 day results are for preliminary approval only. Final acceptance will be based on the 56 day results.
9. The deck will obtain an anticipated strength of 4300psi at 28 days when measured in accordance with ASTM C31. The maturity method according to ASTM C1074 may be considered for subsequent strength determination.

B. Mix design submittals

The Contractor shall submit the following to the Engineer and Mn/DOT for review prior to the beginning of laboratory tests for the mix designs.

1. A completed Contractor mix design form using the Mn/DOT Contractor Mix Design Submittal package available from the Mn/DOT Concrete Engineering website. Any changes or adjustments to the material or mix design require a new Contractor mix design submittal. For mix design calculations, Mn/DOT Concrete Unit will provide specific gravity and absorption data.

2. A Job Mix Formula (JMF) containing proportions of materials and individual gradations of each material, plus a composite gradation.

The JMF submittal shall include working ranges based on the composite gradation of the above sieves. The working range limits of the composite gradation are based on a moving average of 4-tests (N=4). The working ranges are:

Sieve Size	Working Range
4.75 mm [# 4] sieve or greater	+/- 5 %
2.36 mm [# 8] to 600 µm [# 30] sieve	+/- 4 %
300 µm [# 50] sieve	+/- 3 %
150 µm [# 100] sieve	+/- 2 %

The Contractor shall produce a mixture of uniform composition conforming to the approved JMF. If, during production, the Contractor determines from the moving average results of QC aggregate gradation tests that aggregate adjustments to the JMF working range gradation requirements are necessary, adjustments may be made within the limits of the table below without a new mix design providing all other requirements are met to the satisfaction of the Engineer. A JMF adjustment constitutes beginning a new lot and restarting the gradation moving average.

Allowable JMF Adjustments

Sieve Size	Allowable Adjustment
4.75 mm [# 4] sieve or greater	± 5 %
2.36 mm [# 8] to 600 µm [# 30] sieve	± 4 %
300 µm [# 50] sieve	± 3 %
150 µm [# 100] sieve	± 2 %

Individual proportions of aggregate may be adjusted up to 5 % by weight from the original mix design provided all other requirements are met to the satisfaction of the Engineer. Adjustments should be documented on the JMF adjustment worksheet and signed by the Contractor and the Agency's representatives. The Contractor may continue pouring, provided that the changes are documented and submitted to the Concrete Engineer. Approval of further adjustments to the JMF without a new mix design is at the discretion of the Concrete Engineer.

Compliance is determined based on the Contractor's test results as verified by department testing.

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The Department's samples for gradation control acceptance are based on one lot representing the concrete bridge deck slab placement. Each subplot shall represent approximately 150 cubic yards. One complete gradation test of both coarse and fine aggregate is required per subplot. For bridge deck quantities of less than 150 cubic yards the subplot requirement shall be waived and only one complete gradation test is required per bridge.

3. The dosage and types of admixtures proposed for use and their purpose.

C. Laboratory testing requirements and submittals:

To determine the characteristics of the Contractor proposed mix design, the Contractor will be required to prepare test batches and do laboratory testing. The following tests shall be conducted at an AMRL certified laboratory using the exact materials proposed in the mix design:

Lab testing requirements:

1. Slump and air content.
2. Compressive strength at 1, 3, 7, 28, 56 days (sets of 3).
3. Hardened air content (ASTM C457) at a minimum of 7 days.
4. 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).
5. Concrete shrinkage (ASTM C 157) at 28 days.

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

All testing for plastic concrete shall be performed after admixtures have been added to the concrete mixture.

After completion of the laboratory testing specified herein and, at least, 15 working days prior to the full scale test pour, the following material shall be submitted to Mn/DOT for review and approval:

1. Laboratory reports of the design mixes, including the following:
 - (a) Exact batch weights and properties of all ingredients used and all aggregate gradations.
 - (c) Slump and air content (at <5 minutes, 15 minutes, and 30 minutes after the completion of mixing).
 - (d) Cylinder identification, including mix designation.
 - (e) Date and time of cylinder preparation.
 - (f) Date and time cylinder specimen was tested.
 - (g) Compressive strength of each cylinder specimen at 1, 3, 7, 28, and 56 day (sets of 3).

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- (h) A graphic plot of age, from 0 to 56 days, vs. strength for each mix design.

Standard Cylinder Testing: A minimum of 15 test cylinders, 4 inches x 8 inches, shall be made of each proposed mix. A set of 3 cylinders shall be broken at 1, 3, 7, 28, and 56 days. Cylinders shall be made in accordance with AASHTO T126 and tested in accordance with AASHTO T22.

The mix design used in the permanent work shall be of the same materials, same supplier, and same supplier's manufacturing plant, and proportions as were used in the approved test mix. Strength requirements specified for each mix shall also be applicable to the cylinder tests taken during the production work.

D. Trial placement

A minimum of two weeks prior to the actual pour, a separate trial placement utilizing a minimum of two 10 cubic yard loads shall be successfully completed prior to placement of the bridge deck slab concrete. The trial placements may be incorporated into the bridge footings, abutments or end diaphragms. Trial placements need not be incorporated into the completed project, and may be part of a residential /commercial construction in the immediate vicinity of the project, but must be mixed and transported using the same methods that will be used to construct the bridge deck. Final approval of the mixture is based on satisfactory field placement and performance. The Contractor shall verify strength results by casting and testing strength specimens. The number of test specimens (sets of 3) required shall be mutually agreed upon by the Engineer and Contractor.

Payment for design of the concrete mixes shall be considered as incidental to the concrete furnished and placed, and no direct compensation will be made therefore.

E. Structural slab curing

A structural slab placement and curing plan for each bridge shall be submitted to the Engineer for approval at least 2 weeks prior to placement. The Contractor's plan shall include detailed information regarding the anticipated concrete delivery rates, estimated start and finish time, and material, labor and equipment that will be used to place, finish and to cure the deck segment in accordance with specifications, including placement of wet burlap and soaker hose or other system to maintain the deck in a moist condition during the curing period. Information supplied shall also include the number of "work" bridges that will be used, and the number of people responsible for the various tasks. The plan must also discuss bulkheading methods and materials that will be used if it is determined that proposed concrete placement rates cannot be maintained.

A pre-placement meeting shall be held 4 weeks prior to the structural slab placement to review the information and details provided in the placement and curing plan. The meeting shall be attended by the Contractor, Engineer, and if required by the Engineer, the concrete supplier and/or concrete pump supplier.

The Contractor is fully responsible for curing methods. The Contractor shall comply with one of the following curing methods unless other methods are approved by the Engineer.

Deck Slab Curing

After completion of the tine texturing for bridge deck slab and after free water has disappeared from the surface, the Contractor shall apply a membrane curing compound meeting the requirements of Mn/DOT specification 3754, section B (Requirements for Concrete Pavement Membrane Curing Compound). The curing compound shall be applied with approved power-operated spray equipment. The Contractor shall place the membrane cure material homogeneously to provide a uniform solid white opaque coverage on all exposed concrete surfaces (equal to a white sheet of paper). The membrane cure shall be placed within 30 minutes of concrete placement unless otherwise directed by the Engineer. Failure to comply with this provision will result in a price reduction for the concrete item involved in accordance with Mn/DOT Spec. 1503. The curing compound is not a substitute for the cure specified below, but is required for moisture retention until the conventional wet curing material can be placed. Conventional wet curing shall be applied as soon as the concrete can be walked on with insignificant damage. The deck slab surface shall be kept continuously wet with clean fresh water for an initial curing period of at least 7 days. The Contractor must provide adequate personnel to ensure that the deck surface is maintained in a wet condition on weekends and/or holidays.

F. Crack sealing

2401.3J2 is modified as followed:

Any cracks that develop in the deck surface shall be sealed with an approved methylmethacrylate or epoxy sealant just prior to opening the bridge to traffic. Sand shall be broadcast on the surface after flood coat sealant application. All work required to seal cracks prior to opening the bridge to traffic shall be included in the payment for 3Y33AHP deck concrete.

SB-9.8 Contractor Concrete Mix Design: Self Consolidating Concrete (SCC)

For Bridge No. 25024, the Contractor shall design a Self Consolidating Concrete (SCC) for the filling between pier wall elements. The work shall be performed in accordance with the requirements of Mn/DOT 2461 and the following:

The Contractor must have prior experience producing SCC and must have supplied SCC to at least one previous Mn/DOT job.

The Contractor shall be responsible for determining the appropriate concrete mix design proportions based on a volume of 1.000 cubic yard and testing the mixes in accordance with the requirements.

Any Mn/DOT approved admixture including water reducers, super-plasticizers, retarders, accelerators, and any Viscosity Modifying Admixture (VMA) or a combination thereof may be used at the discretion of the Contractor. The approved list is on file in the Mn/DOT Concrete Unit or can be found at the following web site: www.dot.state.mn.us/products

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The Contractor shall obtain a written statement from the manufacturer of the admixtures verifying the compatibility of the combination of materials and the sequence in which they are combined. The manufacturer will further designate a technical representative from the concrete supplier or his company to be in charge of the dispensing of 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 by the representative as being detrimental to the integrity of the placement. The manufacturer's technical representative will be present during the concrete placement unless the Engineer waives his presence.

A. Specific requirements for **Self Consolidating Concrete (SCC)** concrete:

1. Cement complying with ASTM C 150 Type I or I/II or ASTM C595 blended cement currently on the MN/DOT approved list shall be used. Up to a total of 30 percent replacement by mass (weight) with fly ash conforming to ASTM C618, ground granulated blast furnace slag conforming to ASTM C 989, and/or Silica Fume conforming to ASTM C 1240 may be used. Replacement with Silica Fume shall not exceed 5 percent of the total cementitious material.
2. The Contractor shall designate a 4" spread range. The max spread shall be 28" and kept consistent during the entire placement.
3. A Visual Stability Index (VSI) of 1 or less is required according to ASTM C1610.
4. The coarse aggregate shall be class A.
5. The Contractor shall 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.
6. The mixture shall be designed and produced at a water/cementitious ratio of not greater than 0.45.
7. The air content shall be 6.5 percent plus 2.0 percent or minus 1.5 percent at the point of placement.
8. The concrete will obtain an anticipated strength of 4300psi at 28 days when measured in accordance with ASTM C31. The maturity method according to ASTM C1074 may be considered for subsequent strength determination.

B. Mix design submittals

The Contractor shall submit the following to the Engineer and Mn/DOT for review prior to the beginning of laboratory tests for the mix designs.

1. A completed Contractor mix design form using the Mn/DOT Contractor Mix Design Submittal package available from the Mn/DOT Concrete Engineering website. Any changes or adjustments to the material or mix design require a new Contractor mix design submittal. For mix design calculations, Mn/DOT Concrete Unit will provide specific gravity and absorption data.

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2. A Job Mix Formula (JMF) containing proportions of materials and individual gradations of each material, plus a composite gradation.

The JMF submittal shall include working ranges based on the composite gradation of the above sieves. The working range limits of the composite gradation are based on a moving average of 4-tests (N=4). The working ranges are:

Sieve Size	Working Range
4.75 mm [# 4] sieve or greater	+/- 5 %
2.36 mm [# 8] to 600 μm [# 30] sieve	+/- 4 %
300 μm [# 50] sieve	+/- 3 %
150 μm [# 100] sieve	+/- 2 %

The Contractor shall produce a mixture of uniform composition conforming to the approved JMF. If, during production, the Contractor determines from the moving average results of QC aggregate gradation tests that aggregate adjustments to the JMF working range gradation requirements are necessary, adjustments may be made within the limits of the table below without a new mix design providing all other requirements are met to the satisfaction of the Engineer. A JMF adjustment constitutes beginning a new lot and restarting the gradation moving average.

Allowable JMF Adjustments

Sieve Size	Allowable Adjustment
4.75 mm [# 4] sieve or greater	± 5 %
2.36 mm [# 8] to 600 μm [# 30] sieve	± 4 %
300 μm [# 50] sieve	± 3 %
150 μm [# 100] sieve	± 2 %

Individual proportions of aggregate may be adjusted up to 5 % by weight from the original mix design provided all other requirements are met to the satisfaction of the Engineer. Adjustments should be documented on the JMF adjustment worksheet and signed by the Contractor and the Agency's representatives. The Contractor may continue pouring, provided that the changes are documented and submitted to the Concrete Engineer.

Approval of further adjustments to the JMF without a new mix design is at the discretion of the Concrete Engineer.

Compliance is determined based on the Contractor's test results as verified by department testing.

The Department's samples for gradation control acceptance are based on one lot representing the concrete bridge deck slab placement. Each subplot shall represent approximately 150 cubic yards. One complete gradation test of both coarse and fine aggregate is required per subplot. For bridge deck quantities of less than 150 cubic yards the subplot requirement shall be waived and only one complete gradation test is required per bridge.

3. The dosage and types of admixtures proposed for use and their purpose.

C. Laboratory testing requirements and submittals:

To determine the characteristics of the Contractor proposed mix design, the Contractor will be required to prepare test batches and do laboratory testing. The following tests shall be conducted at an AMRL certified laboratory using the exact materials proposed in the mix design:

Lab testing requirements:

1. Spread and air content.
2. Compressive strength at 1, 3, 7, 28, 56 days (sets of 3).

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

All testing for plastic concrete shall be performed after admixtures have been added to the concrete mixture.

After completion of the laboratory testing specified herein and, at least, 15 working days prior to the full scale test pour, the following material shall be submitted to Mn/DOT for review and approval:

1. Laboratory reports of the design mixes, including the following:
 - (a) Exact batch weights and properties of all ingredients used and all aggregate gradations.
 - (c) Slump and air content (at <5 minutes, 15 minutes, and 30 minutes after the completion of mixing).
 - (d) Cylinder identification, including mix designation.
 - (e) Date and time of cylinder preparation.
 - (f) Date and time cylinder specimen was tested.
 - (g) Compressive strength of each cylinder specimen at 1, 3, 7, 28, and 56 day (sets of 3).
 - (h) A graphic plot of age, from 0 to 56 days, vs. strength for each mix design.

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The mix design used in the permanent work shall be of the same materials, same supplier, and same supplier's manufacturing plant, and proportions as were used in the approved test mix. Strength requirements specified for each mix shall also be applicable to the cylinder tests taken during the production work.

D. Full Scale Test Pour

1. The Contractor shall construct a full scale test pour at least 5 days prior to placing concrete in the bridge to demonstrate their ability to handle, place, finish The SCC. The dimensions of the test pour shall be of the same size and dimension as the original bridge element. The Contractor shall construct the test pour so that it complies with the applicable requirements of 2401 and these special provisions using the same SCC mix design accepted for use in the bridge. The contractor shall submit the location and proposed dimensions of the pour to the Mn/DOT for Approval.

The Contractor shall place, finish, cure the test pour using the same personnel, methods and equipment that the Contractor intends to use on the structural slab.

Not less than one day after construction of the test pour, the Contractor shall take four full-depth cores. The four cores will be examined by Mn/DOT to determine if the concrete was properly consolidated during placement.

Acceptance of the test pour is contingent upon demonstrating that the requirements of the Project are satisfied for placement, consolidation, finishing, curing and testing.

The qualification slab shall be removed and disposed of by the Contractor in accordance with 2104.3C.

SB-9.9 Texture Planing of Bridge Slabs

All texture planning work within this provision can be deleted from the Contract at the Engineer's discretion.

The texture planning work shall be only on the final roadway surface. The surface of the sidewalk at the south side of the bridge used as traffic lane during Stage 2 construction shall not be finished with texture planing.

Delete the 3rd paragraph of 2401.3F3b(3) and substitute the following:

Special care shall be taken 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, curing shall be applied as soon as possible.

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Upon completion of curing, a surface smoothness check will be made on the roadway surface. The final surface shall meet the tolerance requirements of 2401.3F3b(3). Surface areas not meeting the specified tolerances shall be corrected by removal and replacement or by grinding the high spots to the extent directed by the Engineer prior to beginning surface texturing operations. Nonconforming areas that are not satisfactorily corrected shall be subject to 1503 and 1512.

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

During planing operations, joints must be adequately protected against damage and special care shall be taken to avoid damage to expansion devices. Planing shall be done 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 3 mm (**1/8 inch**) in 3 meters (**10 feet**) measured with a straightedge laid longitudinally and 3 mm (**1/8 inch**) in 1 meter (**3 feet**) measured transversely at right angles to the centerline of roadway.

All slurry material shall become property of the Contractor and must be disposed of as per Mn/DOT 2104.3C3, as approved by the Engineer, and as described in this special provision.

All concrete residue and water (slurry) resulting from concrete texture planning must be continuously vacuumed from the surface, captured, and containerized 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. The Contractor must 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 lined containment area. If a temporary containment area is used within the highway Right of Way, a Site Plan as per 1717 will be required for the Engineer's approval. The minimum Site Plan shall include 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, the Contractor shall 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 by the Contractor.

As part of the slurry disposal or reuse plan, the Contractor must 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 Mn/DOT 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 planning operation.

Planned areas not meeting requirements may, at the Engineer's option, be replaced, re-planned or left as is and accepted for payment subject to a price reduction of \$2.70 per square meter (**25 cents per square foot**) but, in all cases, positive surface drainage shall be provided.

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.

SB-9.10 Structural Slab Wetting

Add the following to 2401.3F3b:

12 hours prior to placing the bridge slab, use potable water to prewet all surfaces of the inverted T-beams that the new bridge slab will be in contact with. Thoroughly wet the surface to a saturated condition and keep saturated. Keep the surface in a Saturated Surface Dry (SSD) condition by blowing out all standing water in depressions or areas of removal one hour before placement begins.

SB-10 (2402) STEEL BRIDGE CONSTRUCTION

SB-10.1 Metal Railing

This work shall consist of furnishing, coating, and installing metal railing, including all anchorages and fittings, in accordance with the applicable provisions of 2402, 2433, 2471, 2478, the Plan and the following. The contractor is responsible for communicating all applicable specifications, special provisions and requirements to all subcontractors.

A. Engineer

Engineer, as used herein, when relating to shop fabrication and coatings, shall mean the Departments Bridge Construction and Maintenance Engineer.

B. Materials

All materials shall be in accordance with the Plan details. If not specified, all steel shall comply with 3306, except that pipe and pipe sleeves shall comply with 3362. Threaded rods, bolts, nuts, and washers shall meet 3391 and shall be galvanized in accordance with 3392 or electroplated in accordance with ASTM B 633, Type III, SC 4.

C. Anchorages

Except when part of a proprietary anchorage assembly, threaded rods and bolts shall meet the requirements of 3385 and 3391, respectively.

Adhesive or cast-in-place type anchors shall be used unless otherwise specified in the Plan. Adhesive anchors shall not be allowed for "Structural Tube Railing Design T-1" construction.

If the Contractor chooses adhesive anchors, the Contractor shall 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

Anchorage for fastening rail posts shall have an ultimate pull out strength, as specified in the Plan, and shall be installed in sound concrete to a depth equal to at least six times the rod or bolt diameter. Bolt heads and/or nuts shall be in contact with the adjacent surface and shall be torqued to approximately 108 Nm (**80 foot pounds**) unless a different torque is recommended by the manufacturer. Adhesive anchorages shall consist of a continuously threaded rod secured by an adhesive or mortar.

Laboratory tests, that include static load tests for ultimate pullout strengths, shall be performed on anchorage systems that are subject to tensile loads. The tests, in accordance with ASTM E 488, shall be performed and certified by an independent testing laboratory. The Contractor shall furnish the Engineer with the test reports and the specification sheets that are prescribed by ASTM E 488.

The Contractor shall 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 shall include 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. Three anchorages shall be tested to not less than $\frac{1}{2}$ 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 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.

Location	Bolt or Rod Diameter inches	Minimum Embedment Depth inches	Ultimate Pull-out Strength pounds
Ornamental Metal Railing At the South Edge of Deck	5/8	5	24000

TABLE 1
ANCHOR ROD PROOF LOADS, KN (kips)
TYPE OF ROD, FROM SPEC. 3385

DIA., mm (inches)	TYPE A	TYPE B	TYPE C	TYPE D
13 (1/2")	21.0 (4.75)	25.0 (5.7)	45.0 (10.1)	22.0 (4.9)
16 (5/8")	33.0 (7.4)	39.5 (8.9)	70.0 (15.8)	34.0 (7.6)
19 (3/4")	47.0 (10.6)	56.0 (12.6)	101.0 (22.8)	49.0 (11.0)
22 (7/8")	65.0 (14.5)	77.0 (17.4)	138.0 (31.0)	67.0 (15.0)
25 (1")	85.0 (19.0)	100.0 (22.6)	180.0 (40.5)	86.0 (19.5)

Installation of anchorages shall be in accordance with the manufacturer's recommendations and as specified in the Plan.

Any voids occurring between the top of the anchorages and the concrete in which it is embedded shall be filled with caulk approved by the Engineer.

D. Fabrication and Inspection Requirements

All metal railing shall be fabricated in accordance with 2471 and the Plan. The welding code shall be AWS D1.1-Structural Welding Code-Steel. Welding Procedure Specifications (WPSs) shall be submitted to the Engineer, for approval, prior to the start of fabrication.

Prior to fabrication the Contractor shall 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, shall be subject to 1512. The Contractor shall also give the Engineer at least 5 working days notice prior to beginning work so that Quality Assurance (QA) inspection may be provided.

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All metal railing will be inspected by the Engineer. 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.

All parts of the fabrication are to be visually inspected and the inspections are to be documented by the Contractor's QC personnel. Any Nondestructive Testing required by the Contract Documents shall be performed and documented by an ASNT-TC-1A Level II qualified inspector.

Parts found to be in nonconformance shall be documented by using a Nonconformance Report form (NCR). The NCR shall describe in detail the fabrication error and the proposed repair procedure(s) in accordance with the QCP. Repair(s) performed shall be subject to the written approval of the Engineer.

E. Coating Requirements

All railing material shall be galvanized in accordance with 3394 after fabrication and painted (Duplex Coated) using the applicable provisions of 2478. The primer coat shall not be used on galvanized surfaces. The color of the finish coat shall match Federal Standard 595C, Color No. 20062, Dark Brown, and have a semi-gloss finish.

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 inform the galvanizer as to which specific items are going to be duplex coated so that they may comply with any additional cleaning required to meet the "Post Galvanizing Procedures", and, as necessary, meet the visual requirements of aesthetic, ornamental products. The galvanizer shall also be informed which materials, to be galvanized, are reactive (e.g. 3309, etc.).

Galvanizing Procedure(s):

1. All metal railing to be galvanized will be processed utilizing a "dry" kettle. The metal railing shall be prefluxed prior to the galvanizing bath using an aqueous tank of zinc chloride/ammonium chloride. The use of a "top flux" blanket on the molten zinc bath will not be permitted.
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, or heavy deposits of zinc, which will interfere with the "intended use of the product", will not be permitted. Damage to the galvanized zinc coating resulting in uncoated "black" and/or bare areas, blisters, flux deposits, and dross inclusions will also be considered unacceptable. Galvanized material that does not meet the requirements of 3394, shall be repaired in accordance with the methods described in ASTM A780. Required repair(s) may be subject to written approval of the Engineer. "Intended use of the product" shall be defined as surface conditions that, when painted, will produce acceptable aesthetic and/or visual qualities.
4. Galvanized metal railing shall be stored in a manner that will prevent the formation of "white-rust" or wet storage painting. "White rust" or staining of the galvanizing is not acceptable. A written repair procedure shall be subject to the approval of the Engineer. All repairs shall be performed at no expense to the owner.
5. The galvanizer shall provide the Engineer with all galvanizing process-related Quality Control documents prior to shipment of the galvanized product. These documents shall include the following: coating material certifications, visual examinations, and coating thickness examinations.
6. The galvanized metal railing shall have a straightness tolerance of 1/8 inch in 10 ft, prior to any subsequent paint applications. Any galvanized metal railing not meeting this tolerance shall be straightened.
7. It is the galvanizer's responsibility to provide the Engineer with advanced notification of at least 5 working days of intent to ship so that the Engineer can perform a Quality Assurance audit.

Post Galvanizing Surface Preparation:

1. Preparation of galvanized surfaces for painting shall be in accordance with ASTM D6386.

Paint Application:

1. Surface cleaning shall be by the solvent cleaning method and surface preparation shall be performed by sweep blasting.
2. All sweep blasted galvanized railing shall be coated 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 Contractors QC personnel shall document that all parameters were followed.
3. All coating material shall be applied in accordance with the contract documents and the manufacturer's Product Data Sheet (PDS) and application guides for the material and system specified.
4. Coating material(s) shall meet the requirements of 3520. The color of the intermediate coat shall present a distinct contrast from other applied coatings.

5. QC Inspections of all coated products shall be accomplished by an observer with normal color vision, in a "well lighted" area, during each coating phase and prior to final acceptance.

"Well-lighted" shall be defined as a minimum of 50 foot candles of artificial light or natural daylight. A light meter with readings in foot candles shall be used to verify the adequacy of the lighting.

Handling and Shipping of Coated Metal Railing:

All completed, fabricated, and coated metal railing shall be protected during handling, and shipping, to prevent any damage to the coating(s). Coated metal railing shall not be moved or handled 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 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:

All completed coated metal railing shall be stored in accordance with 1606 and the following:

1. All railing shall be clearly tagged/piece marked by the fabricator prior to final storage. Identification markings shall include, 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. The method of identification shall be included in the fabricators QCP.
2. It is the Contractors responsibility to 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.

F. Construction Requirements

The steel posts shall be adjusted to obtain the grade and alignment as shown in the Plans by one of the following methods:

1. The steel posts shall be shimmed with steel shims or washers to the proper grade and alignment, not to exceed 1/4 inch of shim height. Before attaching the nuts, coat the surface between the base plate and concrete rail with an approved silicone caulk. Tighten the anchor rod nuts (as per section "C"-Anchorages) and neatly smooth the caulk around the perimeter of the rail post base plate.

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2. The anchor rods shall have leveling nuts threaded on them and turned down to the base of the anchor rods. The rails shall be installed and the steel posts set to the proper grade and alignment by adjusting the leveling nuts. Install the top nuts and tighten them firmly to the base plate. The space between the base plate and the concrete shall be filled and neatly finished with grout that is approved by the Engineer.

Ground all metal railings. Install all electrical grounding in accordance with the applicable provisions of Mn/DOT specification 2557 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 will 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 inch or more and a minimum length of 8 feet 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.

G. 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, shall be subject to the provisions of 1512.

H. Method of Measurement

Measurement will be by length in feet based on Plan dimensions between the outside ends of metal railings.

I. Basis of Payment

Payment for Item No. 2402.583, "ORNAMENTAL METAL RAILING" and Item No. 2402.584, "STRUCTURAL TUBE RAILING DESIGN T-1" will be made at the contract price per foot and shall be compensation in full for all costs of fabrication, galvanizing, surface preparation, 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.

SB-11 (2405) PRESTRESSED CONCRETE BEAMS

The provisions of Mn/DOT 2405 are modified and/or supplemented with the following:

Delete the first paragraph of 2405.3M and substitute the following:

Prestressed concrete beams shall be erected in a manner that will provide safety to the workers, inspectors, and the public, at all times, as well as reasonable assurance against damage to the prestressed members.

SB-11.1 Prestressed Concrete Fabricator Certification

The Fabricator's quality control office shall maintain 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.

SB-11.2 Special Requirements for Prestressed Inverted T-Beams

A. Surface Requirements

The upper surfaces of the inverted T-beams shall have a roughened surface for bonding to the cast-in-place portion of the deck. The roughened surface must have an amplitude of at least 1/4". The method used to obtain the 1/4" amplitude roughness must be reliable. Subsequent failure of obtaining the 1/4" roughness on the actual inverted T-beams will be grounds for rejection of the beams.

B. Age Requirements

Prior to pouring the cast-in-place bridge deck onto the inverted T-beams, a minimum of 14 days of aging shall be required for the inverted T-beams starting from the date that the beams are initially cast. The date that each beam is cast shall be recorded and clearly marked on the prestressed concrete beam.

C. Shop Drawings

Shop drawings for the prestressed inverted T-beams will be required. Separate shop drawings for each beam type shall be furnished to the Engineer for approval. The Contractor shall allow a review period of 14 calendar days by the Department prior to fabrication of the inverted T-beams. Shop drawings shall be per the design plans, and any changes or deviations will require the Engineer's approval.

The shop drawings shall include all information necessary to completely fabricate the beams, and, as a minimum, shall include beam length, cross-section with dimensions, end-of-beam details, strand size and location, initial prestressing jacking force, initial and final concrete strengths, reinforcement bar size and spacing, projected length of bars extending out of the section, and required number and size of handling devices. All handling devices shall be located within 2'-0" from the ends of the beams.

D. Inspection by Mn/DOT

Only beams bearing a mark indicating that they were examined by a Mn/DOT inspector and approved for shipment shall be delivered to the Project site.

E. Method of Measurement

Measurement of Inverted T-beams will be made by the linear foot for the summation of beam lengths measured out-to-out of beam along the centerline of beams.

F. Basis of Payment

Payment for Item No. 2405.603, "PRESTRESSED BEAM INV-T 18" TYPE _", for invert T-beams will be made at the Contract price per linear foot for each type, and shall be compensation in full for all costs of materials, shop drawings, fabrication, construction of the test section specimen for the roughened surface, transportation and erection of the beams in their final position, as described above.

SB-11.3 Prestress Transfer

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 2405.3H.

Add the following to 2405.3H:

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:

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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, all strands of that beam shall be released in the sequence described above even if cracking is noticed near the end of the beam. Notify the Engineer immediately of any cracking and no other beams with the same strand pattern may be fabricated until the Engineer has approved a revised release sequence.

SB-12 PRECAST CONCRETE ABUTMENT, WINGWALL AND PIER ELEMENTS

Description of Work

This work consists of furnishing, erecting, grouting, filling with SCC, and installing precast concrete elements for abutments, wingwalls, pier caps, pier bases and pier walls, including all necessary materials, equipment, and closure pours to complete the work as shown in the Plan.

In order to meet the required curing time, all precast elements shall be fabricated before the starting of pile driving for the "Accelerated Bridge Construction" (ABC) required schedule for this project. Contractor shall plan the production of the precast concrete element for abutments, wingwalls and piers with the precast element supplier(s) to meet the ABC schedule for this project.

SB-12.1 Materials

- A. The concrete for the precast elements shall be Mn/DOT mix 3Y43.
- B. Use structural non-shrink grout for through holes, keyway, and any blockouts shown on the Plan. The Contractor shall submit test results of the grout mixture verifying compliance with the following requirements:
 - 1. Product Composition
 - 1.1 Neat Grouts: The product shall be composed of all fine particles and have a consistency of a powder.

- 1.2 Extended Grouts: A 3/8 inch pea gravel aggregate extension may be used in conjunction with a neat grout. The aggregate composite shall not exceed 50% by weight.
- 1.3 Neat and extended grouts must comply with the specifications set forth in Section 2 through Section 6 of SB-12.1.B.
2. Compressive Strength
 - 2.1 The product shall meet the following time-based criteria for compressive strength based on ASTM C 109:
 - 1 day: Minimum 4000 psi
 - 7 day: Minimum 5000 psi
 - 2.2 If a 7 day compressive strength is not available for a product, the following criteria shall be used:
 - 28 day: Minimum 6000 psi
3. Splitting Tensile Strength
 - 3.1 The product shall meet the following time-based criteria for splitting tensile strength based on ASTM C 496:
 - 1 day: Minimum 200 psi
 - 7 day: Minimum 400 psi
 - 3.2 If a 7 day splitting tensile strength is not available for a product, the following criteria shall be used:
 - 28 day: Minimum 600 psi
 - 3.3 If no splitting tensile strength information is available for a product, the following criteria shall be used:
 - 1 day compressive strength divided by 15 must be greater than 300 psi
 - 7 day compressive strength divided by 15 must be greater than 400 psi
 - 28 day compressive strength divided by 15 must be greater than 500 psi (in lieu of 7 day strength)
4. Shrinkage
 - 4.1 The product shall meet the following criteria for shrinkage based on either ASTM C 157 or ASTM C 596. Neat grouts shall be evaluated with 1 in. square cross section prisms and extended grouts shall be evaluated with 3 in. square cross section prisms. The criteria shall remain the same regardless of test prism size.
 - 28 day: Maximum 0.04% (400 microstrain)
5. Mixing Procedure
 - 5.1 If an aggregate extension is used, the aggregate shall be added to the initial water content before any powder is added.
 - 5.2 The powder shall be added to the specified minimum water content. An additional water amount shall be supplied after approximately 80% of the product has been added to the initial water. This additional water amount may be specified by the manufacturer or may be taken as the difference between the specified maximum water content and the specified minimum water content. The specified maximum water content for a specific product shall not be exceeded. No water shall be added to the product once placement has commenced.

6. Flow
 - 6.1 The product shall be tested on site according to SB-12.1.B.6.2, after mixing and immediately before pouring the product.
 - 6.2 The product shall be tested on a standard flow table specified by ASTM C 230. The testing procedure shall follow ASTM C 1437 with the following modifications:
 - The average diameter of the product shall be measured after the mold is lifted to determine the product's flow under its own self weight.
 - The table shall then be dropped 10 times in 15 seconds.
 - The average diameter of the product shall be measured after 10 drops.
 - If either the self weight or 10 drops causes the product's diameter to exceed the diameter of the table, then that measurement shall be recorded as the diameter of the table.
 - 6.3 The product shall meet the following criteria for flow based on the procedure in 9.2:
 - Minimum average diameter from self weight flow: 7 in.
 - Minimum average diameter after 10 drops: 9 in.
7. Recognized Grout **Products**
 - Set 45® Hot Weather Grout
 - Five Star® Highway Patch
 - Set 45® Hot Weather Grout extended with pea gravel

SB-12.2 Submittals

- A. Submit the following to the Engineer for review and in accordance with the requirements of 1502 and these special provisions:
 1. Shop Drawings:
 - a. Submit five sets, 11 x 17 inch sheets with a 1½ inch blank margin on the left-hand edge.
 - b. Place the Project designation data in the lower right-hand corner of each sheet.
 - c. Prepare shop drawings and supporting calculations certified by a Professional Engineer licensed in Minnesota.
 - d. Design, show and locate all lifting inserts, hardware or devices, and vertical adjustment hardware on the shop drawings for the Engineer's review. Design lifting hardware according to the provisions of Chapter 5 of the PCI Design Handbook.
 - e. Provide ID for all precast elements to be stamped on elements.
 - f. Contractor shall identify the location of the precast plant or yard and stamp on the precast elements.
 - g. Do not order materials or begin work until review of the shop drawings is complete.
 - h. Do not deviate from the shop drawings unless authorized in writing. Contractor is responsible for costs incurred due to faulty detailing or fabrication.

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- i. The Engineer reserves the right to review these drawings for up to 7 calendar days. This right applies each time the drawings are submitted or re-submitted.
2. Erection Plans:
 - a. Submit five sets, 11 x 17 inch sheets with a 1½ inch blank margin on the left-hand edge.
 - b. Place the Project designation data in the lower right-hand corner of each sheet.
 - c. Prepare drawings and supporting calculations certified by a Professional Engineer licensed in Minnesota.
 - d. Check that all handling and erection stresses, deflections and bracing conform to Chapter 5 of the PCI Design Handbook.
 - e. Include the following at a minimum on the installation plans:
 - 1) Minimum clearances of reinforcing to precast element edges, and to the face of through holes.
 - 2) Locations and details of lifting devices including supporting calculations. Design all lifting devices based on the no cracking criteria in Chapter 5 of the PCI Design Handbook. Use a device that will have a 3" min. top cover and a 1 inch min. bottom cover after installation. Galvanize the device after fabrication per Mn/DOT Spec. 3392 or 3394.
 - 3) Type and amount of any additional reinforcing required.
 - 4) Calculations showing that tensile stresses in all elements do not exceed the modulus of rupture during the handling, fabrication, shipping, and erection of the element.
 - 5) Minimum concrete compressive strength attained prior to handling the precast concrete elements.
 - 6) Load distribution.
 - 7) Cables and lifting equipment.
 - 8) Details of vertical adjusting system and hardware. Galvanize per Mn/DOT 3392 or 3394.
 - f. Include details showing the erection and installation of the proposed precast elements in accordance with the Plan.
 - g. Submit Erection Plan drawings and calculations including the following minimum information:
 - 1) Crane and pick locations
 - 2) Crane charts
 - 3) Element erection sequence
 - 4) Vertical adjustment method for distributing the precast element load to supporting piles as per the Plan, achieving grade elevation and meeting specified dimension/location tolerances.

- h. Submit to the Engineer for review a proposed method for forming through holes, forming vertical element joints and installing grout and SCC, sequences, and equipment for grouting and SCC placement operations. Submit a back-up procedure in the event leaks occur during grout installation and SCC placement. Obtain approval prior to placing grout and SCC.
- i. Submit a method of forming joints between precast elements to watertight.
- j. The Engineer reserves the right to review these drawings for up to 14 calendar days. This right applies each time the drawings are submitted or re-submitted.

B. Submit for Materials.

- 1. Supply test data for concrete element including slump, air content and unit weight for fresh concrete and compressive strengths after 7, 14, and 28 days for the hardened concrete.
- 2. Supply certified test results from an independent accredited test laboratory for the structural non-shrink grout.

SB-12.3 Precast Concrete Element Fabricator Certification

The Contractor shall fabricate the precast element in a precast/prestressed concrete fabrication plant that has been granted certification by the Precast/Prestressed Concrete Institute, or by an organization approved by the Materials Engineer.

If contractor chooses to fabricate precast concrete elements without using certified precast plant, Contractor shall submit completely detailed precasting methods and procedures to ensure the precision of dimensions and locations of all rebars, inserts and accessories per the Plan, and the QA/QC plan for the Engineer's review. The fabrication site for the precast concrete elements shall have been granted plant pre-approval for acceptance of precast concrete products by the Material Engineer of Mn/DOT.

The Fabricator's quality control office shall maintain 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.

SB-12.4 Quality Assurance

- A. Permanently mark each precast unit with element ID number, date of casting and supplier identification. Stamp markings in fresh concrete.
- B. Prevent cracking or damage during handling and storage of precast units.
- C. Defects and Breakage of Prestressed and Nonstressed Elements:
 - 1. Elements that sustain damage or surface defects during fabrication, handling, storage, hauling, or erection are subject to review and rejection.
 - 2. Write and submit proposed repair procedures and obtain approval from the Engineer before performing repairs.
 - 3. Repair work must reestablish the element's structural integrity, durability, and aesthetics to the satisfaction of the Engineer.
 - 4. Determine the cause of any damage and take corrective action.
 - 5. Failure to take corrective action leading to similar repetitive damage is cause for rejection of the damaged elements.
 - 6. Element with cracks that extend to the nearest reinforcement plane and fine surface cracks that do not extend to the nearest reinforcement plane but are numerous or extensive are subject to review and rejection.
 - 7. Element with full depth cracking or breakage greater than nine inches in length is cause for rejection.
 - 8. Cracks wider than 0.02 inches shall be repaired.
- D. Construct elements and panels to tolerances shown in the Plan.

SB-12.5 Shipping and Handling

Precast concrete elements for abutments, wingwalls, pier caps, pier bases and pier walls shall be installed and transported in a manner that will provide safety to the workers, inspectors, and the public, at all times, as well as reasonable assurance against damage to the precast concrete elements. The precast concrete elements shall be temporarily anchored, braced, and stabilized as they are transported and erected so as to preclude sliding, tipping, buckling, or other movement that may otherwise occur. Struts, bracing, tie cables, and other devices used for temporary restraint shall be of a size and strength that will ensure their adequacy.

SB-12.6 Construction

- A. Do not place concrete in the forms until the Engineer, or Engineer's representative, has inspected the placement of all materials in the precast elements.
- B. Finish the precast concrete elements as shown in the Plan. The tolerance for the through hole spacing shall be within $\pm 3/16"$. The overall size of through holes shall be within $\pm 1/4"$ of the plan dimensions. All inserts shall be located within 1" of the location as shown in Plan.
 - 1. Wet cure elements and panels by covering all exposed surfaces with wet burlap, cotton mats, or both, and plastic sheets.

- C. Do not strip the forms before the precast elements have obtained a minimum compressive strength of 3500 psi.

SB-12.7 Shear Studs on Pier Piles

A. Installation of the Shear Studs

1. Install shear studs at the locations shown on the plans.
2. Weld shear studs to the pier piles according to AWS specifications.
 - a. Use method and equipment recommended by the manufacturer of the studs and approved by the Engineer.
 - b. Contractor shall provide grounding method.
 - c. Steel shell of CIP piles per Mn/DOT Spec. 3371.
 - d. Welded stud material per Mn/DOT Spec. 3391.D.

- B. Work for shear studs shall be paid under Item No. 2402.602, "SHEAR STUDS", per each shear stud installed, and is not included in the pay Item No. 2405.602, "PRECAST PIER WALL".

SB-12.8 Installing Precast Concrete Elements

- A. Install precast concrete elements per the Plan and approved Erection Plans.
- B. Support the erected precast concrete elements from shifting or dropping throughout the installation of grout, SCC and concrete closure pours. The supports for the precast concrete elements are detailed per the Plan or approved working drawings.

SB-12.9 Preparation and Installation of Non-Shrink Grout, SCC and Closure Pours

- A. Form around holes and voids between precast elements for grouting or placing SCC as shown in the approved Erection Plan.
- B. Clean and remove all debris from the through holes, blockouts, voids and shear keyways prior to placement of the structural non-shrink grout and SCC.
- C. Keep bonding surfaces free from laitance, dirt, dust, paint, grease, oil, rust, or any contaminant other than water.
- D. Mix and place grout and SCC product following manufacturer's and supplier's recommendations for preparation and installation.
- E. Place structural non-shrink grout and SCC in the locations as per the Plan and approved Erection Plans in a continuous operation within a precast element after all precast concrete elements are prepared for grout.
- F. Voids are not allowed in the grout and SCC.
- G. Do not apply superimposed dead loads or live loads to the precast concrete elements until the structural non-shrink grout has reached a strength referenced in SB-12.1, and SCC has reached a strength of 3500 psi based on the 7-day strength test form concrete cylinders.

- H. Cure structural non-shrink grout and SCC per manufacturer's recommendation.
1. Contact the manufacturer's representative for advice on how to reduce heat such as wet curing or adding retarding admixture if the heat of hydration is excessive.
- I. Finish grout and SCC flush or a maximum of 1/8 inch above element top surface.
1. Grout the through holes to the top of the holes. Fill with grout in the annular void between the pile and the through hole wall carefully so there shall be no trapped air and void in the grout.
 2. Grout the keyways and void per the Plan and approved Erection Plans.
 3. Install dowels into wall element inserts before forming the pier wall with the paired precast wall elements. Form around voids between the paired precast pier wall elements. Place SCC in voids between the paired precast pier wall elements per the Plan and approved Erection Plans. Fill the gap between the bottom of pier caps and the top of pier wall elements with SCC or grout with caution so that no void will form.
 4. No additional compensation will be made for any corrections to the finish of grouting the through holes, keyways and void, or filling void with SCC.
- J. Place required structural concrete closure pours in the locations as per the Plan and approved Erection Plans in a continuous operation for precast substructures. The pier walls shall have matched architectural texture finish between walls from staged construction as per the Plan. The closure pours shall fill all gaps and voids between precast elements without gaps or cracks.

SB-12.10 Basis of Payment

- Payment for Item No. 2405.601, "PRECAST PIER WALL", will be made at the Contract price per lump sum for pier walls.
- Payment for Item No. 2405.602, "PRECAST PIER CAP ELEMENT", will be made at the Contract price per each for each precast pier cap element.
- Payment for Item No. 2405.602, "PRECAST PIER BASE ELEMENT", will be made at the Contract price per each for each precast pier base element.
- Payment for Item No. 2405.602, "PRECAST ABUTMENT ELEMENT", will be made at the Contract price per each for each precast abutment element.
- Payment for Item No. 2405.602, "PRECAST WINGWALL ELEMENT", will be made at the Contract price per each for each precast wingwall element.

All payment for these items will be compensation in full for all costs of manufacturing, transporting, grout installation, required SCC filling, erecting the precast concrete elements in their final position with any required temporary bracing, and closure pours, as shown in the Plan. All payment for these items shall also include accessories, mock-up panels, labor, materials, equipment and temporary supports to install abutments and piers to the completion of the work.

Due to the staging construction, a partial payment of 40% to each pay item shall be applied to the completion of Stage 1 construction for the work of installing precast abutment, wingwall and pier elements.

SB-12.11 Alternatives

Contractor may choose to construct the pier walls and/or pier bases with cast-in-place (CIP) concrete, or other methods, instead of the precast concrete elements with SCC filling and closure pours without changing the original construction schedule and completion date. Contractor shall submit this CIP concrete construction or other methods for pier walls and/or pier base to Engineer for review prior to the pile driving construction. The submittal shall consist of design computations, a complete and fully detailed design plan, shop drawings and erection plan, and shall be certified by a licensed engineer in Minnesota. A CPM scheduling shall also outline the date of submittals for the alternative construction methods.

Pier caps shall be precast.

SB-13 (2433) STRUCTURE RENOVATION

The provisions of Mn/DOT 2433 are modified and/or supplemented with the following:

SB-13.1 Anchorages

Each anchorage shall be furnished and installed in accordance with the applicable requirements of 2433 and the following:

Adhesive, cast-in-place type anchors, or mechanical anchorages shall be used unless otherwise specified in the plans.

Except when part of a proprietary anchorage assembly, threaded rods and bolts shall meet the requirements of 3385 and 3391, respectively.

Threaded rods, bolts, nuts, and washers not encased in concrete after project completion shall be galvanized in accordance with 3392 or be electroplated in accordance with ASTM B 633, Type III, SC 4. As an alternate to galvanizing or electroplating, threaded rods, bolts, nuts, and washers which are part of a proprietary anchorage may be fabricated from stainless steel in accordance with 3391.

<u>Location</u>	<u>Anchor Rod Type</u>	<u>Bolt or Rod Diameter inches</u>	<u>Embedment Depth inches</u>	<u>Minimum Ultimate Pull-out Strength pounds</u>
Temporary Barrier	A	1 1/8"	6" (Exact)	30,000

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Anchorage for which the Contract specifies an ultimate pull-out strength shall be installed 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 shall be in contact with the adjacent surface and shall be torqued to approximately 108 N·m (**80 ft pounds**) unless a different torque is recommended by the manufacturer. Adhesive anchorages shall consist of a continuously threaded rod secured by an adhesive or mortar. Installation of anchorages shall be in accordance with the manufacturer's recommendations and as specified in the Plans.

Laboratory tests that include static load tests for ultimate pullout strengths shall be performed on anchorage systems that are subject to tensile loads. The tests, in accordance with ASTM E 488, shall be performed and certified by an independent testing laboratory. The Contractor shall furnish the Engineer with the test reports and the specification sheets that are prescribed by ASTM E 488.

The Contractor shall 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

The Contractor shall 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 shall 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. Three anchorages shall be tested 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, KN (kips)
TYPE OF ROD, FROM SPEC. 3385

DIA., mm (inches)	TYPE A	TYPE B	TYPE C	TYPE D
13 (1/2")	21.0 (4.75)	25.0 (5.7)	45.0 (10.1)	22.0 (4.9)
16 (5/8")	33.0 (7.4)	39.5 (8.9)	70.0 (15.8)	34.0 (7.6)
19 (3/4")	47.0 (10.6)	56.0 (12.6)	101.0 (22.8)	49.0 (11.0)
22 (7/8")	65.0 (14.5)	77.0 (17.4)	138.0 (31.0)	67.0 (15.0)
25 (1")	85.0 (19.0)	100.0 (22.6)	180.0 (40.5)	86.0 (19.5)

If anchorages are installed vertically and are not encased in concrete after project completion, any voids occurring between the top of the anchorages and the concrete in which it is embedded shall be filled with approved caulk.

Payment will be made as 2433.516 "ANCHORAGES TYPE 1", at the contract price per each, which shall include all costs of furnishing, testing, and installing the anchorages.

The anchorages shall be removed with coring and the coring holes shall be filled with grout after the removal of temporary barriers. This work shall be included in the pay item as described in SB-13.4.

SB-13.2 Reinforcement Bar Anchorage (Post-installed)

A. Description of Work

This work consists of furnishing and installing a drilled-in reinforcement bar anchorage system of the type, shape and size specified, and its satisfactory placement on Bridge No. 25024 at the following locations:

- Between abutments and approach panels, using stainless steel rebars
- Between abutment/pier and cast-in-place deck, using stainless steel rebars
- Between deck and F-barrier that is between roadway and sidewalk, using epoxy-coated rebars

All work shall be performed in accordance with the applicable provisions of Mn/DOT 2433, 2472, and 3301; shall meet the requirements of the Plans; as directed by the Engineer; and the following:

Anchorage shall be installed with a chemical adhesive and tested to the anchorage proof load as per this provision.

The Contractor shall 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

The Contractor shall supply an anchorage system that meets the requirements of these special provisions and the plan, and be installed as per the manufacturer's recommendations.

The holes for anchoring the reinforcement bars will be drilled into 4000 psi concrete with a minimum embedment depth and at the locations as the following:

<u>Location</u>	<u>Minimum Embedded Depth (inches)</u>
Between abutments and approach panels	8"
Between abutment/pier and cast-in-place deck	8"
Between deck and Mod. P-2 barrier	6" (Exact)

C. Pullout Tests

Laboratory tests that include static load tests for ultimate (nominal) pullout strengths shall be performed 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), shall be performed and certified by an independent testing laboratory. The Contractor shall furnish the Engineer with the test reports and the specification sheets that are prescribed by ASTM E 488.

The Contractor shall demonstrate the rebar anchorage system at the first site of field installation prior to actual use in the Project. The demonstration shall 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. Three anchorages of each reinforcement bar size shall be tested 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 shall 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.

For the anchorages between the bridge deck and the F-barrier, all tests have to be at the anchorages in the front side row that are next to the roadway traffic.

TABLE 1
REINFORCEMENT BAR PROOF LOADS

Rebar Size	Minimum Ultimate Bond Strength kN (pounds)	Anchorage Proof Load kN (pounds)	Yield Strength of Rebar kN (pounds)
10	49 (11,000)	24 (5,300)	29 (6,600)
13	89 (20,000)	43 (9,600)	53 (12,000)
16	138 (31,000)	66 (14,900)	83 (18,600)
19	196 (44,000)	94 (21,100)	117 (26,400)
22	267 (60,000)	128 (28,800)	160 (36,000)
25	351 (79,000)	169 (38,000)	211 (47,400)
29	445 (100,000)	124 (48,000)	267 (60,000)
32	565 (127,000)	271 (61,000)	339 (76,200)

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", for the anchorage using epoxy-coated reinforcement bars, and made as Item 2433.516, "ANCHORAGES TYPE REINF BARS (STAINLESS STEEL)", for anchorages using stainless steel reinforcement 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 in place.

SB-13.3 Remove Anchorage

This work consists of removal and disposal of the anchorages between the bridge deck and temporary barriers, and grouting of the hole due to the coring. The removal of the anchorage shall be a complete removal, including the embedded part of the anchorages. Contractor shall cut the A307 anchor bolts to the top of the concrete deck, and, then, core drill the 6" embedded part of the anchor part out without damaging the lower part of the deck below the hole. Grout the holes using the non-shrink grout, as specified in SB-12.1.B, to flush with the finished bridge deck surface without extrusions that may damage car tires.

All damage to other portions of the structure which are to remain in place which is due to the Contractor's operations shall also be repaired at the Contractor's expense.

A. Method of Measurement

Measurement of anchorage removal will be by the single unit of each anchorage removed, based on the quantities and locations shown and noted in the Plan.

B. Basis of Payment

Payment for Item No. 2433.601 "REMOVE ANCHORAGE" will be made at the Contract price per each, and shall be compensation in full for all costs of performing all of the work described above, including anchor bolt cutting, concrete coring and grouting.

SB-14 (2442) REMOVAL OF EXISTING BRIDGES

This work shall consist of the removal and disposal of existing bridge and existing timber piling that was left over from an old bridge that has been removed. The location of the existing timber piling is noted and shown in the bridge plans. Only the concrete and timber piles of the existing bridge below the waterline that are in the way for the new bridge construction shall be removed and disposed. For the existing bridge, all reinforcement and large concrete debris above the flowline shall be removed from the Gilbert Creek.

During Stage 1 construction, the north end of the existing Bridge No. 6773 shall be partially removed for installation of temporary steel sheet piling. This partial removal shall include, but not limit to, the north railing and curb, part of slab and pier caps, wingwalls, part of the abutment stems, part of the abutment pile caps and some abutment piles. This work shall be part of the bridge removal and be included in the payment for the removal of the existing bridge.

The provisions of Mn/DOT Specification 2442 shall apply except as supplemented herein.

Disposal of materials by the Contractor shall be in accordance with 1506, 2104.3C, 2442, Mn/DOT "Asbestos and Regulated Waste Manual for Structure Demolition or Relocations for Construction Projects" and the following: The Contractor shall furnish written information to the Engineer as to disposal of steel bridge beams and other steel bridge components coated with lead paint. This information shall 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. All lead paint that has been identified as peeling must be stabilized by coating with a paint or similar material that will prevent the peeling paint from flaking during demolition, or must be scraped. This must all be completed as per the Mn/DOT "Asbestos and Regulated Waste Manual for Structure Demolition or Relocations for Construction Projects". The form supplied in this special provision shall consist of the signature of the authorized Superintendent verifying that the information is correct.

SB-14.1 Salvaged Materials

No salvage of any material is required for the bridge.

SB-15 (2451) STRUCTURE EXCAVATIONS AND BACKFILLS

The provisions of Mn/DOT 2451 are modified and/or supplemented with the following:

SB-15.1 Structure Excavation

The item Structure Excavation shall include all excavation, sheeting and shoring and/or other protection, preparation of foundation, and placing of backfill necessary for construction of Bridge No. 25024, which is not specifically included in the grading portion of the Contract. It shall also include the disposal of surplus material.

No measurement will be made of 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:

Bridge 25024	Each Abutment	30%
	Each Pier	20%

SB-15.2 Foundation Preparation for Pile Bent Piers – Bridge No. 25024

This item of work, Foundation Preparation Pile Bent Piers, shall consist of furnishing all material for and performing all work involved in the preparation of the foundation for construction of the pile bent substructures and pier walls. The item shall include, but not be limited to, earth excavation, backfilling the excavation, leveling pad for pier base elements, and disposing of surplus excavated materials as may be necessary to build pier walls.

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 PREPARATION PILE BENT PIERS", at the contract lump sum price.

For purposes of partial payments, the portion of the lump sum Foundation Preparation Pile Bent Piers will be defined as follows:

Bridge 25024	Stage 1 – Each Pier	25%
	Stage 2 – Each Pier	25%

SB-16 (2452) PILING

The provisions of Mn/DOT 2452 are modified and/or supplemented with the following:

Delete the second paragraph of 2452.3H and substitute the following:

Pile welders shall be qualified using AWS D1.1 standards or current Mn/DOT welding certification.

For the required precision to install the precast elements, all piles shall be driven to within $\pm 1/4$ " of the final location as per the Plan. Contractor may use positive and rigid templates to ensure the piles to be driven to the desired locations. The top elevation of piles shall be within $\pm 1/2$ " of the design elevations per the Plan.

SB-16.1 Equipment for Driving

Delete the first and second paragraph of 2452.3C1 and substitute the following:

All pile driving equipment to be furnished by the Contractor shall be subject to approval by the Engineer. Approval is based on the satisfactory results of a wave equation analysis.

At least 30 calendar days prior to the start of pile driving operations, the Contractor shall submit the following:

1. A completed pile and driving equipment data form for each hammer proposed for the project. The form may be downloaded from the following website:
<http://www.pile.com/pdi/users/grlweap/equipdatafrm-en.pdf>
2. A wave equation analysis in accordance with GRL WEAP or similar program for each pile type and hammer. A hard copy of the results of the analysis, including a WEAP bearing graph, shall be submitted to the Engineer.

For the pile driving equipment to be acceptable, the required number of hammer blows indicated by the wave equation at 155% of the pile factored design load as shown in the Plans shall be between 30 and 180 blows per foot.

The pile stresses indicated by the wave equation shall be reviewed to determine that the piles can be driven as described in 2452.3D without failure. If stress levels are such that damage to the piling is considered to be likely, adjustments shall be made to the pile driving system or to the strength of the pile until satisfactory results are obtained. Substantial refusal is defined in subsequent paragraphs.

All costs associated with providing the wave equation analysis and submittals as described above shall be an incidental expense to the test piles and no additional compensation will be made for this work.

SB-16.2 Penetration and Bearing

Delete 2452.3E and substitute the following:

A. General

The nominal pile bearing resistances shown in the Plans were calculated using design loadings and indicate the factored loads that the piles are required to support. The nominal resistance determined using the dynamic methods, defined under Determination of Nominal Bearing Resistances, is the basis for establishing the minimum criteria for pile acceptance in which the driving resistance is not less than the resistance specified in the Plans. It may be necessary to drive the foundation piles beyond the specified resistance until the required penetration as shown in the Plan is reached, or until the piles have been driven to a penetration as determined by the engineer based on the test pile results.

Since the purpose of a test pile is to provide information for authorizing the length of the foundation piles, it shall be driven full length unless substantial refusal (as defined below) is encountered at a lesser penetration. If the test pile has been driven full length and 115% of the nominal resistance required for the foundation piles has not been attained the Engineer may order the test pile be driven further as per 2452.3D2 and 2452.4A. If pile redriving is specified in the Plan, the penetrations and time delays shall be in accordance with 2452.3D7 and/or these special provisions.

Substantial refusal, as referenced in 2452.3D, shall be considered to have been attained when the penetration rate is equal to 0.05 inches per blow.

B. Determination of Nominal Bearing Resistance

The required nominal resistance shown in the Plans is based on a field control method as noted. The driven pile nominal resistance shall be determined in accordance with the following provisions using the appropriate corresponding field control method indicated in the Plans. Unless otherwise specified, if more than one field control method is shown, the method used shall be determined in accordance with the following:

- When the "Pile Analysis" pay item is included for a bridge, the Pile Driving Analyzer (PDA) shall be required for the field control.
- When the "Pile Analysis" pay item is not included for a bridge, the field control method shall be at the Contractor's option. The cost of the PDA shall be incidental to the cost of Piling Driven.

B1. Mn/DOT Nominal Resistance Pile Driving Formula Used as Field Control Method

The nominal pile bearing resistance shall be determined by dynamic formula as follows:

All types of piling driven with power-driven hammers.

$$R_n (\text{metric}) = \frac{867E}{S+5} \times \frac{W + (CxM)}{W + M} \qquad R_n (\text{english}) = \frac{10.5E}{S+0.2} \times \frac{W + (CxM)}{W + M}$$

WHERE:

- R_n = Nominal Pile Bearing Resistance in Newtons (**pounds**).
 W = Mass of the striking part of the hammer in kilograms (**pounds**).
 H = Height of fall in millimeters (**feet**).
 S = Average penetration in millimeters (**inches**) per blow for the last 10 or 20 blows, except in cases where the pile may be damaged by this number of blows.
 M = Total mass of pile plus mass of the driving cap in kilograms (**pounds**).

- C = 0.1 for Timber, Concrete and shell type piles, 0.2 for Steel H piling

*The following definition is for Metric units. See English units below:

- E = $WH \times 0.00981$ for single acting power-driven hammers. It is equal to the joules or newton-meters (joule = newton-meter) of energy per blow for each full stroke of either single acting or double acting hammers as given by the manufacturer's rating for the speed at which the hammer operates.

*The following definition is for English units:

- E = WH for single acting power-driven hammers. It is equal to the foot pounds of energy per blow for each full stroke of either single acting or double acting hammers as given by the manufacturer's rating for the speed at which the hammer operates.

NOTES:

When provisions are not made available for field determination of the energy output on a power-driven hammer, such as measurement of the drop for single-acting hammers, or such as pressure gauges or determination of energy on the basis of the frequency of the blows (cycles per minute) for double-acting hammers, the manufacturer's rated energy shall be reduced by 25 percent. This reduction is not intended to apply when determining the required hammer size. Double-acting hammers, for the purpose of these requirements, will include all hammers for which a power source is utilized for acceleration of the down-stroke of the ram. The dynamic formula specified herein-before are applicable only when:

- (a) The hammer has a free fall.
- (b) The head of the pile is free from broomed or crushed fibre.
- (c) The penetration of the pile is at a reasonably uniform rate.
- (d) There is not noticeable bounce after the blow. When there is a noticeable bounce, twice the bounce height shall be deducted from H to determine the value of H in the formula.

B2. Pile Driving Analyzer (PDA) Used as Field Control Method

The nominal pile bearing resistance shall be determined using the pile driving analyzer and the Case Pile Wave Analysis Program (CAPWAP) in accordance with the following section, Dynamic Monitoring of Pile Driving. The WEAP bearing graph listed below under deliverables shall be used to determine the bearing resistances that are recorded on the pile driving report (attach a copy of the bearing graph to the report). For informational and comparison purposes, the bearing resistances shall also be computed using the Mn/DOT formula and recorded on the report.

B3. Piling Supporting Concrete Retaining Walls

The nominal pile bearing resistances shown on Mn/DOT Standard Concrete Retaining Wall Sheets (Mn/DOT Standard Figures 5-297.620 through 5-297.632 dated May 31, 2006) were calculated using the Allowable Stress Design (ASD) Method, Not the LRFD method. If dynamic formulas are used to determine pile resistance for concrete retaining walls in the field, follow Mn/DOT specification 2452.3E as detailed in the 2005 Standard Specifications for Construction in lieu of 2452.3E-A and 2452.3E-B1 shown above. Do not use the formulas shown above to compute pile capacities for concrete retaining walls. For retaining wall plan sheets dated later than May 31, 2006 the inspector must confirm which dynamic formula to use.

SB-16.3 Dynamic Monitoring of Pile Driving**A. Description of Work**

The Contractor shall provide all equipment and personnel necessary to perform dynamic pile testing of driven piles using a Pile Driving Analyzer (PDA). The work shall be performed in accordance with the requirements of ASTM 4945. The dynamic pile testing shall be performed on the initial driving and redriving of the test piles as directed by the Engineer. Testing may also be required on additional piles as designated by the Engineer.

B. Pile Preparation and Wave Matching

The Contractor shall prepare each pile to be tested by attaching instrumentation to the piles except that for testing on initial driving of steel shell piles, the Contractor shall attach the instrumentation after the pile has been placed in the leads. In addition, the Contractor shall perform wave matching of the PDA data using the Case Pile Wave Analysis Program (CAPWAP). This work shall be performed by an engineer experienced in dynamic testing and CAPWAP analysis. The program shall be run on all piles dynamically tested, or as directed by the Engineer.

C. Wave Equation Analysis

Following the wave matching, the Contractor shall use the GRLWEAP program and CAPWAP data to produce a refined Wave Equation Analysis Program (WEAP) bearing graph and inspector's chart to be used as the basis for pile acceptance. The bearing graph shall be used to determine the foundation pile's nominal bearing resistance that is to be recorded on the pile driving report. The wave matching analysis and wave equation analysis shall be performed in a timely manner.

D. Deliverables

The Contractor shall provide the following items to the Engineer within the specified time intervals described herein:

1. Results from each dynamic test performed with the PDA and checked with the CAPWAP program. The results shall be in the form of a hard copy of columnar data produced with the PDAPLOT program. The data shall consist of blow counts, stresses in the pile, pile capacities, hammer energies and hammer strokes for each one foot (0.25 meter) depth increment. The results shall be provided in a timely manner. In addition, the Contractor shall provide expert advice regarding the analysis of the PDA and CAPWAP data.
2. A WEAP bearing graph and inspection chart showing blow count-versus-pile resistance and stroke-versus-blow count that will be used for determining the nominal bearing resistance of the foundation piles. The graph/charts shall be developed based on the results of the PDA and CAPWAP data. Both the maximum force and maximum transferred energy calculated by WEAP shall match within 10% of those calculated by the CAPWAP. The bearing graphs shall be delivered to the Engineer within two days after completion of driving the test piles at any single substructure unit. These graphs/charts shall also be documented in the appropriate reports listed below.
3. A brief report for the piles at each substructure tested including a summary of the PDA and CAPWAP results. In addition, the Contractor shall supply one or more 3.5 inch diskettes or CD containing all data for the piles tested for that substructure. The data shall be in the form of X01 (PDA file) and Q00 (PDAPLOT file) files and shall be properly labeled. These reports shall be sent to the Engineer no later than three working days after dynamic pile tests have been completed at any given substructure unit.
4. A PDA summary report which summarizes the findings from the PDA and the associated CAPWAP computer program and the developed GRLWEAP bearing graphs. This report shall be sent to the Engineer no later than one week following the completion of the dynamic pile tests, addressed separately.

E. Method of Measurement

When the Pile Driving Analyzer field control method is required by the contract, measurement will be by the number of piles on which the pile driving analysis is performed. Initial analysis and redrive analysis on an individual pile shall be counted as one pile analysis. The Department reserves the right to increase or decrease the number of piles which are required to be dynamically monitored.

When the Pile Driving Analyzer field control method is not required by the contract but is chosen at the Contractor's option, no measurement will be made of the analyses performed and all costs associated with the dynamic testing will be at the Contractor's expense.

SB-16.4 Extensions and Splices

Delete the fourth paragraph of 2452.3H and substitute the following:

Commercial drive fit splices will NOT be permitted on Bridge No. 25024.

SB-16.5 Steel Sheetpiling (Temporary)

This work consists of furnishing, installing, and removing temporary sheetpiling retaining walls, as shown in the Plan, during staging construction. The work shall be performed in accordance with the applicable provisions of Mn/DOT 2105, 2452, and the plans, as directed by the Engineer, and the following:

A. Materials

The steel sheet piling shall conform to Mn/DOT 3373 (ASTM 328)

Structural steel shall conform to Mn/DOT 3306 (ASTM A36)

B. Submittals

At least (21) working days before starting construction of the temporary sheet piling, the contractor shall supply the Engineer with three copies of the detailed plans and specifications and two copies of associated calculations of the temporary sheet piling.

The plans and specifications shall be prepared by an Engineer, thoroughly checked for completeness and accuracy, and certified by a professional engineer licensed in the State of Minnesota. The documents shall include sufficient details so that construction of the proposed system can be completed solely by reference to the plans and specifications. The design criterion shall be shown on the first sheet of the plan.

C. Construction Requirements

Piling shall be at the locations indicated in the Plan, the Contractor's submittal, and as directed by the Engineer.

The temporary steel sheetpiling should be installed to a minimum elevation of 690.00 at the top and can support the approach fills for both abutments during the entire bridge abutment staging construction, as shown in the Plan.

D. Payment

Payment will be made as ITEM No. 2452.601, "STEEL SHEET PILING (TEMPORARY)", at the Contract price per lump sum, which shall be payment in full for furnishing, installing, and removing sheet pile walls, and shall include all necessary tie bars, hardware, and equipment required to install sheet pile walls.

SB-17 (2471) STRUCTURAL METALS

The provisions of Mn/DOT 2471 are modified and/or supplemented with the following:

Delete the fourth paragraph of 2471.3A2 and substitute the following:

The Contractor/Fabricator performing coating application must demonstrate qualification by obtaining the AISC Sophisticated Paint Endorsement (SPE), the SSPS QP Certification, or a Quality Control Plan (QCP) that is acceptable to the Engineer.

Add the following to the end of the second paragraph of 2471.3C:

The Engineer will audit suppliers with approved QCP's on a biannual or annual basis or as deemed necessary by the Engineer to determine if the QCP is being implemented. The Department will invoke its Corrective Action Process if the audit indicates non-conformance. Corrective action, up to and including the supplier hiring a third party Quality Control Inspector, may be required as a disciplinary step, at no cost to the Department. A copy of the Departments Corrective Action Process is available from the Engineer.

Add the following to 2471.3E1 as the first paragraph:

Steel plates and splice plates for major structural components shall be cut and fabricated so that the primary direction of rolling is parallel to the direction of the main tensile or compressive stresses.

Add the following to 2471.3F:

F1b Web-to-Flange Welds

For the purpose of this specification, a repair is defined as any area of the welded product not in compliance with the current edition of AASHTO AWS D1.5 Bridge Welding Code. Limit each individual web-to-flange weld repairs to 2 percent of the weld length and grinding web-to-flange weld repairs to 5 percent of the weld length. Exceeding these limits will result in revocation of the Welding Procedure Specification (WPS) used to perform the initial production welding.

Add the following as 2471.3G1:

G1 Fracture Critical Welder Qualifications

Fracture Critical Welder Qualifications shall be in accordance with AASHTO/AWS D1.5-Bridge Welding Code. Annual requalification shall be based upon acceptable radiographic test results of either a production groove weld or test plate. If a welder is requalified by test, a WPS written in accordance with the requirements of D1.5, shall be used and the test plate shall be as shown in Figure 5.24. The WPS shall be included in the Fabricators QCP.

Add the following to 2471.3N1:

Work that is not performed in accordance with the suppliers approved QCP shall be subject to rejection in accordance with 1512.

SB-18 (2511) RIPRAP – GEOTEXTILE FILTER TYPE IV (MODIFIED)

The provisions of Mn/DOT 2511 are modified and/or supplemented with the following:

SB-18.1 Adhere to 2511.2 and 3733 material requirements except as modified below:

Modify 3733.2A as follows:

Delete the first sentence of the first paragraph and replace with the following:

Use non-woven needle punched fabric for geotextile.

Modify 3733.2B as follows:

Delete the first sentence of section and replace with the following:

Geotextile property requirements are the same as shown in Table 3733-1 except as modified below:

Table 3733-1 (Modified):

Geotextile Property	Test Method (ASTM) Units	Type (A)
		IV
B1 Grab Tensile Strength minimum, each principal direction	D4632 kN (pounds)	1.45 (315)

SB-18.2 Delete the second paragraph of 2511.3A and replace with the following:

Place riprap on a filter material, to the thickness and extent specified in the plans.

Delete the last paragraph of 2511.3B2 and replace with the following:

Place Geotextile Filter as shown in the Plans.

SB-18.3 Measurement will be made to the nearest square meter (**square yard**) of area on the basis of actual surface dimensions as staked, with no allowance for overlaps or seams.

SB-18.4 Payment will be made under Item 2511.515 "GEOTEXTILE FILTER, TYPE IV (MODIFIED)" at the Contract bid price per square meter (**square yard**), which shall be payment in full for all costs involved, including the geotextile filter, labor and equipment.

SB-19 (3371) STEEL SHELLS FOR CONCRETE PILING

The provisions of Mn/DOT 3371.2 are modified and/or supplemented with the following:

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Add the following to 3371.3:

The use of small quantities of piling from the Contractor's surplus of cut-offs and overruns may be submitted for use and approved by the Engineer. These materials shall be certified by the Contractor to be remaining quantities of materials previously submitted with accompanying Mill Test Reports and subsequently approved for use on other projects. Pile splices used to make up authorized pile lengths shall be considered to have been made at the Contractor's convenience and shall not be considered eligible for extra compensation under 2452.4B.

SB-20 (3391) FASTENERS

Delete the contents of 3391.2B and substitute the following:

Field and shop bolts for steel bridges shall meet ASTM A325, Type 3 bolts. The bolts shall project through the nut not less than 3 mm (**1/8"**) nor more than 10 mm (**3/8"**). Field and shop nuts for steel bridges shall meet ASTM A563/A563M, Grade C3 or DH3 nuts and field and shop washers for steel bridges shall meet ASTM F436/F436M, Type 3 washers.

For all other bridges and structures the bolts shall meet ASTM A325, Type 1 (for painted and/or galvanized applications) or Type 3 (for unpainted weathering steel applications). The bolts shall project through the nut not less than 3 mm (**1/8"**) nor more than 10 mm (**3/8"**). The nuts shall meet ASTM A563/A563M and the washers shall meet ASTM F436/F436M.

ASTM A325 bolts may only be retightened once after having been previously fully tightened.

At the time of installation of fasteners, all nuts, regardless of their specified finish, shall be lubricated with a lubricant of contrasting color as per ASTM A 563 Supplementary requirements S1, S2, and S3.

SB-20.1 Delete the first two sentences of 3391.2E and add the following:

Stainless steel bolts are to meet the requirements of ASTM F 593, Condition CW1, Type 304, 316, or 316L, with a minimum yield strength of 415 MPa (**60,000 psi**), an ultimate tensile strength of 660 MPa (**95,000 psi**), and a minimum elongation of 20 percent in 50 mm (**2 inches**). The nuts are to meet the requirements of ASTM F 594, Condition CW1, Type 304, 316, or 316L.

SB-21 (3741) ELASTOMERIC BEARING PADS

The provisions of 3741 shall apply except as modified below:

Replace the first sentence in 3741.2A with the following:

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The elastomeric portion of the bearing pads shall be in accordance with AASHTO M251-04 with a specified Shore A scale hardness of 60 ± 5 durometers. The elastomer compounds shall be classified as of low-temperature Grade 4 as specified by the grade requirements of Table 14.7.5.2-2, "Low temperature Zones and Minimum Grade of Elastomer", of the *AASHTO LRFD Bridge Design Specifications*.

Delete all of 3741.2B1 except for the last paragraph.