Section 713. BRIDGE REHABILITATION - STEEL

713.01 Description. Repair and replace structural steel portions of bridges. A “redundant structure” is a structure whose remaining supporting elements will provide an alternate stress path should one element fail or be taken out of service. In contrast, the loss of any supporting element of a “nonredundant” structure will result in failure of the complete structure.

713.02 Materials. Use materials meeting the following.

- Concrete, Grade S2 ................................ 701
- Steel Reinforcement, Grade 400 ...................... 905
- Structural Steel .................................. 906
- High Strength Bolts, Galvanized A 325 ................. 906
- Structural Timber and Lumber........................ 912

A. Steel for Temporary Supports. Provide temporary hanger rods meeting ASTM A 193 Grade B7 (AISI 4140). Provide rods with longitudinal Charpy V-notch impact values of 50 ft-lbs at 30 °F. Heat treat the steel, if necessary to meet the Charpy V-notch impact requirements. The Engineer will reject rods with notches, nicks, or welds.

Furnish a sample 15 inches long, saw cut from each bar length to be supplied for hanger rod fabrication. A Department representative must witness the removal of the test sample from each bar length supplied. The Department will use these samples for tensile strength, yield strength, and impact testing. Reduce the sample length to 8 inches (for impact testing only) if a Certified Mill Test Report traceable to the material is provided. Match mark each bar sample and corresponding remainder, by stenciling in the end cross-section. Acceptance of the rod material will be based only on Department testing and traceable Certified Mill Test Reports.

Provide heavy hex nuts for the temporary hanger rods according to ASTM A 563 Class 10S, and washers according to ASTM F 436.

Provide other steel for the temporary supports according to ASTM A 36 and section 906.

B. Sealant for Perimeter of Beam Plates. Select the sealant from the Qualified Products List. Provide the sealant in caulking tubes.
713.03 Construction.

A. Furnishing and Fabricating Structural Steel. Furnish and fabricate structural steel additions and replacements for existing structures and steel portions of temporary supports according to section 707. Submit shop drawings for approval before fabrication.

Measure the center-to-center-of-pins dimension of the existing link plates. If they differ by more than \( \pm \frac{1}{8} \) inch from the plan dimensions, build replacement link plates to the existing dimensions rather than to plan dimensions. The Engineer will direct changes to other plan dimensions to fit the existing dimensions.

Submit a final report on the pin and hanger assemblies that lists the as-built dimensions of the new link plates and pins. Show that the tolerances are according to subsection 707.03.C.11. Install bushings according to subsection 707.03.C.12. Pin and link plate pairs must be assembled and shipped as a unit or be match marked.

B. Temporary Supports for Girder Ends. Use the plan drawings, or propose an alternate design and secure approval of the Engineer, for temporary supports for girder ends. Base the alternate design on loads and allowable soil pressures noted on the plans. Include the calculations for the alternate design in the submittal. Alternate design must maintain the redundancy and material safety factors of AASHTO Standard Specifications for Highway Bridges. Alternate designs must be sealed by a professional engineer licensed in the State of Michigan.

The Department reserves the right to verify the structural adequacy of the entire system if the Contractor elects to use a temporary support that is already fabricated. Verification may include, but is not limited to, visual inspection and nondestructive testing by Department personnel. The Department may require submittal of mill test reports for the material used and shop drawings of the original fabrication. Make corrections, deemed necessary by the Department, before using the temporary support.

Provide hydraulic jacks that have a minimum stroke of 3 inches with pumps capable of extending the jacks their full stroke. Equip the hydraulic system with a dial gage that enables determination of the external load.

Provide hydraulic jacks that have locking rings or other positive locking devices to prevent settlement in case of hydraulic failure. Use the
locking devices during and after jacking cycles until stable shims are in place and all loads are removed from the jacks.

Maintain the temporary support including replacing the support in case of partial or complete failure. The Department reserves the right to furnish labor, materials, and supervision of work to restore the movement of traffic, in case of delay or inadequate progress in making repairs and replacement. All costs associated with work performed by the Department will be borne by the Contractor.

1. Column-Type Supports. After erection and before loading the temporary support, use a plumb line to determine the horizontal offset of the top of the column from the bottom of the column. Determine the horizontal offset of the hydraulic jack from the column center-line. Measure the column and hydraulic jack offsets parallel and perpendicular to the column web. Place jacks and temporary supports at each location so that the individual offsets and the sum, in each measured direction, do not exceed 1 inch. Consider jack offsets positive regardless of the direction of the column offsets.

   Where structure embankment (CIP) is not called for, compact the natural ground to a depth of 9 inches to not less than 95 percent of its maximum unit weight before placing the temporary supports.

   When the temporary support is to be placed on a paved shoulder or roadway, place a leveling course of 21AA aggregate, asphaltic cold-patch, or other material approved by the Engineer. Compact the leveling material to 95 percent of its maximum unit weight before placing the temporary supports.

   The Engineer may require bracing of the temporary supports depending on the method selected by the Contractor for doing the rehabilitation work.

   Leave the jacks in place until the link plates and pins are installed and fully operational. The lines and pump may be disconnected provided they remain available at the job site.

   Check for settlement of the temporary support hourly during the first four hours after loading. Make subsequent settlement checks daily. Take corrective action by adding shims to the temporary support, to prevent the girder end from subsiding more than \( \frac{1}{16} \) inch from its original position.
2. **Suspension-Type Supports.** After stable shims are in place, the Engineer may approve removal of the jacks.

   Repair all concrete removed for erecting the temporary support or for access to the girder end, as approved by the Engineer.

C. **Pin and Hanger Replacement.**

1. **Measurement of Existing Hanger Assemblies.** Take field measurements of all hanger assemblies to be replaced and submit these as-built dimensions, along with a drawing showing the span and girder end where the measurements were taken, to the Engineer.

   Measure the existing pin diameter, center-to-center-of-pin distance (measured on each side), and the length, width, and thickness of the link plates.

   Check girder web alignment by laying a straight edge across the pin plate gap at both the top and bottom of the girder. Measure and report girder offsets.

   Lane or shoulder closures required to permit the field measurements must be according to the *Michigan Manual of Uniform Traffic Control Devices* and the contract documents, and must be approved by the Engineer. Do not leave a lane or shoulder closed overnight for field measurements.

2. **Removal of Existing Hanger Assemblies.** Remove according to the plans, subsection 204.03.A.4 and the following.

   When removing and replacing the link plates and pins of more than one girder at a time, do not work on the same end of adjacent girders. Ensure that the suspender at the opposite end of a girder from which the link plates or pins are being removed is completely operational.

   Completely support the girder end on stable shims without the use of hydraulics before removing any component. Remove the two pins and two link plates in each assembly. Flame cut the link plates and pins for removal, when necessary, according to the following.

   a. Flame cut the link plates into two pieces by making a sloping transverse cut that coincides with the joint opening between the girder ends. If the link plates are cut at the pin, position a sheet metal heat shield behind the link plate to protect the girder.
b. Place a metal heat shield around the pin hole before flame cutting the pins. Pin ends may be trimmed to within 1 inch minimum of the girder pin plate. A hole may be burned through the center of the pin to ease removal. If this removal gouges the hole in the girder pin plate, grind it smooth before blast cleaning and coating. Obtain written authorization from the Engineer for all welding repair of the girder pin plate hole.

3. Installation and Coating of New Hanger Assemblies. When the end diaphragms prevent the installation of the new pin (may occur on sharply skewed bridges at the top pin), flame cut an oblong hole in the web of one end diaphragm using a minimum $\frac{3}{8}$ inch thick steel hole template, clamped to the channel section, as a cutting guide. After flame cutting, grind the hole edges to a maximum surface roughness of 125 microinches per inch rms. Clean and coat this hole and leave it in the finished structure. Do not loosen or remove the end diaphragm.

After the pins have been removed, grind all notches and deep pits that exist in the girder pin plate around the periphery of the hole to a maximum surface roughness of 125 microinches per inch rms. Clean and coat the girder ends, within 3 feet each side of the centerline of the pin holes or to the nearest stiffener, before the new hanger assembly is installed. Clean and coat according to section 715.

Assemble the new hanger assembly before removing the falsework shims.

D. Bearing Stiffeners at Temporary Supports. Erect bearing stiffeners at temporary supports according to section 707. Leave these stiffeners in place as a permanent part of the structure. Field drill the bolt holes in the existing girder; do not flame cut or air arc gouge the existing girder or proposed attachments. Complete field drilling before blast cleaning and prime coating the faying surfaces.

Before erecting the bearing stiffeners, clean and coat the faying surfaces and other contact surfaces. Faying surfaces are all surfaces internal to a connection that bear on an adjacent surface. Clean and coat according to section 715.

After the bearing stiffeners have been bolted in place, clean and coat the exposed areas according to section 715. This cleaning and coating
may be done immediately after erection or when the remainder of the girder is cleaned and coated.

E. Retrofit Structural Steel. Erect retrofit structural steel according to subsection 707.03.D. Leave retrofit structural steel in place as a permanent part of the structure. Field drill the bolt holes in the existing steel; do not flame cut or air arc gouge the existing steel or proposed attachments. Complete field drilling before blast cleaning and prime coating the faying surfaces.

Before erecting the structural steel, clean and coat the faying surfaces and all other contact surfaces. Clean and coat according to section 715.

After the structural steel has been bolted in place, clean and coat the exposed areas according to section 715. This cleaning and coating may be done immediately after erection or when the remainder of the girder is cleaned and coated.

F. Sealing the Perimeter of Beam Plates. Apply the sealant around the perimeter of bolted or riveted plates or angles on a steel beam as directed by the Engineer. Apply the sealant over the intermediate coat when dry to the touch. Clean and dry the surfaces between the repair plate or angle and the beam and the surfaces to which the sealant is to be applied before applying the sealant. Apply the sealant when the air and surface temperatures are above 40 °F. Immediately after applying the sealant, tool to form a 5⁄16 inch fillet and to force it against the contact surface. Apply sufficient sealant to completely fill all pits and depressions, regardless of width and depth, in the steel beam at the seam line. Apply the top coat over the sealant when the intermediate coat is fully cured.

G. Heat Straightening Damaged Structural Steel. Perform this work under the direct on-site supervision of a specialist in heat straightening bridge structural steel. This specialist must submit written documentation of three years experience, on a continuous basis, with successfully heat straightening comparable steel structures.

Before beginning work, obtain the Engineer's approval for complete details of the type and method of heat straightening to be used. Notify the Engineer at least 48 hours before starting the heat straightening work. Ensure that the final straightened member retains as little residual stress as possible. Do not perform heat straightening when the area is exposed to precipitation unless the area is housed as approved by
the Engineer. Apply heat at or below 1200 °F and monitor with contact thermometers, pyrometric sticks, or other heat indicating devices approved by the Engineer. Supply the heat indicating devices and make them available to the inspector at all times. Provide torch tips ¾ to 1 inch diameter. Heat all plastic yield zones and only plastic yield zones. Use line, strip, spot, and “V” (triangular) heats. Do not use a “V” angle greater than 20 degrees. Limit the base of the “V” heat to 6 inches. Heat the “V” from the apex, in a serpentine pattern, to the base so that the only place showing color is directly under the torch. Forced cooling is not permitted. After each heat straightening cycle, allow the steel to cool to below 250 °F before beginning the next heating cycle.

Straighten with as little mechanical force as possible. Use constraints that will not resist contraction during the cooling phase and will not produce local buckling of the compression element during the heating phase.

Eliminate bends, creases, folds, and dents of the web plates, flange plates, angles, stiffeners, channels, gusset plates, and torn areas.

Straighten the flange plates and angles to within ¼ inch of tilt rotation at the edges from the web and ½ inch of sweep in 20 feet (¾ inch at the point of impact). Straighten the web to less than ½ inch out of plumb. Reduce localized deflections in the web to no more than ½ inch as measured with a straight edge held vertically and horizontally. Straighten to these tolerances before attaching any cross frames or other lateral restraint devices. Do not force the beams/girders into position and then attach to the cross frames to hold them in position.

Do not flame cut any existing structural steel except as noted on the plans.

Grind burrs, nicks, gouges, scrapes, etc. to 125 microinches per inch rms and taper to the original surface using a 1:10 slope. Provide surface quality according to ASTM A 6.

Report all cracks or tears in the beam/girder, or in other structural steel members not shown on the plans, to the Engineer. The Engineer will recommend repair methods.

Inspect the completed straightening for cracks in the welds, web, flanges, plates and connections. Inspect and test according to subsection 707.03 D.B.c. Repair cracks by welding according to subsection
713.03

707.03. D.8. This work must be witnessed by the Engineer. All costs associated with this inspection and testing will be borne by the Contractor.

713.04 Measurement and Payment.

<table>
<thead>
<tr>
<th>Contract Item (Pay Item)</th>
<th>Pay Unit</th>
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<tbody>
<tr>
<td>Structural Steel, Furn and Fab, Pin and Hanger</td>
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<tr>
<td>Hanger Assembly, Field Measurement</td>
<td>Each</td>
</tr>
<tr>
<td>Hanger Assembly, Rem and Erect</td>
<td>Each</td>
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<tr>
<td>Heat Straightening Steel (Structure No.)</td>
<td>Lump Sum</td>
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<tr>
<td>Stiffeners, Furn, Fab, and Erect</td>
<td>Pound</td>
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<tr>
<td>Structural Steel, Retrofit, Furn, Fab, and Erect</td>
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<tr>
<td>Support, Column, Temp</td>
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<tr>
<td>Support, Suspension, Temp</td>
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<tr>
<td>Beam Plate, Seal Perimeter</td>
<td>Foot</td>
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</tbody>
</table>

A. Hanger Assembly.

1. **Hanger Assembly, Field Measurement** includes payment for taking and recording the measurements, maintaining traffic while the measurements are being taken, and providing the Engineer with a location drawing showing the span and girder end where the measurements were taken.

2. **Hanger Assembly, Rem and Erect** includes payment for removing two pins, two link plates, and shear locks; blast cleaning and applying and curing the coating in the joint area; installing the new link plates and pins; protecting the completed joint area by enclosure; and protecting the newly painted area adjacent to the joint area. No payment will be made for **Hanger Assembly, Rem and Erect** until the final top coat has been applied.

3. Structural steel required for pins and plates in new construction will be measured and paid for as specified in subsection 707.04 for structural steel, furnish and fabricate.

4. Bushings will be measured and paid for as specified in subsection 707.04.

B. **Heat Straightening Steel** includes payment for the necessary materials, labor and equipment to attain the desired position of the structural steel. Payment also includes field welding and nondestructive testing according to subsection 707.03.D.8.
C. **Stiffeners, Furn, Fab, and Erect** includes field drilling, installing bearing stiffeners on existing steel and blast cleaning and prime coating all contact surfaces.

D. **Structural Steel, Retrofit, Furn, Fab, and Erect** includes field drilling, installing new structural steel on existing steel and blast cleaning and prime coating faying and all other contact surfaces.

E. **Support, Temp**, of the type specified, includes payment for furnishing, placing, maintaining, and removing the necessary materials and equipment. The quantity for **Support, Temp**, of the type specified, indicates the number of girder ends to be supported and not necessarily the number of temporary support devices required. A sufficient number of support devices must be furnished and used to fulfill the requirements shown on the plans and to ensure completion of the project within the contract time.

All concrete removal and replacement necessary for access for temporary supports is included in **Support, Temp**.