May 1, 2024

Mr. Jimmy Sullivan
Superintendent
Blackstone Department of Public Works
15 Saint Paul Street
Blackstone, MA 01504

RE: Evaluation of Repairs for Bridge No. B-13-001
Blackstone, Massachusetts
Pare Project No. 24061.00

Dear Mr. Sullivan:

At the request of the Town of Blackstone (Town), Pare Corporation has evaluated Bridge No. B-13-001 carrying Bridge Street over the Blackstone River. The bridge, constructed in 1955, is a 175-foot two span structure with steel stringers and a concrete deck supported on cast-in-place concrete substructures with spread footings. It carries two lanes of traffic, one sidewalk, and metal railings. The Town is the owner and is responsible for maintaining the bridge. To identify needed repairs and help with planning for required maintenance, the Town has requested that existing conditions be reviewed to determine the scope and extent of recommended repairs to the various bridge components. An Opinion of Probable Construction Cost (OPCC) for identified repairs was also requested.

The latest plans, inspection reports, and load-rating report were obtained from The Massachusetts Department of Transportation, Highway Division (MassDOT). The structure was evaluated during a field visit on April 9, 2024. Access was obtained to the abutments and the abutment beam seats on foot and using a ladder. Hands-on access to the pier and pier beam seats was not obtained, and the evaluation of components at this location is based on the inspection report and observations from the riverbanks. Access to the top of the bridge was attained on foot. Conditions reported in the latest inspection report were verified, and sketches and photographs were taken to document the conditions. Based on this information, Pare developed repair recommendations and OPCC. This letter report summarizes existing conditions and field observations, recommends maintenance and repair activities, and provides an OPCC for each of the recommended repairs.

Existing Structure Condition:

The latest available routine inspection report is dated August 10, 2023, and the latest available Special Member Inspection Report is dated July 5, 2022. Both detail the existing structure condition. The bridge is a 175-foot two span structure that spans from south to north, with steel stringers numbered west to east. The spans are numbered south to north with one solid pier wall. The bridge has a concrete deck supported on cast-in-place concrete substructures with spread footings. It carries two lanes of traffic, one sidewalk on the west side, and metal railings. The Blackstone River flows west to east. A summary of conditions is provided below. The latest inspection reports are attached for a more complete description of existing conditions.

- The deck wearing surface is a two-inch bituminous concrete wearing surface with transverse, longitudinal, and map cracks throughout. Both spans have numerous bituminous concrete patches and small potholes. Notably, the pavement at the paved-over pier joint has moderate to wide transverse and map cracking. Typical wearing surface conditions are shown in Photos 1 and 2.

Photo 1: Wearing Surface at Bridge Joint Over Pier

- The deck underside has many full width transverse hairline cracks with efflorescence ranging from light to heavy. Typical deck conditions are shown in Photo 3.

- The steel beam ends and bearings at the abutments are in good condition. Only Beam #10 at the North Abutment exhibited deterioration with light rust flaking. The bearings have heavy surface rust with no significant section loss.

- The steel beam ends at the pier are in significantly worse shape than those at the abutments, as detailed in the Special Member Inspection Report, dated July 5, 2022. Ten beam ends at the pier exhibit significant section loss in the web and bottom flanges. Typical steel conditions are shown in Photo 4.

Photo 2: Typical Wearing Surface Conditions

Photo 3: Typical Deck Conditions

- Both concrete curbs have several small, isolated spalls with exposed steel reinforcement. The east bridge railing has minor collision damage.

Photo 4: Typical Beam-End Conditions at Pier
(Span 1, Beam 7 at Pier Shown)

- The concrete abutments have minor spalls with exposed steel reinforcement, cracking, and efflorescence, but otherwise appeared to be in generally good condition. No spalls were noted.

- Based on the latest inspection report, the concrete pier has abrasion at the water line and a single 5'-4" high × 2'6" wide × up to 1" deep spall with exposed steel reinforcement (see Photo 5).

Photo 5: Spall at Pier

Recommended Maintenance and Repairs

The primary concerns on this bridge are the conditions observed at the pier, deterioration of the wearing surface, and the potential future condition of the deck. The repairs recommended in this letter are intended to restore the load-carrying capacity of the structure and extend the bridge's service life by providing additional resistance to deterioration. The following repairs are recommended:

Beam End Repairs

The existing structural steel deterioration at the pier is the most critical condition observed on the structure. Further deterioration could result in a reduced load capacity or even bridge closure until repairs can be completed. Typical beam-end repairs consist of installing temporary shoring, removing existing paint and rust, patching the remaining steel with an epoxy filler, and bolting repair plates and angles to the affected areas to restore the load-carrying capacity. Typically, the repair plates, angles, and bolts are galvanized for added protection. An example of a typical beam-end repair detail is shown in Figure 1 below.

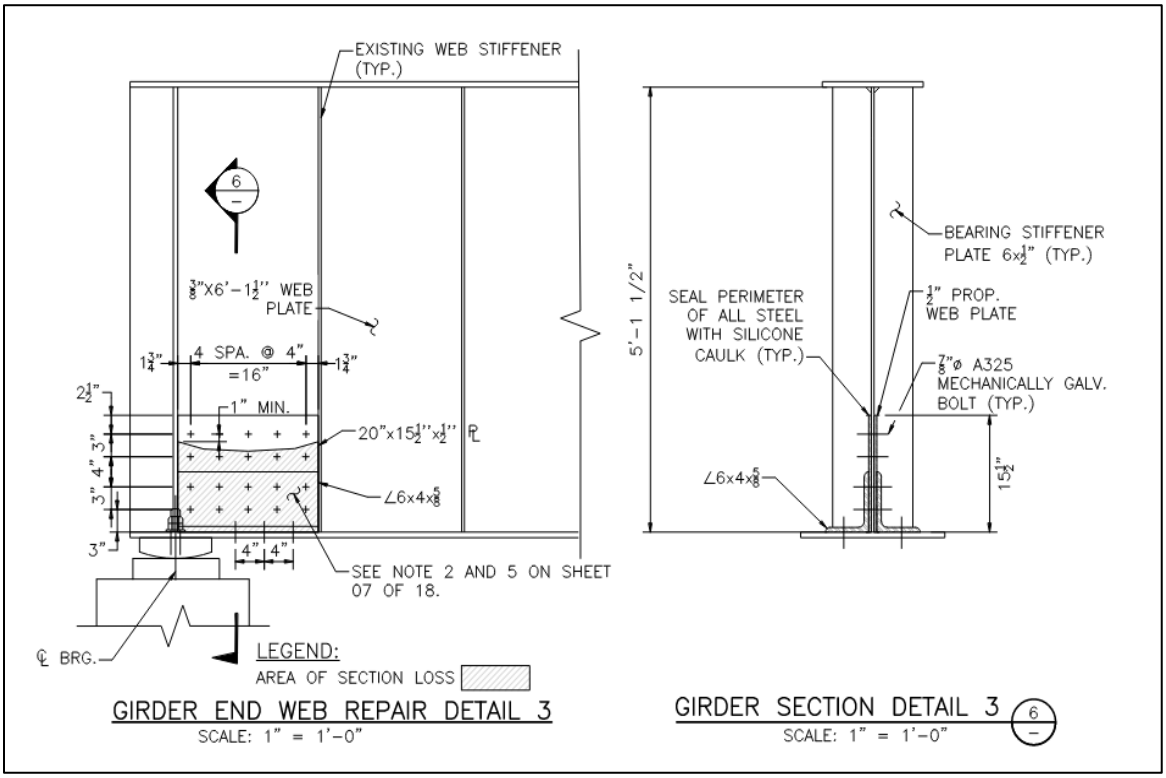


Figure 1: Sample Beam-End Repair Detail

Paint Structural Steel and Bearings

While the paint system throughout this bridge is in poor condition, much of the steel exhibits only minor surface rust. The exception is at the pier, where significant section loss has occurred. Following beam end repairs, Pare recommends painting the structure. There are significant cost implications to this recommendation, as it is expected to cost over $2 million for a complete painting based on recent MassDOT project bids. While complete painting is recommended to protect the entire structure, a more targeted approach could also provide significant benefits. Painting only the steel within the first few feet of the pier where the bulk of deterioration has occurred would provide significant benefits without the cost of painting the entire structure and is recommended should full painting not be a viable option. Painting the steel at the abutments in conjunction with painting the steel at the pier would also provide additional protection where surface rust and paint flaking is heavier than along the span.

Mill and Overlay

It is Pare's understanding that the Town intends to mill the existing wearing surface to the bridge deck and repave the bridge. In conjunction with this operation, we recommend the following:

- Perform milling operations using a lightweight milling machine to avoid overstressing the structure and minimize vibrations that may cause additional damage.

- Upon removal of the existing wearing surface, have the deck conditions observed and documented by a qualified engineer. This will provide a better indication of deck repairs that may be required in the future. It will also serve to identify critical deck repairs that should be conducted before repaving.

- Prepare for and conduct selected concrete deck repairs prior to repaving. This action would address worst-case deck areas, avoiding the need to revisit the structure and open the pavement to conduct the repairs at a later date. (See also deck repairs below).

- Install a waterproofing membrane on the concrete deck before repaving.

- Install an asphaltic plug roadway joint and seal the sidewalk joints at the pier. Sawcut and seal joints at the pavement at the abutments. These joints will allow for movement and reduce the potential for cracking, leakage, and future patching, especially at the pier.

Deck Repairs

The extent of deck repairs required is difficult to estimate. Based on conditions observed on the bottom of the deck and in the wearing surface, it is reasonable to assume a portion of the deck requires repair. A more thorough evaluation can be made as part of the mill and overlay process described above. For the purposes of this evaluation, and based on observable conditions, we estimate up to 25% of the deck area may require partial or full-depth repairs in the future. Typical deck repair details are shown in Figure 2.

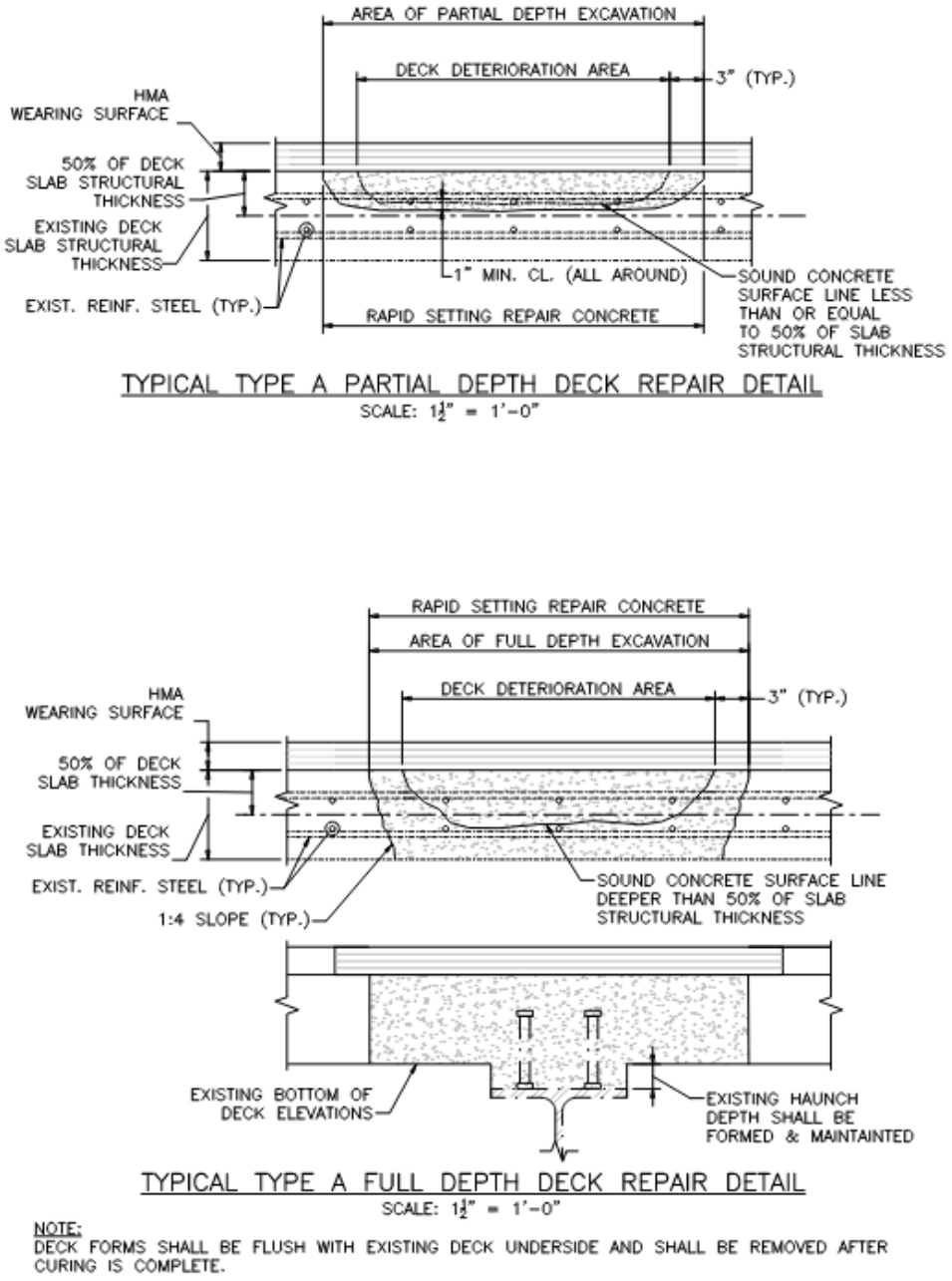


Figure 2: Examples of Typical Partial and Full Depth Deck Repair Details

Pier Joint Replacement

While milling and overlaying with an asphaltic plug joint will improve existing conditions and help to reduce further deterioration at the pier, a complete joint replacement is recommended. This involves chipping out the existing sliding-plate joint and surrounding deteriorated concrete, recasting the deck at the joint, and installing a modified asphaltic-plug joint with compression seal as shown in Figure 3. This will provide a higher level of protection than installing only an asphaltic joint in the new paving.

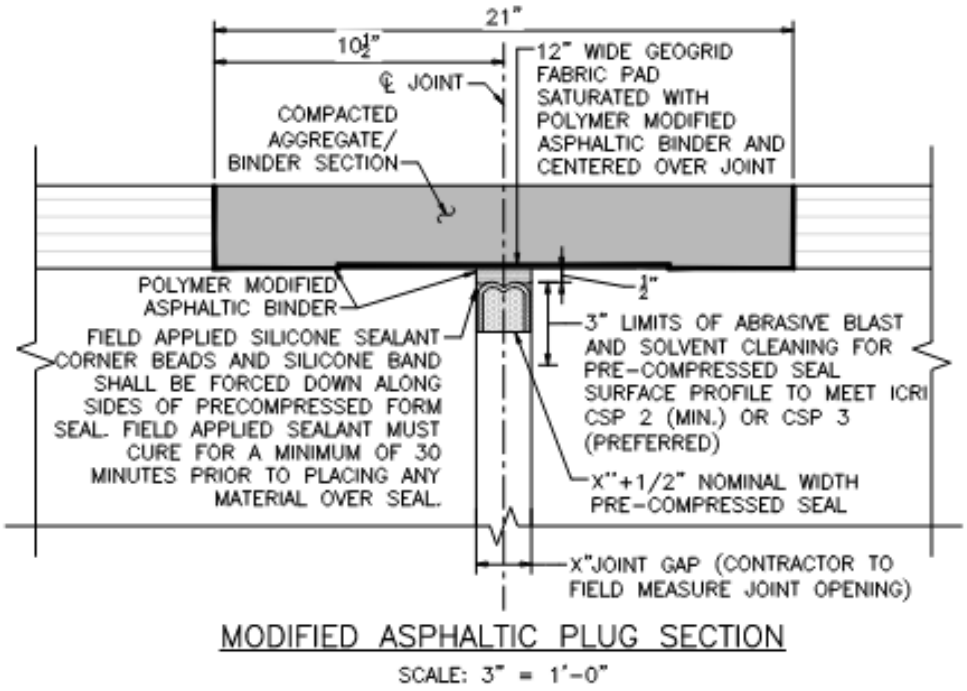


Figure 3: Example of a Modified Asphaltic Bridge Joint System

Seal Abutments and Pier

While no significant concerns were identified on the abutments and pier. Installation of a protective coating on the abutments and pier will seal small cracks and provide an extended service life for these components. Any cracks too wide to seal with a protective coating can be sealed with urethane prior to applying the protective sealer. One spall observed at the pier and described in the latest inspection report may require repair, though it is a shallow spall and not critical at this time.

Opinion of Probable Construction Cost

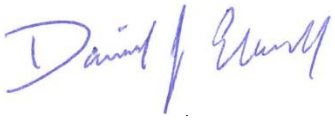
Pare has developed estimated quantities and OPCCs for the recommended repairs described in this report. The quantities and costs are based on Pare's cursory site review and the latest Routine and Special Member Inspection Reports. As Pare was unable to access the beams over the pier, the dimensions used in the structural steel cost estimate were taken from the relevant inspection reports. Costs are based on average and recent bids for similar MassDOT projects.

The costs in the table below do not include costs such as design and contract development, traffic control, police details, mobilization, administrative costs, and other conditions. In addition, the costs may be impacted by work being combined under a single contract and work that is self-performed and/or self-administered by the Town.

Type of Repair	Estimated Quantity	Estimated Cost	Notes
Beam End Repairs Breakdown: Steel Repairs Working Platform Temporary Shoring	LUMP SUM 3,000 LB 1 EACH 10 EACH	$330,000 $180,000 $200,000 $50,000	Ten beam ends at pier
Painting Entire Structure	LUMP SUM	$2,500,000	Includes platform to perform work over water.
Painting Beam Ends at Pier and Abutments	LUMP SUM	$600,000	Includes platform to perform work over water.
Mill & Overlay Breakdown: Pavement Removal Waterproofing Membrane Asphalt Pavement Asphaltic Joint (Pier) Sawcut & Seal (Abut.)	LUMP SUM 540 SY 540 SY 65 TON 26 FT 52 FT	$121,000 $20,000 $50,000 $40,000 $8,000 $3,000	Mill & overlay 2± inches to bridge deck. Potential deck repairs are not included in this item.
Deck Repairs Breakdown: Working Platforms Concrete Deck Excavation Reinforcing Concrete for Deck Repairs	LUMP SUM 1 EACH 135 SY 5,000 LB 30 CY	$510,000 $200,000 $135,000 $25,000 $150,000	Full depth repair on 25% of concrete area. Pavement removal and replacement not included.
Replace Pier Joint Breakdown: Remove Joint & Concrete Reinforcing Concrete for Deck Repairs Modified Asphaltic Joint	LUMP SUM 26 LF 800 LB 4 CY LF	$55,000 $15,000 $4,000 $20,000 $16,000	This work assumes repair of the deck is required across the full width of the roadway.
Substructure Prot. Coating	4,000 SF	$40,000	Cost includes access at pier.

We are available to discuss the results of our evaluation at your convenience. If you have any questions or need additional information, please feel free to contact me.

Sincerely,



Managing Engineer

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Enclosures

Inspection Report dated August 10, 2023
Special Member Inspection Report, dated July 5, 2022
Existing Plans dated November 1955