

COLORADO DEPARTMENT OF TRANSPORTATION STAFF BRIDGE BRIDGE DETAIL MANUAL	Chapter: 16 Effective: August 31, 2022 Supersedes: December 15, 2010
REPAIR DETAILS	

16.1 PURPOSE

Repair drawings graphically present all pertinent information necessary in the field construction of repairs to a structure. Some of these repair types include:

- A) Bridgerail Replacement
- B) Expansion Joint Replacement
- C) Deck Rehabilitation / Overlay
- D) Pier Cap and Column Repair
- E) Impact Repair
- F) Corbel Placement
- G) Timber Pile Repair
- H) Timber Bridge Girder Repair
- I) Falsework
- J) Wall Repair
- K) Steel Corrosion/Fatigue Repair
- L) Culvert Repair
- M) Bearing Replacement

More than one kind of repair may be included in a drawing set for a given structure or multiple structures, e.g. deck rehabilitation and expansion joint replacement may share the same general layout. Figure 16.1-1 presents a portion of the general information sheet for a repair project that includes multiple structures. The checklists in this chapter will sometimes contain both design issues and detailing issues. The detailer shall verify any unknown design issues with the designer of the repair. Worksheet B-100-1AR should be used in the repair set.

If time allows, redraw details to show existing conditions. The appropriate portions of the as-built plans into the drawings may be included in the contract plans if the appropriate details cannot be redrawn.

The repair details shall provide all the information required to describe the work and any items that may affect the work. If specifications, calculations or other documentation is required for the work, it should be included per the Design Manual.

16.2 RESPONSIBILITY

This drawing shall be prepared and checked in the Design Unit. The graphic presentation of information on this drawing shall be the responsibility of the individual preparing the drawing.

16.3 SCALES

Standard Architectural and Civil scales should be used that are suitable to fit the details to a standard sheet.

<u>BRIDGE DESCRIPTION (E-17-GL & E-17-GM)</u>	<u>INDEX OF DRAWINGS</u>	
<p>E-17-GL (Westbound) and E-17-GM (Eastbound) are seven span (50'-0" typ.) CSG bridges located on I-76 at MP 7.652. Structures are 30'-0" curb to curb with 2'-0" wide curb on both sides and type 10 rail. The average skew is 68°. The bridges have approximately 4" of asphalt.</p>	<p>Dwg. No. B01 GENERAL NOTES AND WORK DESCRIPTION</p> <p>Dwg. No. B02 SUMMARY OF QUANTITIES</p> <p>Dwg. No. B03 GENERAL LAYOUT E-17-GL & E-17-GM</p> <p>Dwg. No. B04 SECTIONS & DETAILS E-17-GL & E-17-GM</p> <p>Dwg. No. B05 BEARING REPAIR DETAILS E-17-GL & E-17-GM</p> <p>Dwg. No. B06 TEMPORARY SUPPORT DETAILS E-17-GL & GM</p> <p>Dwg. No. B07 GENERAL LAYOUT F-16-FL</p> <p>Dwg. No. B08 COLUMN AND PIER CAP REPAIR F-16-FL</p> <p>Dwg. No. B09 BEARING REPAIR DETAILS F-16-FL</p> <p>Dwg. No. B10 TEMPORARY SUPPORT DETAILS F-16-FL</p> <p>Dwg. No. B11 PIER CAP SUPPORT DETAILS F-16-FL</p> <p>Dwg. No. B12 GENERAL LAYOUT AND REPAIR DETAILS E-17-GA & E-17-GB</p>	
<p><u>WORK DESCRIPTION (E-17-GL & E-17-GM)</u></p> <p>Install temporary support as shown in the plans. Remove unbound concrete from surfaces of concrete girder and pier cap and place concrete patching as shown in the drawings and as directed by the Engineer. Install corbels under girders as shown in the drawings.</p>		
<p><u>BRIDGE DESCRIPTION (F-16-FL)</u></p> <p>F-16-FL is a four span (31'-8", 50'-0", 50'-0", 31'-8") bridge; concrete on rolled I beam, composite and concrete tee. It is located at the intersection of SH 6 and SH 95 at MP 282.273. Structure is .98'-0" curb to curb with no skew, it has 2'-0" wide curb on both sides. Existing rail type 4.</p>		
<p><u>WORK DESCRIPTION (F-16-FL)</u></p> <p>Install pier cap supports as shown in the plans. Install temporary support as shown in the plans. Remove unbound concrete from surfaces of concrete column and pier cap and place concrete patching as shown in the drawings and as directed by the Engineer. Install corbels under girders as shown in the drawings.</p>		
<p><u>BRIDGE DESCRIPTION (E-17-GA & E-17-GB)</u></p> <p>E-17-GA (Westbound) and E-17-GB (Eastbound) are three span (31'-0", 66'-6", 31'-0") bridges, Concrete Slab and Girder, Composite. They are located on I-70 at MP 278.49 over SH 35 (Quebec Street). Structures are 48'-0" curb to curb with a 0° skew. They have 2' curbs on both sides with Type 10 Bridgerail.</p>		
<p><u>WORK DESCRIPTION (E-17-GA & E-17-GB)</u></p> <p>Remove unbound concrete from surfaces of columns. Sandblast reinforcing steel, place new reinforcing steels as required. Patch concrete removal areas. Apply concrete sealer to pier columns.</p>		

Fig. 16.1-1 Portion of General Notes Sheet for Multiple Structures

16.4 ORIENTATION OF DETAILS

The PLAN of the bridge shall be placed, if possible, at the upper left of the drawing. The location of the repairs should be shown in plan view when possible. The ELEVATION of the bridge shall be projected below the PLAN if necessary for clarifying the repair location. When possible, the END ELEVATION and/or Sections shall be placed to the right of the PLAN and ELEVATION. If space is limited, the sections or secondary views may be shown on another sheet. Generally, sections should be taken from the PLAN and ELEVATION rather than from secondary views or other sections.

Bridge specific details should be shown on sequential sheets so a Contractor can pull the sheets for a specific bridge easier. If there are details common to multiple bridges, those details may be put at the end of the plan set to avoid duplication.

16.5 CONTROL

Original Horizontal Control Lines, Stationing, Layout Lines, Profile Grade Lines and Centerlines are not required to complete the work and should not be shown. All locations or control lines should be dimensioned off of the existing structure. Abutments, piers and girders shall be labelled according to the current inspection report. A note should be added on the drawings if this numbering is different from original drawings, (e.g., "Abutment & Pier Numbers match Structure Inspection Reports; Previous As-Built Drawings may differ.") The display of lane lines and shoulders are helpful for determination of traffic control, but are not required.

16.6 CENTERLINES

Centerlines shall be identified and shown as discussed in the following subsections:

Location - Centerlines shall be shown on views which help locate the repair, when applicable.

Plan View

Centerline of all girders (if part of the repair)

Elevation View

Centerline of Piers

Centerline of columns and footings

Identification - The centerlines shall be identified in the following ways:

Centerline of Girder - A circle containing the girder letter is placed on each girder centerline, as shown in the PLAN views in the graphic examples. Widened bridges may have a letter / number naming convention. These girder letters shall correspond to those shown in the Inspection Sketch. Span number may be added to the girder label.

Other Centerlines - When it is applicable to identify other centerlines, it should be done by using their particular names. Examples: Centerline Bearing, Centerline Anchor Bolts, Centerline Columns, Centerline Footings, etc.

16.7 ELEVATIONS

Elevations are not typically required on repair projects since most of the work is relative to the existing structure. Elevations may be useful in determining scale, clearances and access issues.

16.8 DIMENSIONS

A sufficient number of dimensions shall be shown on the details to provide adequate information necessary in the checking of the plans and the construction and/or design of the repair. Quantities should be able to be verified based on plan dimensions.

The +/- symbol should only be used to draw the Contractor's attention to items that should be field verified and are critical to design or fabrication. A general note such as "Dimensions are subject to typical construction tolerances" could be used as well.

16.9 ANGLES

The following angles shall be shown in the PLAN view of the structure, when applicable.

- A) Bent angle
- B) Angles that the girders generate with the centerline of pier or centerline of bearings, if they are different than the bent angle.

16.10 TEMPORARY SUPPORT

Some repairs will require temporary support of the girders in order to complete the required work. At a minimum, a conceptual temporary support detail should be provided. See Section 16.12(l).

16.11 WORKSHEETS

The use of the Bridge Worksheets is encouraged, but the designer shall verify the dimensions and applicability of the worksheet for the required repair.

16.12 PLAN SHEET INFORMATION

The following paragraphs provide a brief overview of each repair type, a checklist of information that is likely to be required for each repair type, photographs and sample plan sheets. The repair examples shown here are a guide only; each repair shall be evaluated for applicability of examples and worksheets on a case by case basis. See Chapter 1 for border information checking procedures.

- A) **Bridgerail Replacement** – Typically these projects involve replacing substandard bridge rails with new standard rails. The option of missing the existing post locations or matching the post locations is typically determined by the region's bridge unit leader but may be required by bridge restrictions as well.

Check Items

The following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. A field visit should be made prior to FOR to verify as-built locations, curb heights and conflicts.

- 1) Distance from last bridge rail posts to end of bridge or approach slab
- 2) Standard post to post dimensions
- 3) Details to match existing anchor bolts if required

- 4) Illustration that standard Guardrail Terminators can be installed without hitting abutment or approach slab
- 5) Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
- 6) Any required bridge rail transitions
- 7) Work Description
- 8) Bridge Description

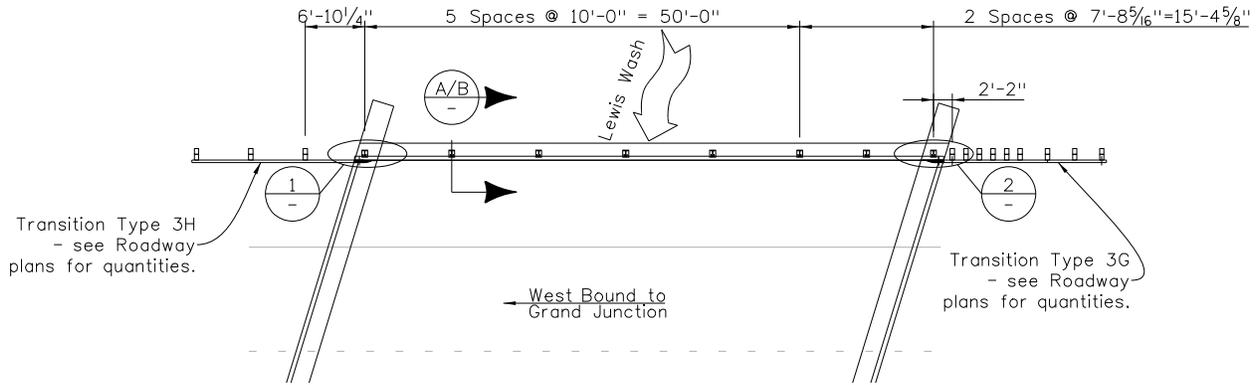


Fig. 16.12(A)-1 Sample Plan showing Bridgerail Post Spacing

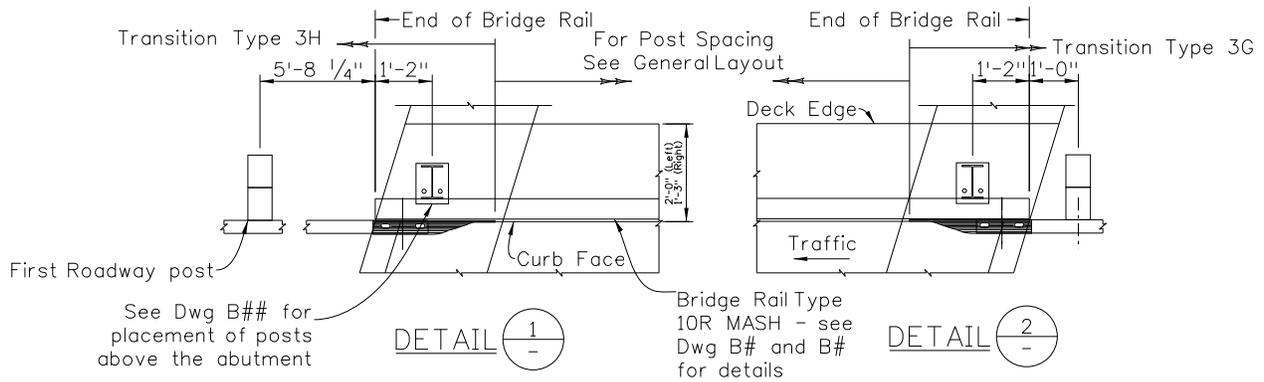


Fig. 16.12(A)-2 Sample Detail showing Bridgerail post locations/clearances near Abutment

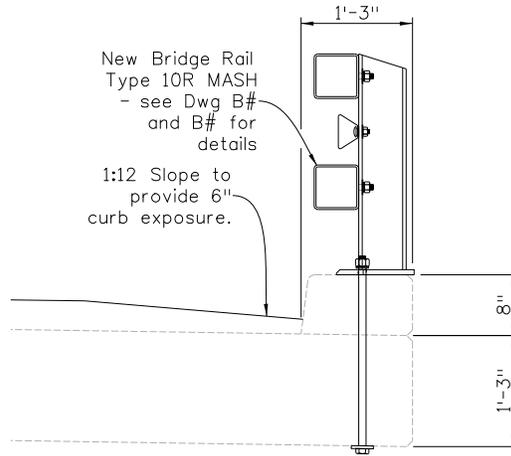


Fig. 16.12(A)-3 Sample Section showing paving detail and Post Connection

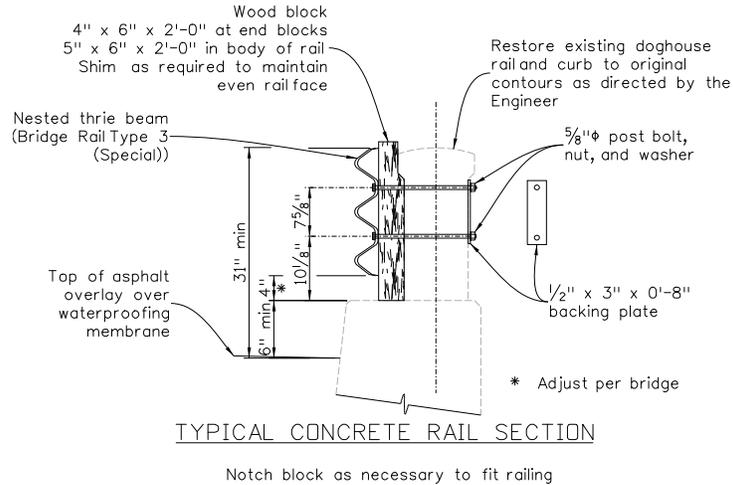


Fig. 16.12(A)-4 Sample Section showing Bridgerail Repair for Doghouse Type Rail (To be used if replacement is not an option)

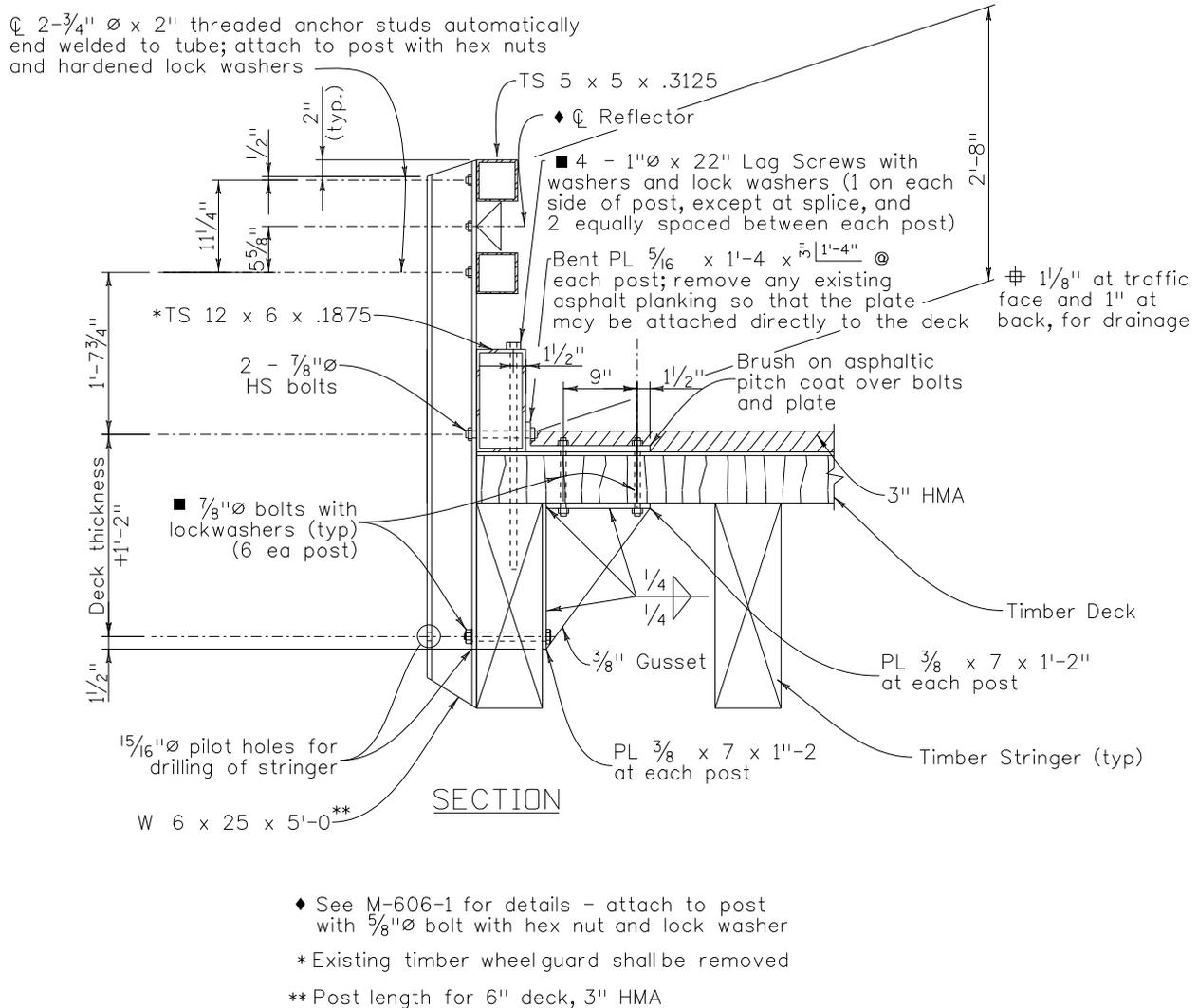


Fig. 16.12(A)-5 Sample Section showing Timber Bridge Rail Replacement (To be used if replacement is not an option)

B) **Expansion Joint Replacement** – These repairs are typically removal of existing expansion joints and replacement with a new standard expansion joint. Some modular joints can be repaired in place, although the repair longevity is questionable. Expansion Joint Replacement should typically be done with overnight closures if lanes cannot be closed. Provide temporary bridge decking / cover plates if repair area will need to be traversed by daytime traffic.

Check Items:

The following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. A field visit should be made prior to FOR to verify as-built locations, curb heights and conflicts.

- 1) Existing reinforcing and interferences and resolve issues
- 2) Existing utilities

- 3) Depth of concrete removal
- 4) Depth of asphalt (height of header)
- 5) Bridge rail type
- 6) Curb plate size
- 7) Construction phasing and details
- 8) Opening dimensions
- 9) Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
- 10) Work Description
- 11) Bridge Description

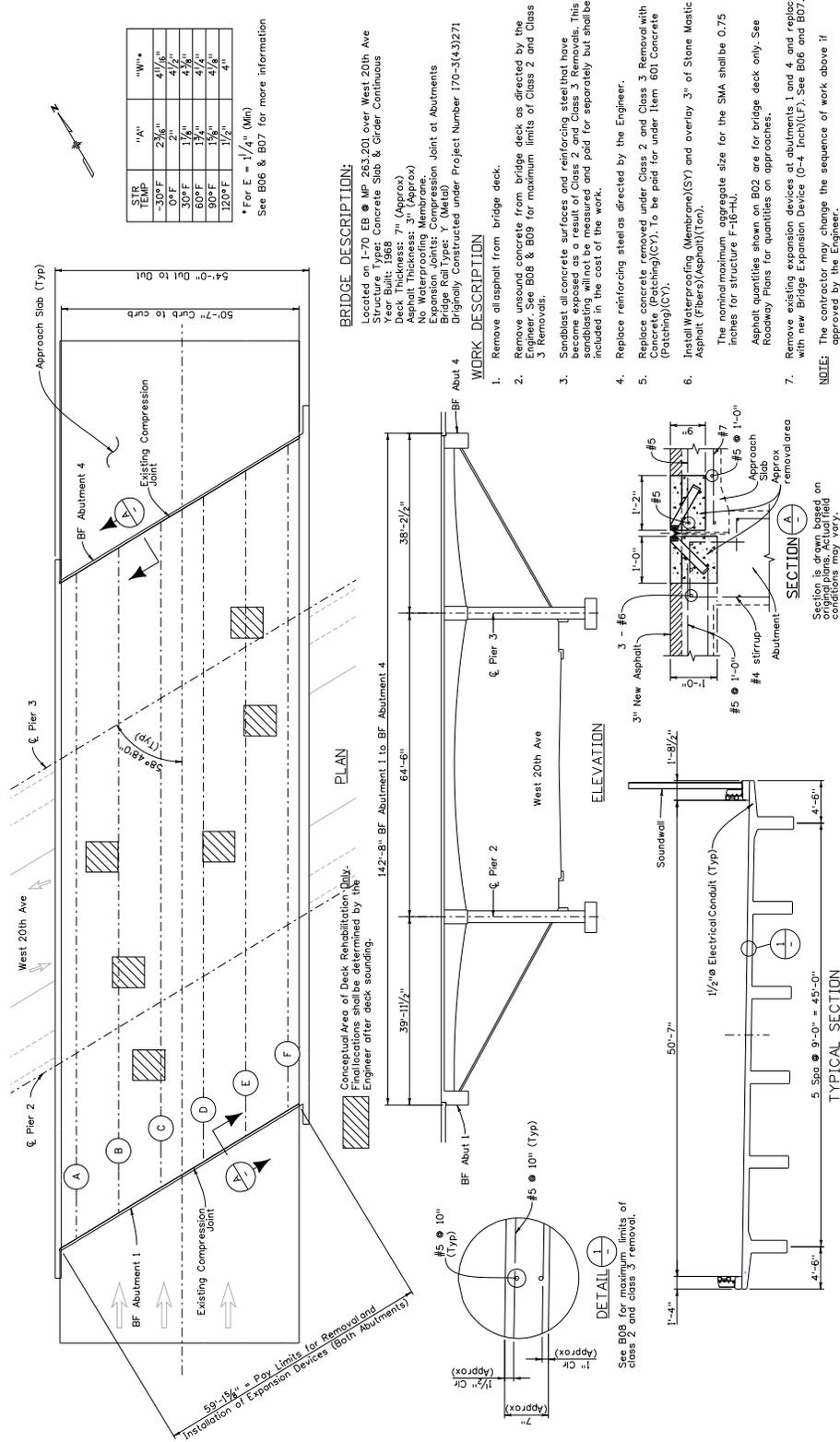


Fig 16.12(B)-1 Sample General Layout for Expansion Joint Replacement

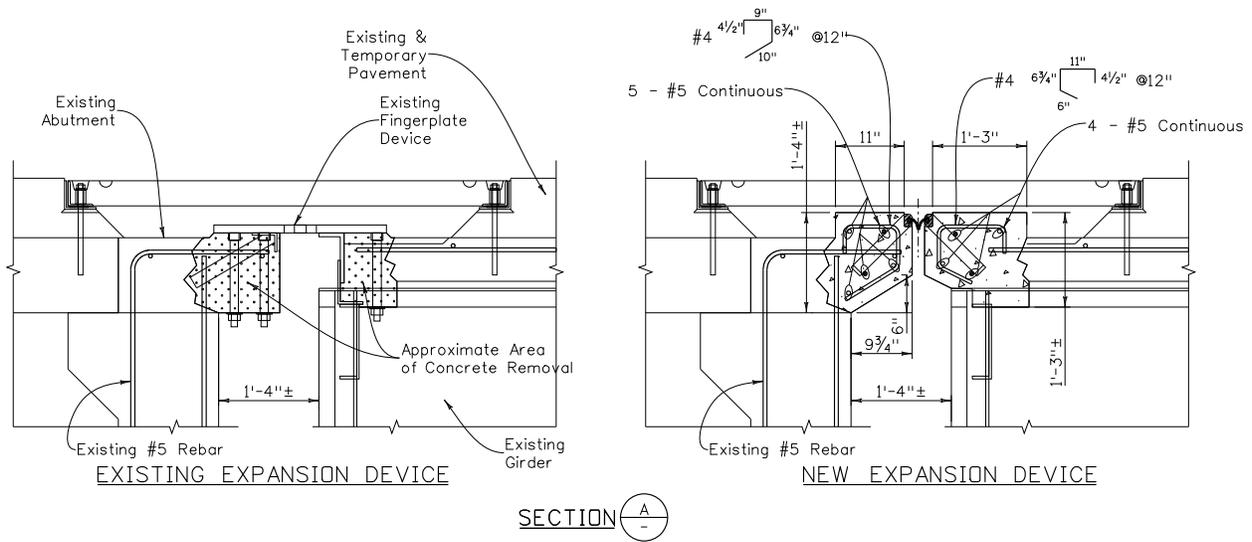


Fig. 16.12(B)-2 Sample Sections showing existing and proposed expansion joint devices



Fig. 16.12(B)-3 Photo of new Expansion device shown in Fig. 16.12(B)-2

- C) **Deck Rehabilitation** – Typical requirements for deck rehabilitation include removal of asphalt mat, location of rehabilitation areas, and removal and replacement of concrete. Pay Items for removal vary between regions, e.g. Region 1 construction prefers using only Class 2 & Class 3 Removals. Rehabilitation areas shown are generally conceptual but may be based on deck sonars or mapping of lower side of the deck & soffit. Waterproofing Membrane should be added to extend the life of the deck. A Typical General Layout Sheet is shown in figure 16.12(C)-4.

Check Items:

The following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. A field visit should be made prior to FOR to verify as-built locations and conflicts.

- 1) Approximate locations of rehab, if locations are only conceptual, label accordingly
- 2) Length and width of bridge
- 3) Removal details and pay items
- 4) Phasing details
 - i) For cast-in-place concrete boxes, tee girder bridges and other girder types which rely on the deck for stability, show amount of removal permissible without the requirement of falsework
 - ii) For steel girders, precast girders and other girder types which do not rely on the deck for stability, show permissible amount of removal similar to Figure 16.12(C)–3
- 5) Joint details to clarify any interference with rotomilling operations
- 6) Existing reinforcing, sizes, and spacing
- 7) Typical section
- 8) Depth of asphalt for milling/replacement
- 9) Existing utilities, especially those in the deck
- 10) Dimension girder spacing
- 11) Show drain locations and details
- 12) Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
- 13) Work Description
- 14) Bridge Description
- 15) Existing concrete strength (if pertinent)

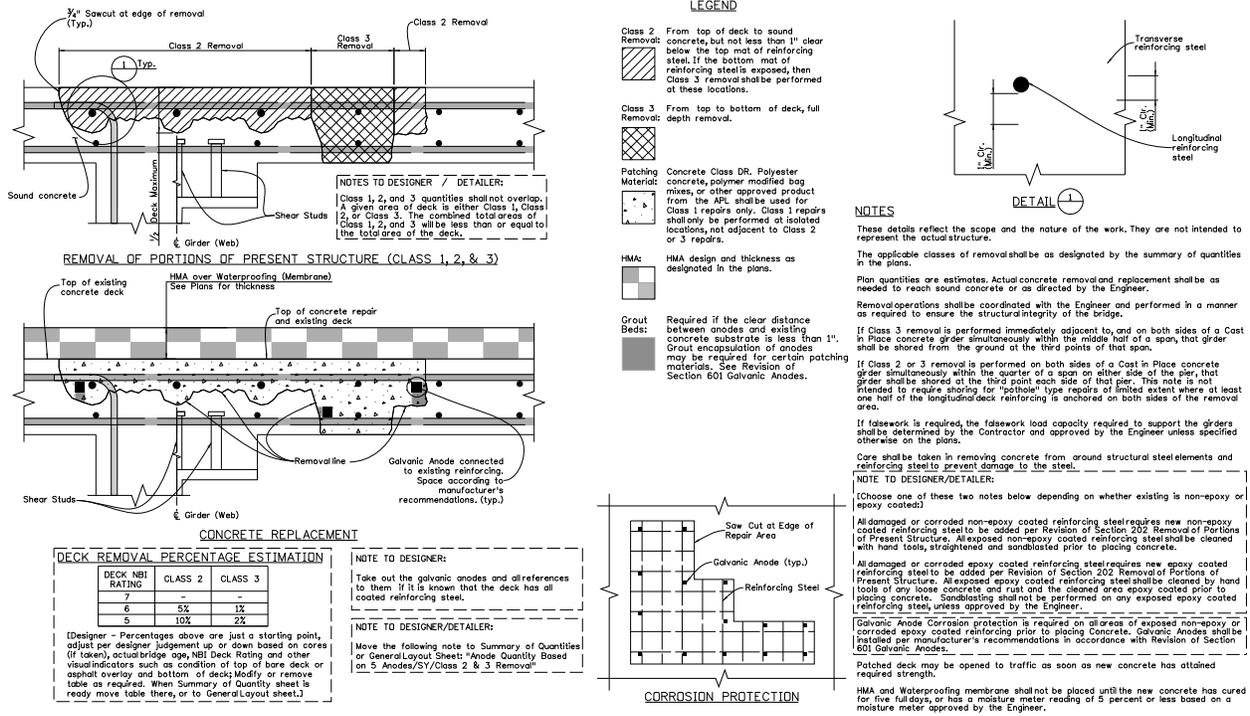


Fig. 16.12(C)-1 Sample of Worksheet for Deck Rehabilitation Removal Details

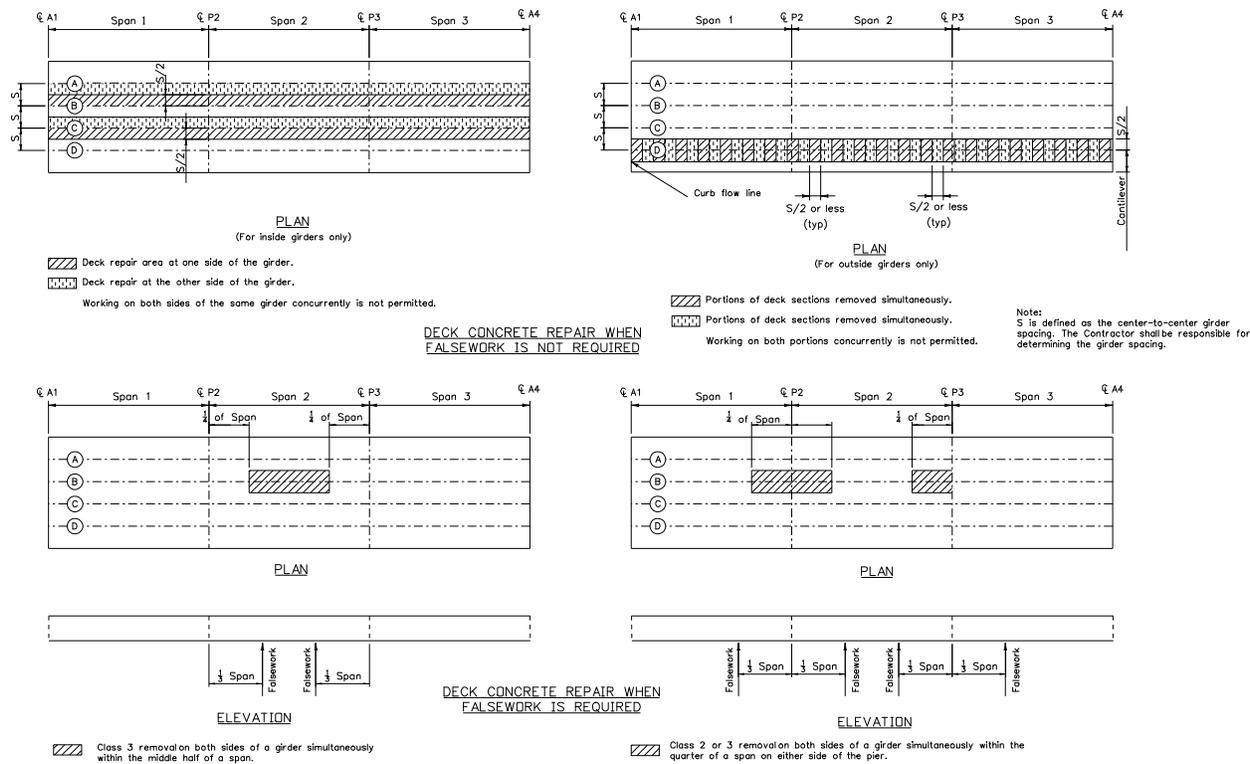
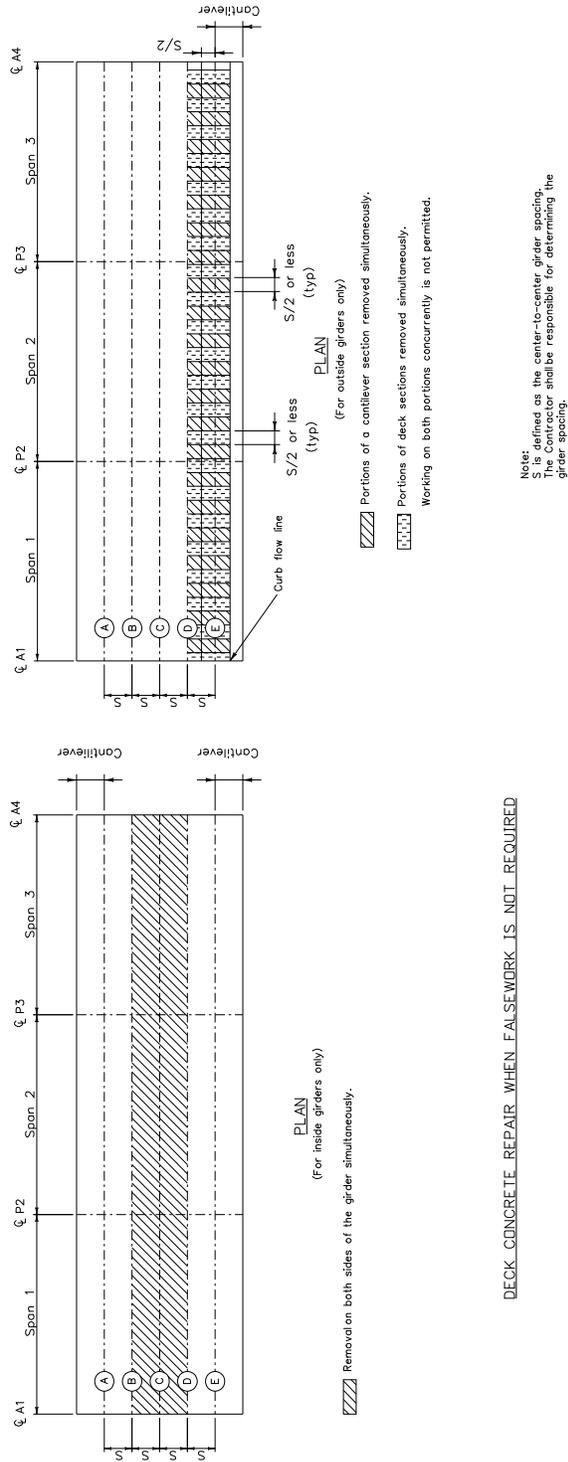


Fig. 16.12(C)-2 Sample Phasing Details for Girders where Falsework may be required



DECK CONCRETE REPAIR WHEN FALSEWORK IS NOT REQUIRED

Fig. 16.12(C)-3 Sample Phasing Details for Girders where Falsework is generally not required

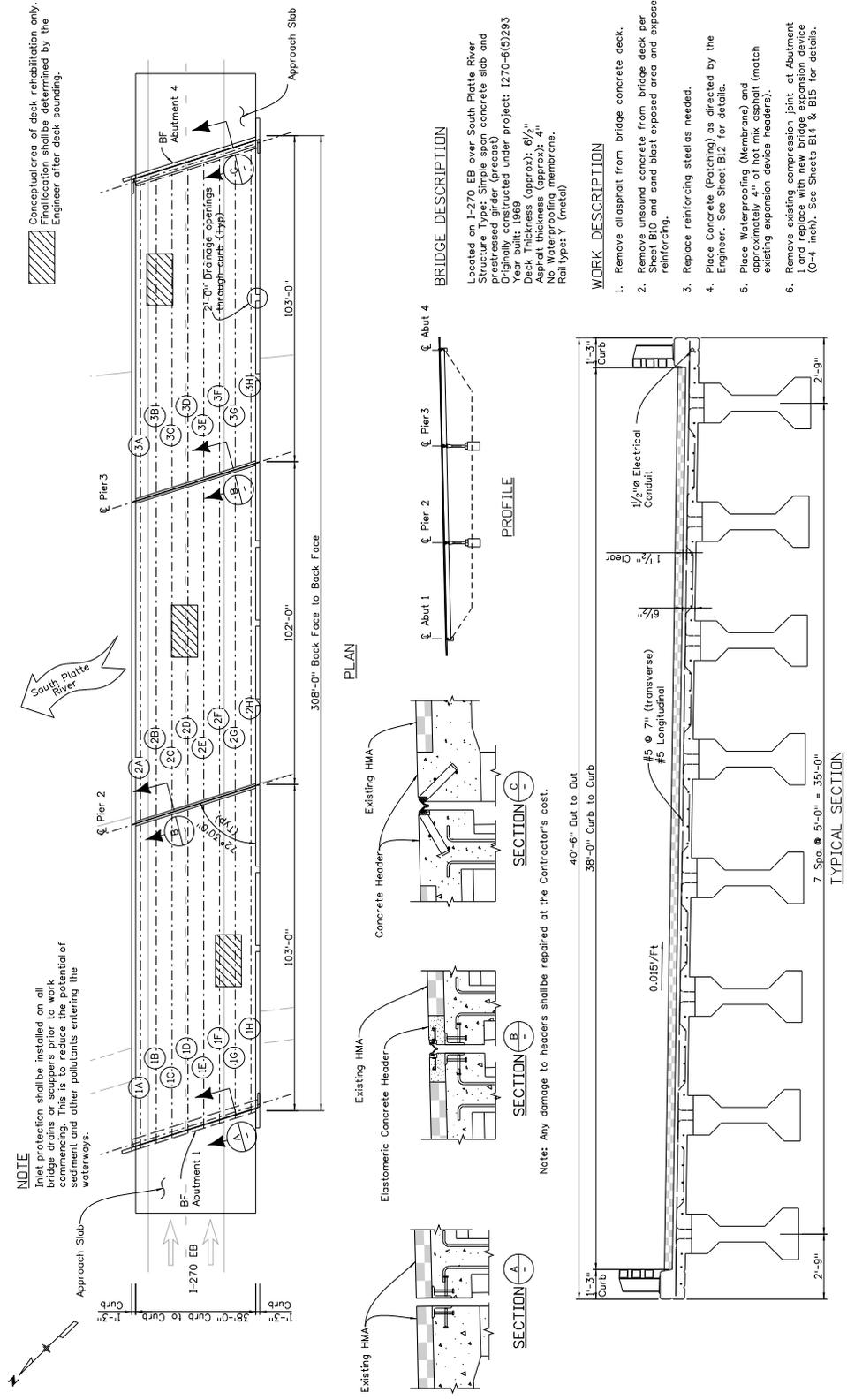


Fig. 16.12(C)-4 Sample Layout and Details for Deck Rehabilitation Project



Fig. 16.12(C)-5 Close-up Photo of Deck Rehabilitation



Fig. 16.12(C)-6 Photo of Deck Rehabilitation (Removals approaching critical levels)

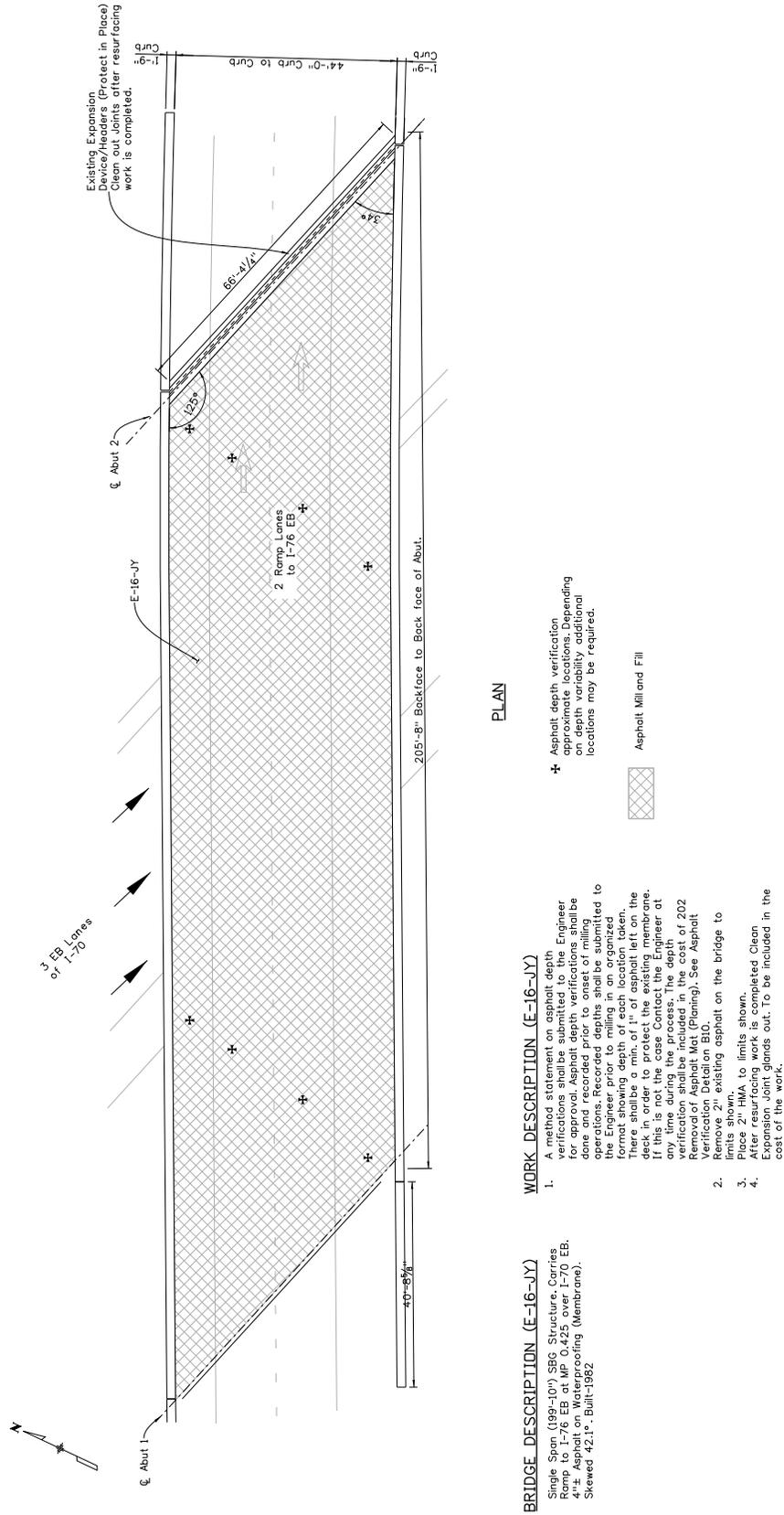


Fig. 16.12(C)-7 Example of asphalt deck coring

BRIDGE DESCRIPTION

1. Span (30'-3", 78'-6", 30'-3")
2. Bridge, CS&C Built in 1966
3. Over Lowell Blvd. at M.P. 271.491
4. Out to Out 106'-0"
5. Deck Course - Type 3 Bridge Roll
6. Asphalt Sealant
7. Asphalt Depth - 4"

WORK DESCRIPTION E-16-DN

1. Remove 2 1/2" existing asphalt on bridge deck.
2. Place 2 1/2" SMA in limits shown.
3. Saw and Seal Joints.
4. Place Delineators on bridge approaches per S-612-1.



Asphalt Mill and Fill

- + Asphalt depth verification locations. Depending on depth variability additional locations may be required.

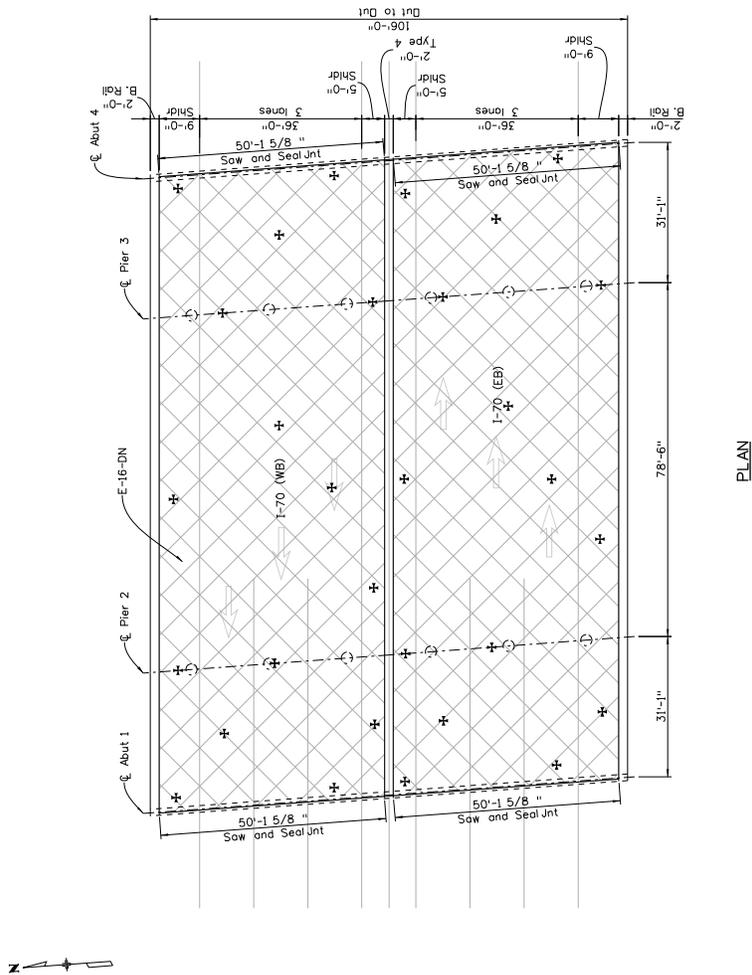


Fig. 16.12(C)-8 Example of asphalt deck coring

- D) **Pier Cap and Column Repair** – These repairs are typically rehabilitation of column, abutment & pier damage due to water leakage or corrosive salts. Often they are done in conjunction with the addition of corbels. If possible, the source of leakage should be removed. Waterproofing/Sealing can extend the life of the repair. Sample repair details are shown in Figures 16.12(D)-1 through 6.

Check Items:

The following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. A field visit should be made prior to FOR to verify as-built locations and conflicts.

- 1) Approximate locations of repair
- 2) Existing reinforcing, sizes and spacing
- 3) Amount of permissible loss from column prior to contacting Staff Bridge or providing temporary support
- 4) Splicing details
- 5) Repair details
- 6) Rebar replacement details
- 7) Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
- 8) Work Description
- 9) Bridge Description

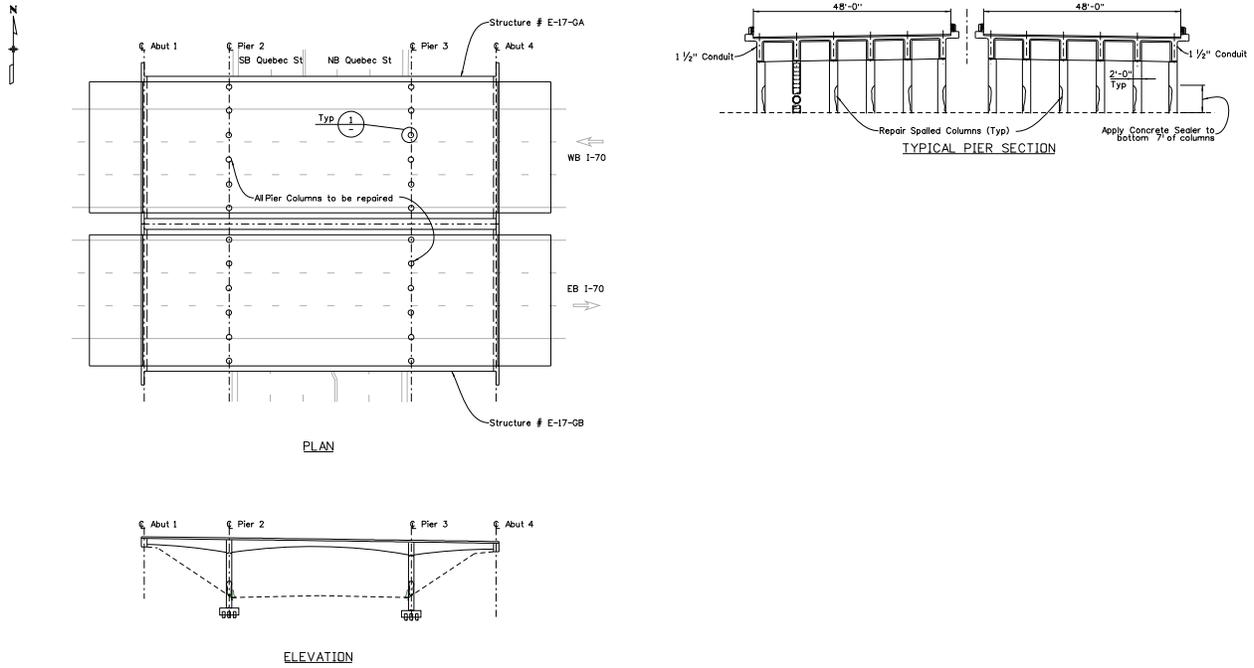
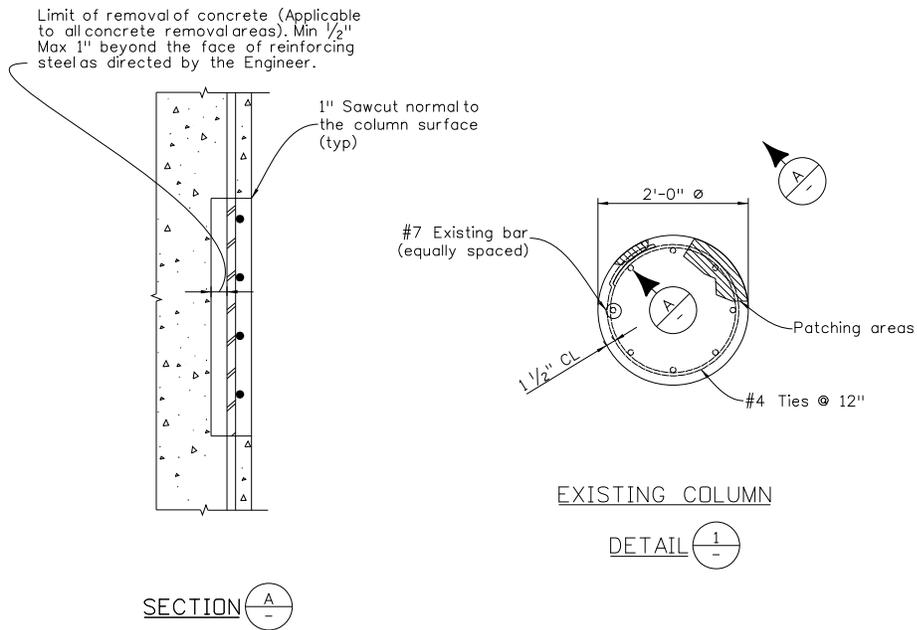


Fig. 16.12(D)-1 Sample General Layout for a Pier Cap/Column Repair



Note: Apply approved Concrete Sealer to all columns after patching repairs are complete per Manufacturer's recommendations.

Fig. 16.12(D)-2 Sample Detail showing Removals and Patching



Fig. 16.12(D)-3 Photos showing column damage and repair process

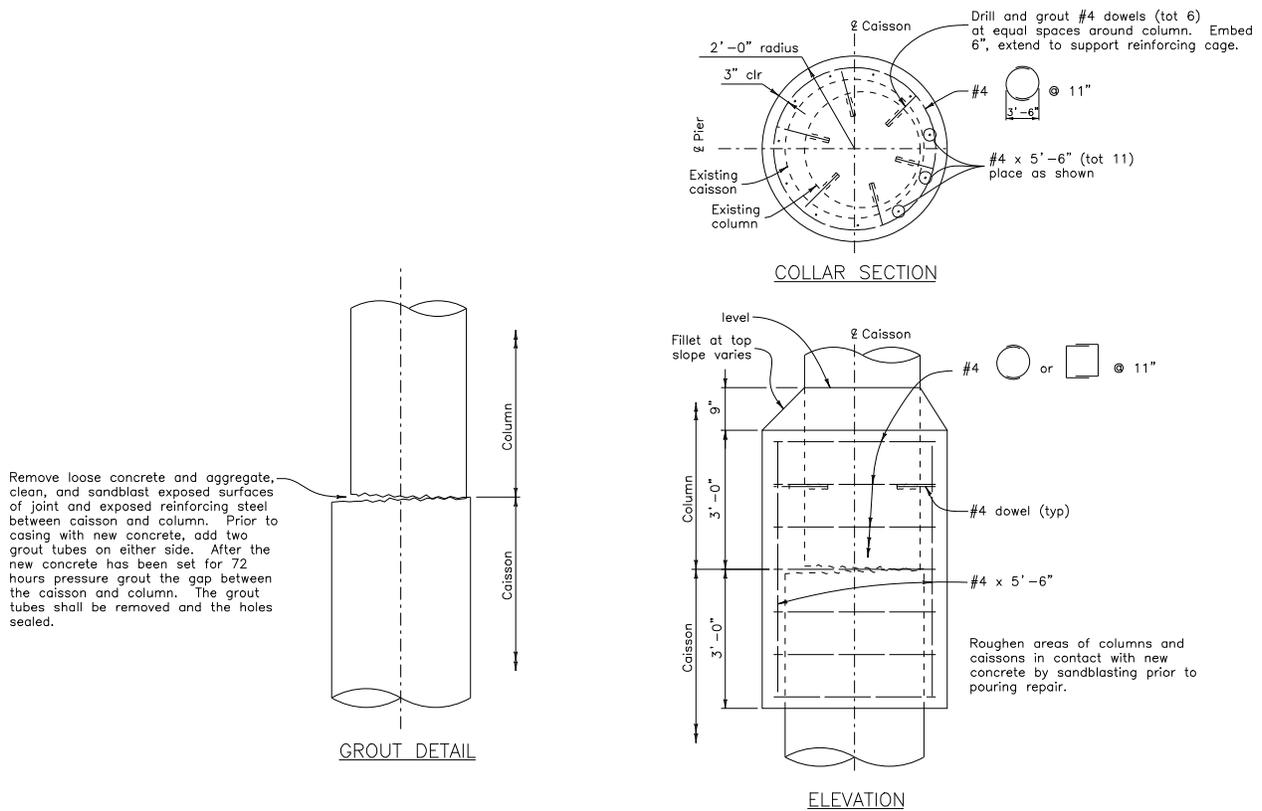


Fig. 16.12(D)-4 Sample of Column Repair



Fig. 16.12(D)-5 Photo of Damage to be repair by (D)-4 details

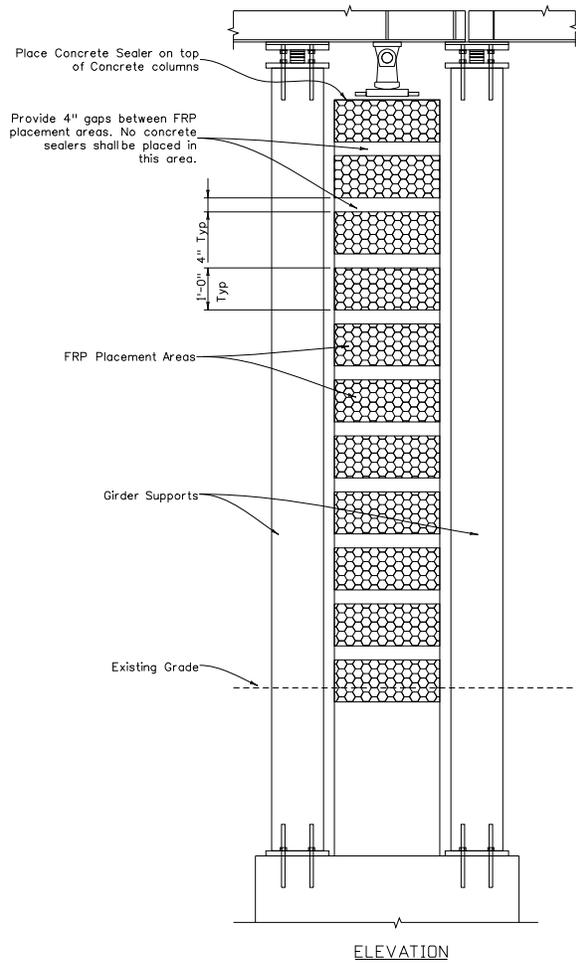


Fig. 16.12(D)-6 Sample of Fiber Wrap Details



Fig. 16.12(D)-7 Photo of Fiber Wrap

- E) **Impact Repair** – These repairs are typically required due to high loads hitting and damaging the bridge girders. If the damage is not too severe for steel girders, flame straightening can often be used to bring the girder back to its original position although lead based paints can be an issue. Lead based paints or coatings should be addressed in the repair details. Provide appropriate specifications for dealing with the lead based coatings prior to the repair. Depending on the amount of damage to the girder, partial or full closure of the bridge may be necessary.

Check Items:

The following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. A field visit should be made prior to FOR to verify as-built locations and conflicts.

- 1) Amount of impact deflection in steel girders
- 2) Approximate area of repair (Pictures may be used to depict the amount of damage but should not be the sole description)
- 3) Layout, girder spacing & typical section
- 4) Grade of steel
- 5) Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
- 6) Specifications for Hazardous Coatings
- 7) Work Description
- 8) Bridge Description

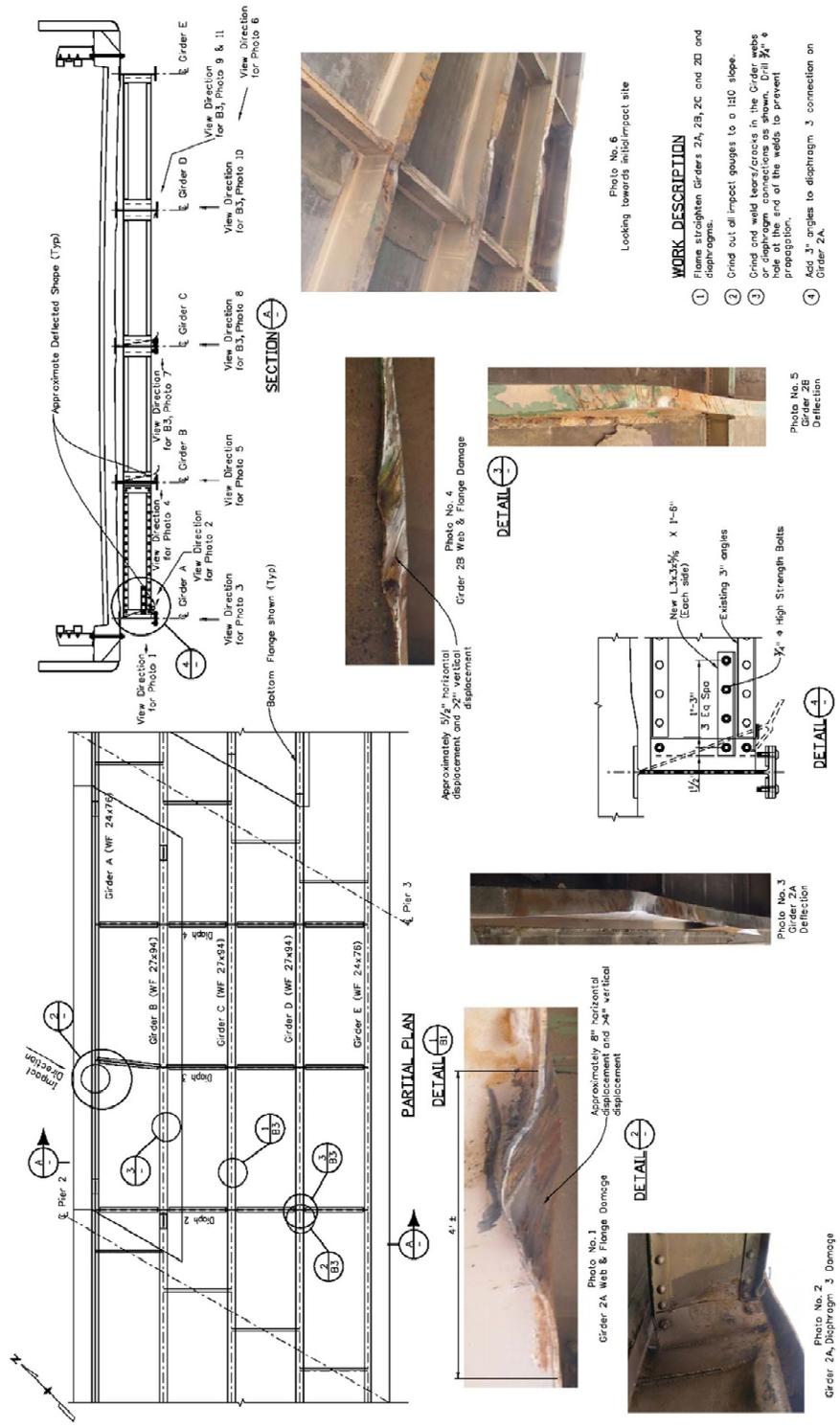


Fig. 16.12(E)-1 Sample of Plan for Steel Repairs

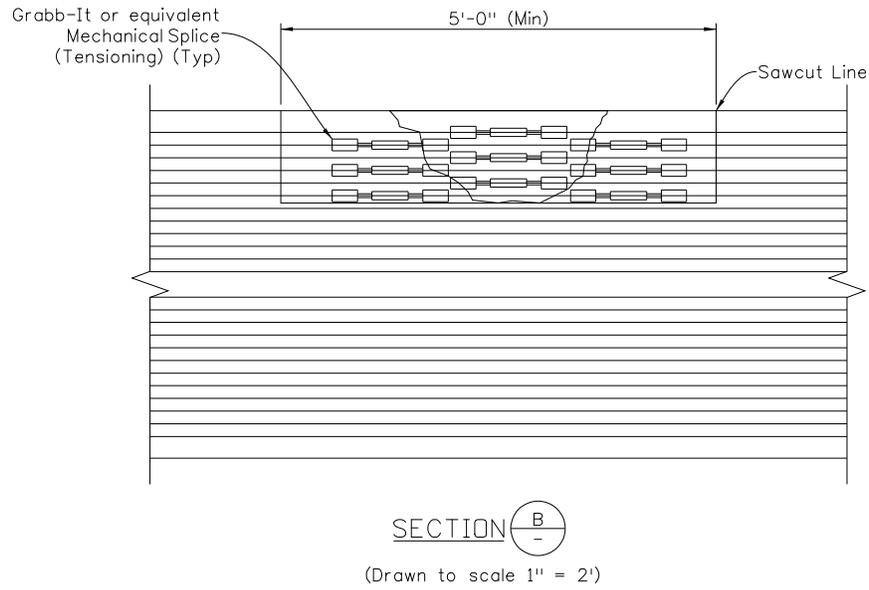


Fig. 16.12(E)-3 Sample Section of Precast Prestressing Repair

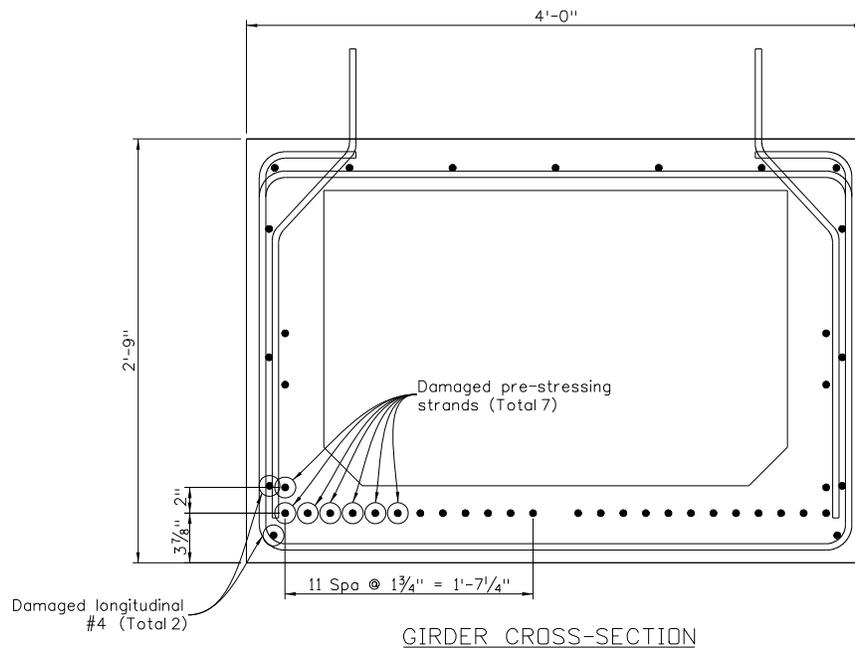


Fig. 16.12(E)-4 Sample Section of Precast Girder Repair



Fig. 16.12(E)-5 Photo of Precast Girder repair in progress

- F) **Corbel Placement** – These repairs are typically requested by Bridge Inspection when the amount of girder bearing has been significantly reduced. Corbels could be considered as permanent falsework, but are considered more of a secondary support. If the loss or removal area for the pier or abutment patching is greater than ~33% of the bearing area, temporary supports will probably be required during pier repair and corbel installation. In some cases, the temporary support may be able to be used for a more permanent support, e.g. pier straddle supports. See Section (I) for sample falsework details.

Check Items:

The following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. A field visit should be made prior to FOR to verify as-built locations and conflicts. In addition, constructability and “fit” of supports will be checked (see Section I)

- 1) Conflicts with existing reinforcing and/or resolutions
- 2) Location of bolt pattern
- 3) Skew angle and angle of corbel if different than skew
- 4) Dimension from top of cap to bolt layout
- 5) Width of Pier Cap
- 6) Copy of the existing plans or enough details to depict reinforcing & conflicts clearly
- 7) Temporary support details as required (See Section I)
- 8) Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
- 9) Work Description
- 10) Bridge Description

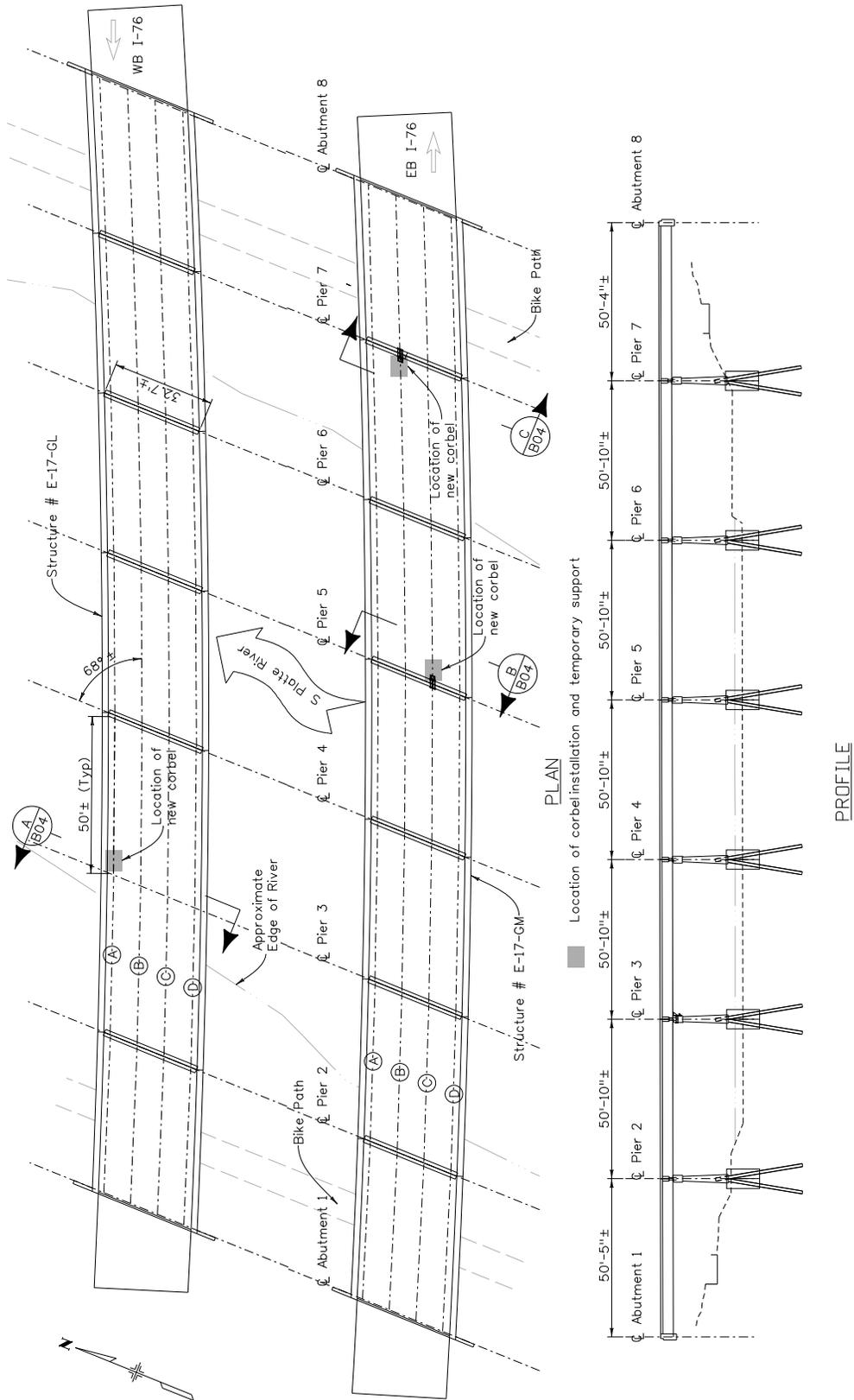


Fig. 16.12(F)-1 Sample Plan for Corbel Placement

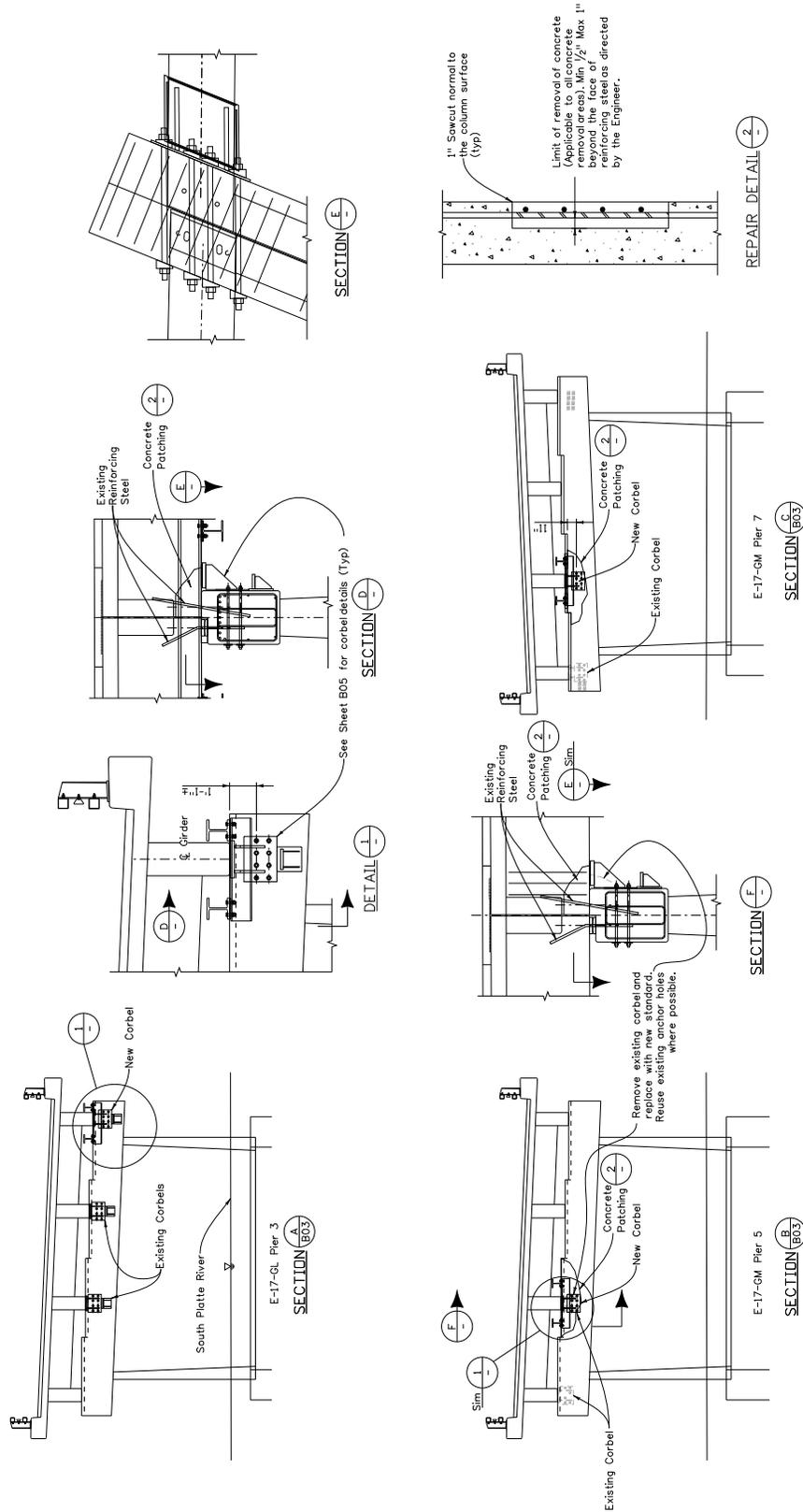


Fig. 16.12(F)-2 Sample Sections and Elevations for Corbel Placement

GENERAL NOTES:
Design lengths below assume a CSG structure with a 44' loading with an 8" deck and 4" of asphalt.
Notes where applicable are required on both sides of bearing assembly on both sides as shown in the section.
All bolts shall be A449 high strength bolts.
The Contractor shall verify all dimensions prior to ordering materials.

SUGGESTED CONSTRUCTION PROCEDURE

1. Locate and mark centerline of the girder on the pier cap.
2. Mark location of bolt holes as pier cap, see elevation view and section.
3. Drill holes in pier cap and place bolts.
4. Cut holes in plywood form to match bolt holes in pier cap.
5. Remove loose concrete and clean reinforcing steel.
6. Bolt the form in place and restore the pier cap to its original section using an approved grout (Duracal, etc.)
7. Allow curing time as recommended by the manufacturer before removing the form.
8. Using the form for a pattern, cut the bolt holes in the front plate.
9. Attach plates and tighten bolts. (100 lb-ft Torque).
10. Raise the support assembly until the elastomeric pad is compressed $\frac{1}{8}$ " (200 psi x pad area = jacking force).
11. Field weld the support assembly to the front plate.
12. Point all steel as directed by the Engineer.

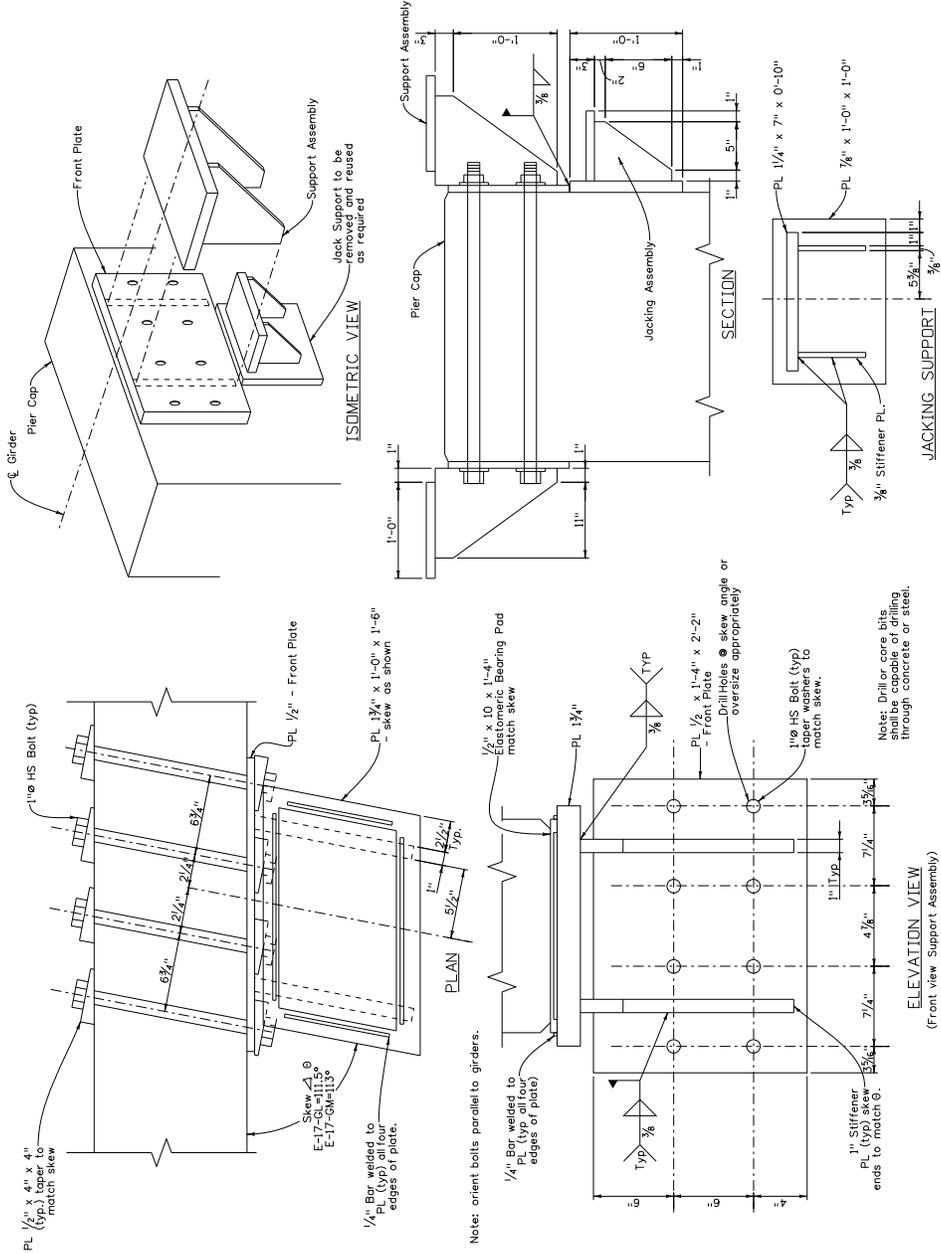


Fig. 16.12(F)-3 Sample Worksheet for Corbel Placement Details



Fig. 16.12(F)-4 Photo of Corbel Placement and Pier Cap repair



Fig. 16.12(F)-5 Front Side of Corbel



Fig. 16.12(F)-6 Back Side of Single Corbel

G) **Timber Pile Repair** – Typically timber piles need repair due to rotting or insufficient diameter. Repairs include replacing decomposed areas with timber, concrete encasing, or adding supports or bracing.

Check Items:

The following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. A field visit should be made prior to FOR to verify as-built locations and conflicts and to confirm applicability.

- 1) Location of damaged column
- 2) Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
- 3) Work Description.
- 4) Bridge Description.

NOTE:

If $Y < L_2 + 6"$, omit cripple and leave shoring in place until concrete reaches 2100 psi compressive strength.

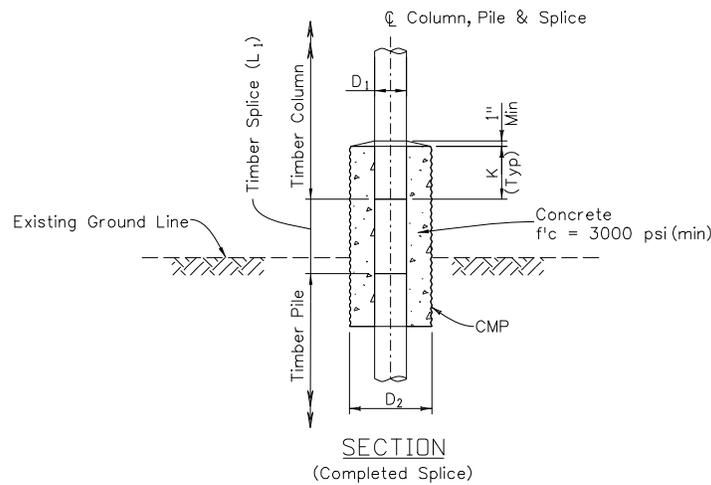
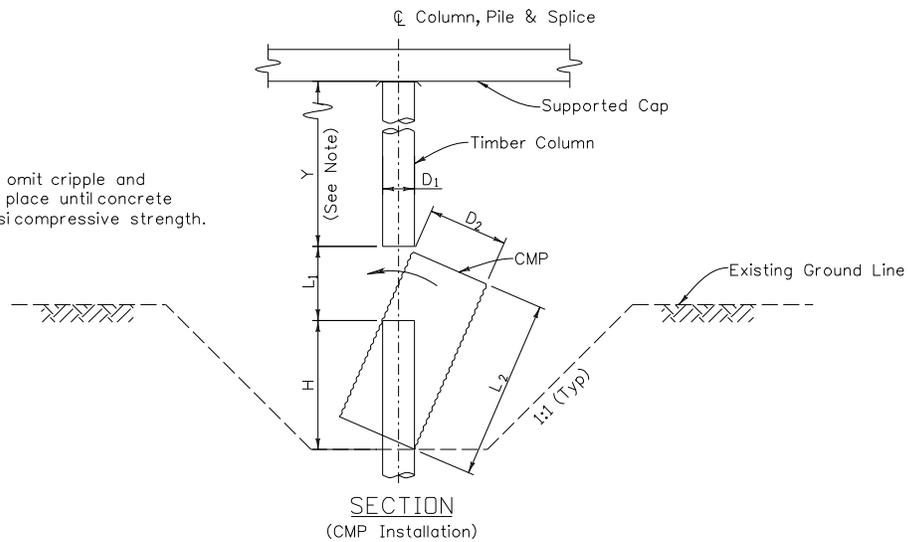


Fig. 16.12(G)-1 Sample Repair Detail for a Timber Pile/Column Repair



Fig. 16.12(G)-2 Photo of Timber Pile/Column Repair in progress

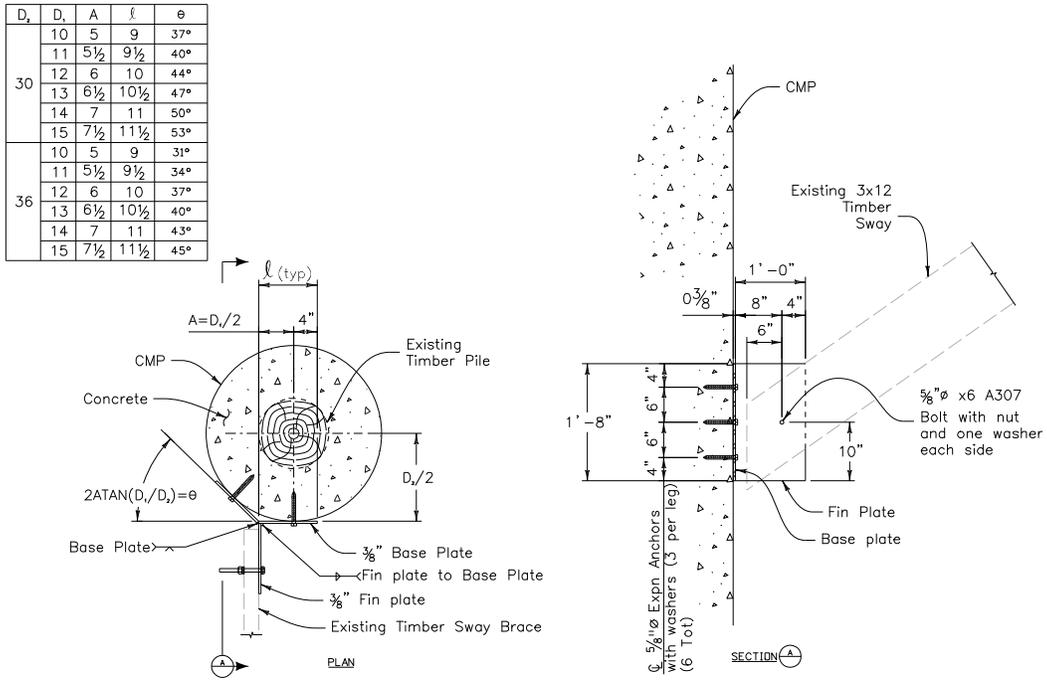


Fig. 16.12(G)-3 Sample Detail of Timber Pile Repair and Bracing



Fig. 16.12(G)-4 Photo of Timber Pile Repair and Bracing Connection

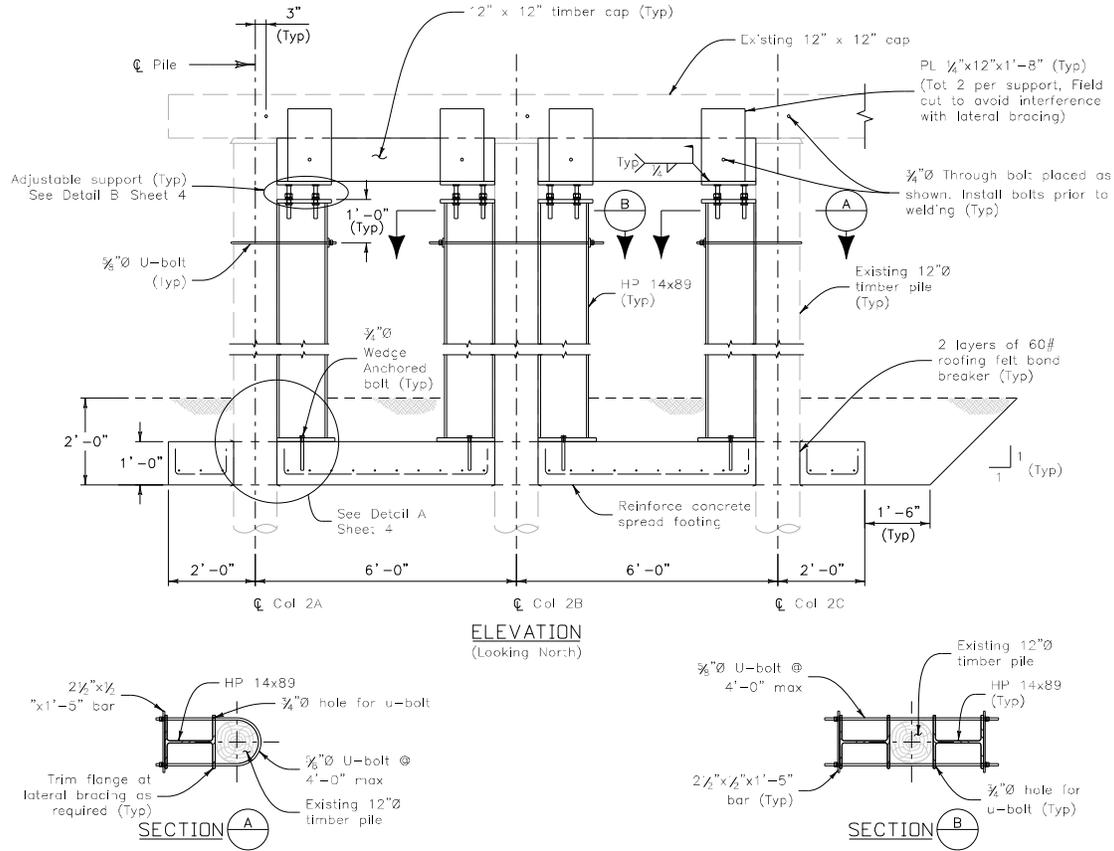


Fig. 16.12(G)-5 Sample of Adding Columns to a Pile



Fig. 16.12(G)-6 Photo of Adding Columns to a Pile

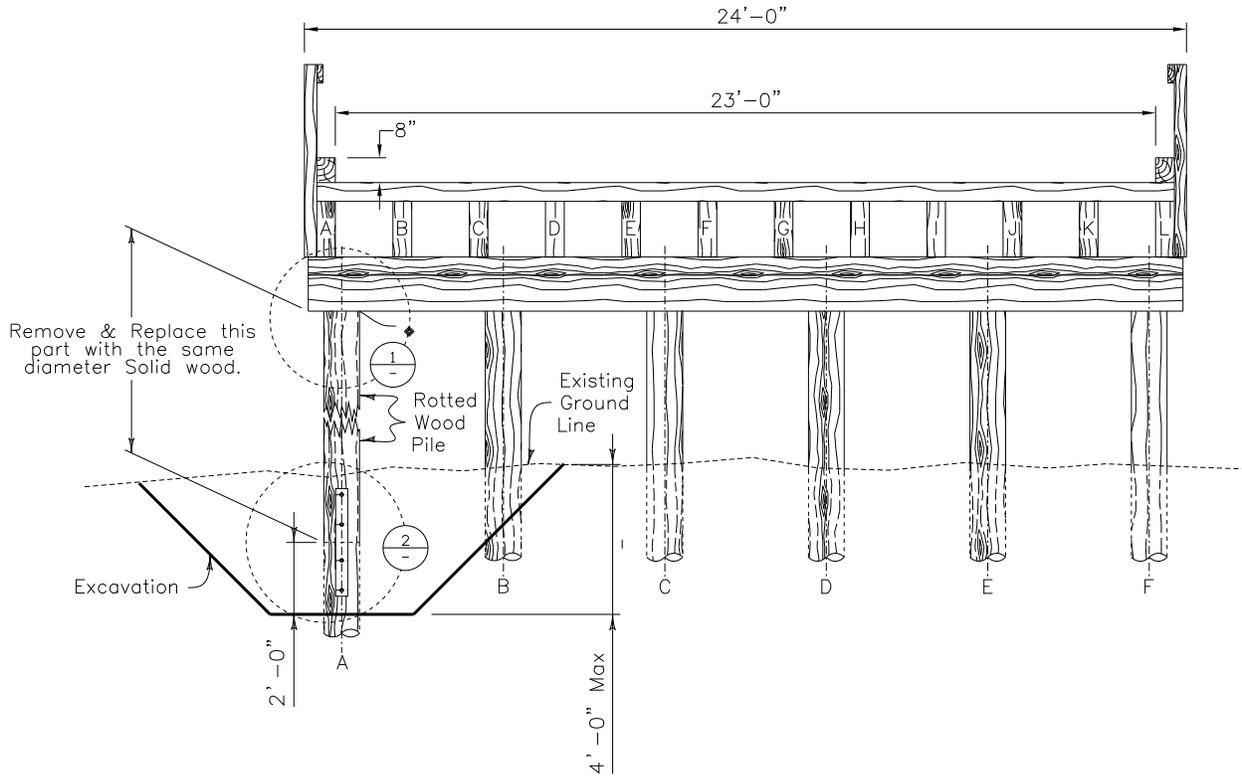


Fig. 16.12(G)-7 Sample Section of Replacing Portion of Timber Pile

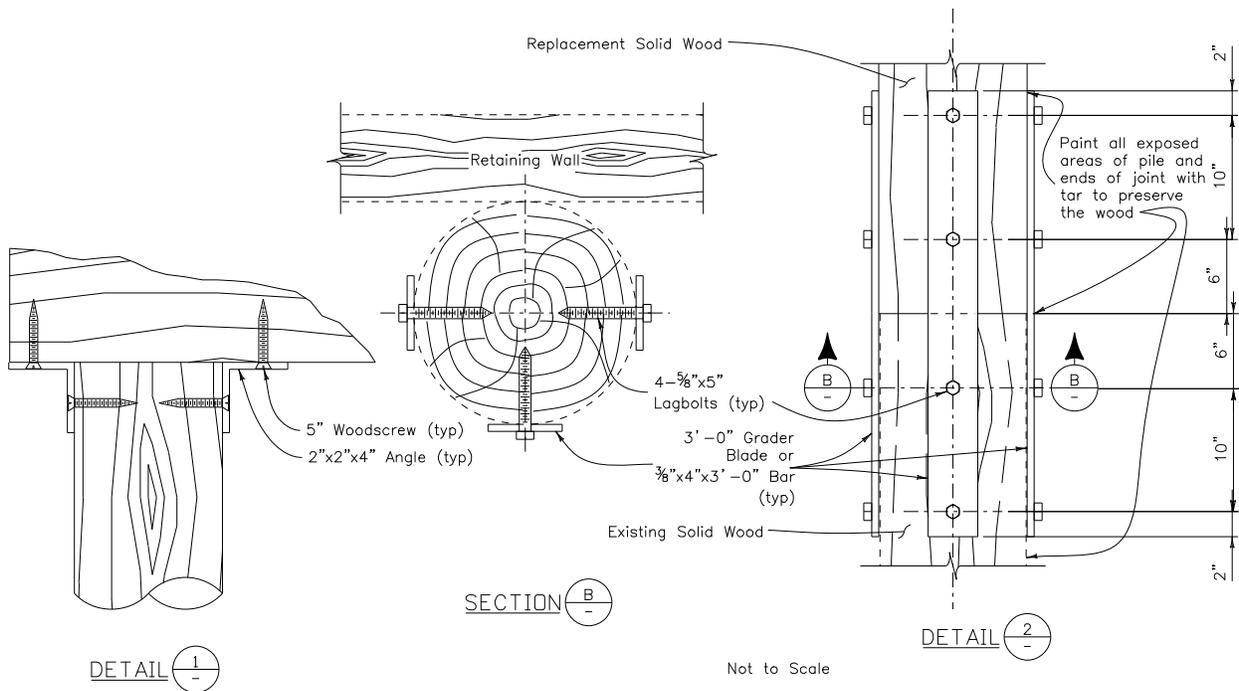


Fig. 16.12(G)-8 Sample Details of Replacing Portion of Timber Pile

H) **Timber Bridge Girder Repair** – Typically Bridge Girder repairs are necessary when girders split or have deficient ratings. Some repairs include bolting split girders (done in the past), adding new bents or adding additional girders. New bents may be of timber construction or steel construction.

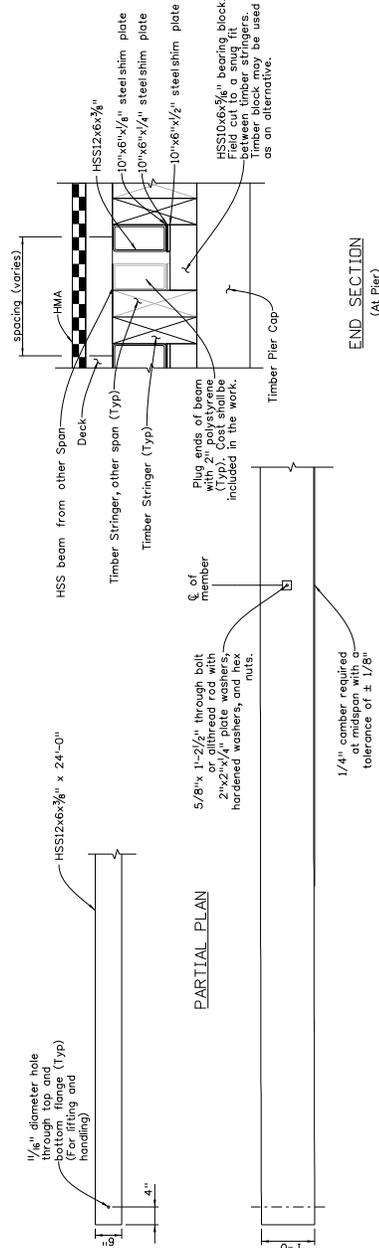
Check Items:

The following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. A field visit should be made prior to FOR to verify as-built locations and conflicts as well as to confirm applicability.

- 1) Location of damaged girders
- 2) Lag bolts in cracked stringer, attachment of snow plow or grader blades, false bents, etc. Lag bolting new damage is not recommended
- 3) Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
- 4) Work Description
- 5) Bridge Description

DESIGN DATA:
 AASHTO, Ninth Edition LRFD, 2020
 Design Method: Load and Resistance Factor Design (for sister beam)
 Live Load: HL-93 (design truck or tandem, and design lane load)
 Dead Load: Assumes 35 lbs. per sq. ft. for bridge deck overlay
 Structural Steel: AASHTO M570 Grade 50 (ASTM A500 Grade C)
 $f_y = 50,000$ psi

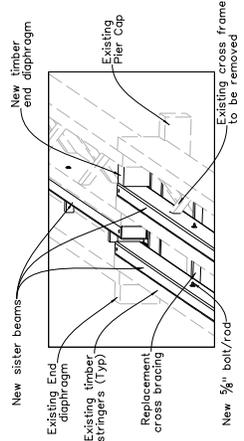
(Note to Designer & Detailer:
 This sheet is for a timber bridge with nominal span lengths of 23'.
 To change to a bridge with nominal span length of 19':
 -Change HSS12x6 $\frac{3}{8}$ " x 24'-0" to HSS10x4 $\frac{1}{2}$ " x 24'-0"
 -Change the HSS10x4 $\frac{1}{2}$ " bearing block to a HSS10x4 $\frac{1}{2}$ " in the End Section
 Change quantities for the information only to 112,24lbs. per beam.



CONSTRUCTION NOTES:

- Remove end diaphragm, lumber and cross bracing lumber.
- Place a steel member next to stringer 1C, 1F, 1G, 1H, 1L, 2C, 2F, 2J, 3C, 3F, and 3J.
- Place steel HSS10x4 $\frac{1}{2}$ " bearing block. Field cut to a snug fit between timber stringers. Add steel shims, and if needed, add additional 1/4" steel shims above the bearing block until the member is snug tight. Next, jack the ends of the steel member and place an additional 1/8" steel shim underneath the member at each end.
- Drill on 1/4" hole through the timber stringer at midspan and place the allthread rod through the steel member and timber stringer. Add plate washers, washers, and nuts. Tighten nuts to snug tight.
- Replace cross bracing with a nominal 4"x4" select structural No. 2 lumber horizontal diaphragm. Field cut to a snug fit between the timber stringers and connect to the timber stringers by toe nailing each end with two 30d nails or 4" deck screws.
- Replace end diaphragms. Field cut to a snug fit between the timber stringer and steel member, and connect to timber stringer with two 30d nails or 4" deck screws. The replacement of timber diaphragms are required at the Abutment. Replacement diaphragms may utilize existing material.

ISOMETRIC VIEW



PARTIAL ELEVATION

STEEL FABRICATION NOTES:

- HSS member shall be ASTM A500 Grade C.
- Member shall be shop bent to provide a 1/4" camber at midspan, with a tolerance of $\pm 1/8$ ".
- Drill holes at end of girder and at midspan prior to hot dip galvanizing.
- Member shall be hot dipped galvanized after fabrication.
- Plate washers shall be ASTM A36. Bolts shall be ASTM A325 and nuts shall be per ASTM A563. All threaded rod per ASTM F1554 grade 55 may be substituted for bolts. All material including bolts nuts and washers shall be galvanized. Zinc plated may be used in lieu of hot dipped galvanizing.

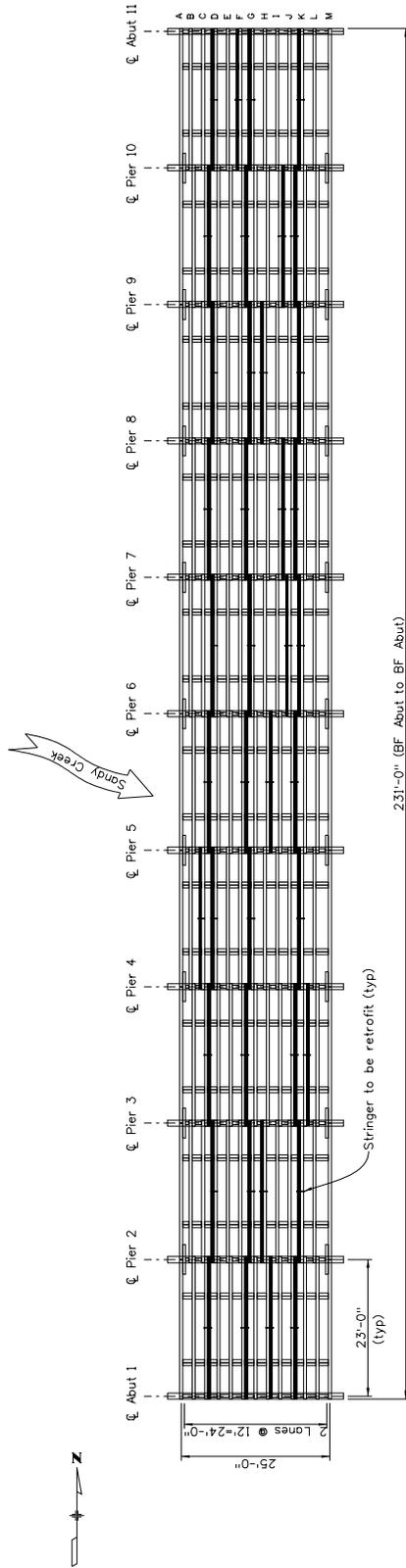
INFORMATION ONLY

DESCRIPTION	UNIT	PER BEAM
Structural Steel (Galvanized)	LB	1408

- Quantity includes sister beam, shims, 1"-3" bearing blocks, allthread rod, washers and hex nuts.

(Note to Designer & Detailer:
 This sheet is for timber bridges with two or more spans and a minimum stringer spacing of 2'-0". Note this sheet will need to be modified for timber bridges with concrete decks.
 To determine which stringers need a steel member, use the process below:
 1. Place a steel beam at stringers that have a current split or log screw repair.
 2. Place a steel beam at stringers that have a current split or log screw repair.
 3. Don't place a steel beam at the exterior two stringers on each side, even if there is a split or log screw repair. This avoids conflicts with the Type 10 roll, and is outside the wheel lines.

Fig. 16.12(H)-1 Current worksheet for Timber Girder repaired with Steel Sister Beam



PLAN VIEW

GENERAL NOTES:

All work shall be done in accordance with the Colorado Department of Transportation 2019 Standard Specifications for Road and Bridge Construction and the contract documents.

Unless otherwise noted, dimensions contained in these plans are calculated from the "As Constructed Plans." These dimensions may be adjusted to meet the existing structure. The Contractor shall verify all dependent dimensions in the field before ordering or fabricating any material.

All longitudinal and transverse dimensions are measured horizontally and include no correction for grade.

The Contractor shall be responsible for the stability of the structure during construction.

The Contractor is responsible for making his own determination as to the type and location of utilities as may be necessary to avoid damage thereto. The Contractor shall contact the Utility Notification Center of Colorado at 811 (1-800-922-1987) at least three business days (two full business days in advance not including the day of notification) prior to any excavation or other earthwork.

Existing log bolts to remain in place.

TABLE OF STEEL MEMBERS

Span	1	2	3	4	5	6	7	8	9	10
Girder	C	D	C	C	C	D	C	D	C	D
	F	G	F	D	F	G	F	G	F	G
	H	H	J	G	H	J	H	J	H	J
	J	K	K	K	J	K	J	K	J	K

SUMMARY OF APPROXIMATE QUANTITIES:

Item No.	Description	Unit	Structure B-26-F	Total
① 509-00001	Structural Steel (Galvanized)	LB	44350	44350

① Pay item 509-00001 Structural Steel (Galvanized) shall include removal and resetting of timber diaphragms. Cost of all thread rod, plate washer, washers, and nuts shall not be paid for separately but included in the cost of the work.

DESCRIPTION OF WORK:

Repair and Strengthen using steelHSS sections, and bolt to existing split timber stringer

Fig. 16.12(H)-2 Example of General Layout for a timber stringer repair project

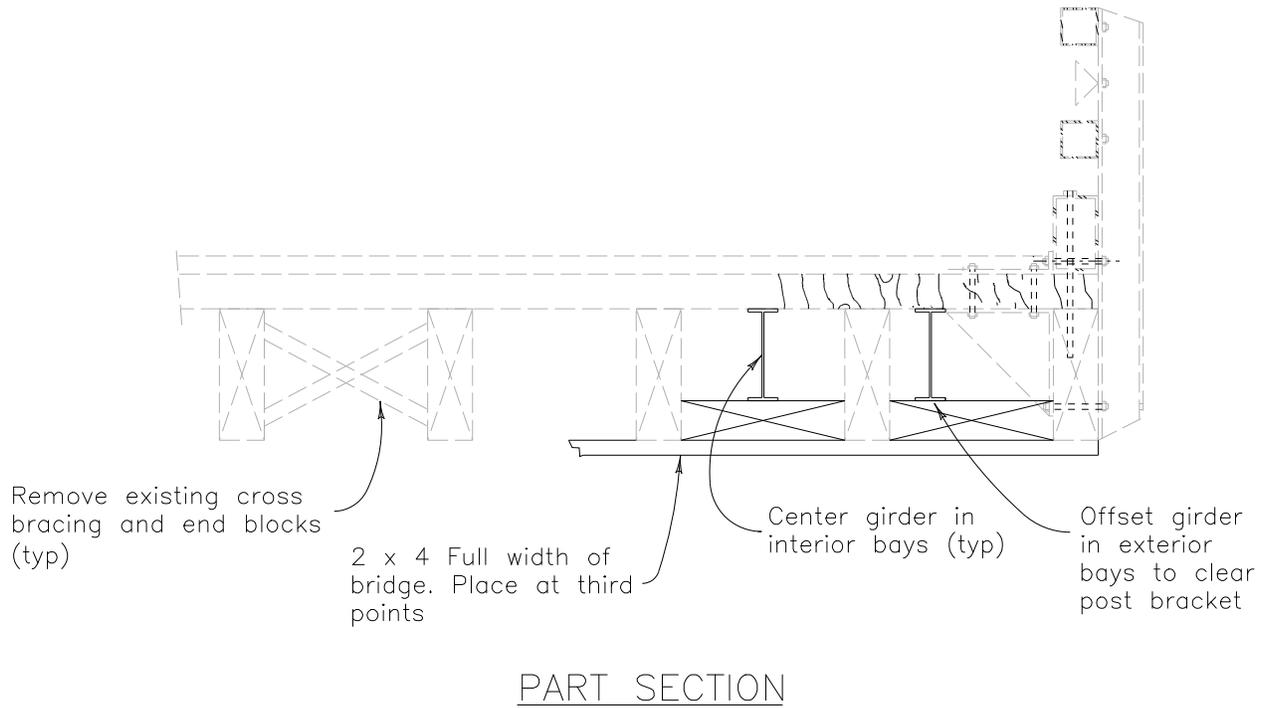


Fig. 16.12(H)-3 Sample Section of adding steel girders to a Timber Bridge



Fig. 16.12(H)-4 Photo of steel girders added to a Timber Bridge



Fig. 16.12(H)-5 Photo of Added Steel Girder and Grader Blade on Timber Girder

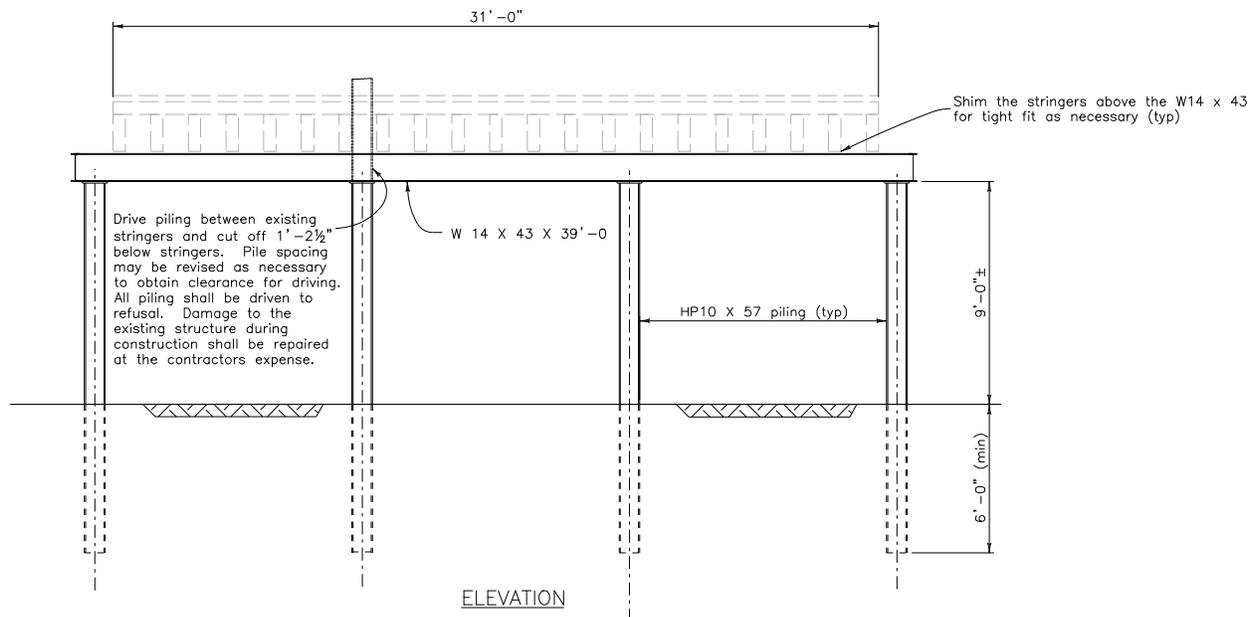


Fig. 16.12(H)-6 Sample Section showing additional Bents



Fig. 16.12(H)-7 Photo of New Support Bent near Abutment



Fig. 16.12(H)-8 Photo of New Support Bent at Midspan



Fig. 16.12(H)-9 Photo of New Timber Bent

- l) **Falsework** – Falsework may be required to support a bad deck or may be required to support a girder, etc. during repair work. A conceptual idea should be presented as a minimum.

Check Items:

The following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. A field visit should be made prior to FOR to verify as-built locations and conflicts. In addition, constructability and “fit” of supports will be checked.

- 1) Location, grade, size and spacing of timber or other material as required. Timber is typically used because of weight and availability issues
- 2) Provide typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
- 3) Work Description
- 4) Bridge Description
- 5) Construction details as required

Timber Notes:

All timber dimensions are nominal.

6"x6" Timber shall be #1 Southern Pine or better.

Other Timber shall be #2 Southern Pine or better.

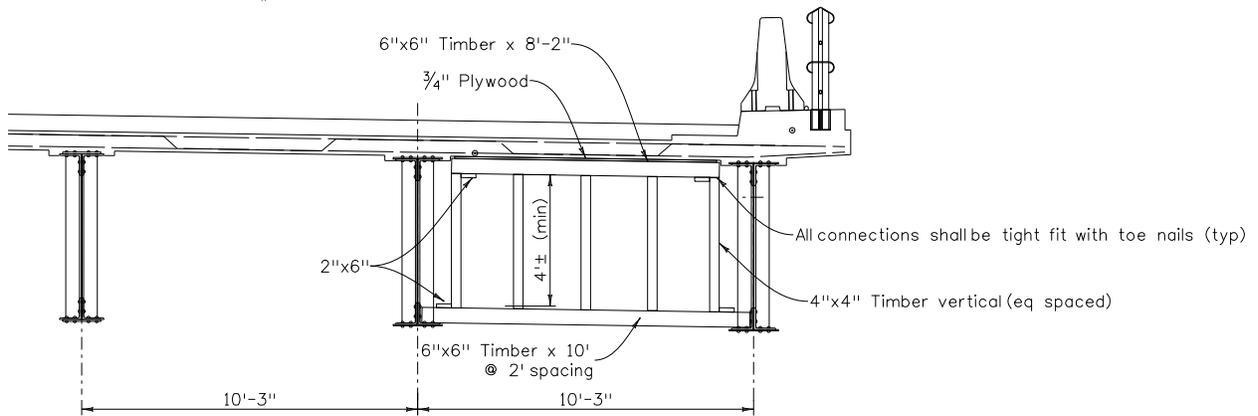


Fig. 16.12(I)-1 Sample Section of Falsework to support a deck



Fig. 16.12(I)-2 Photo of Deck Falsework



Fig. 16.12 (I)-3 Photo of Falsework to support a steel girder

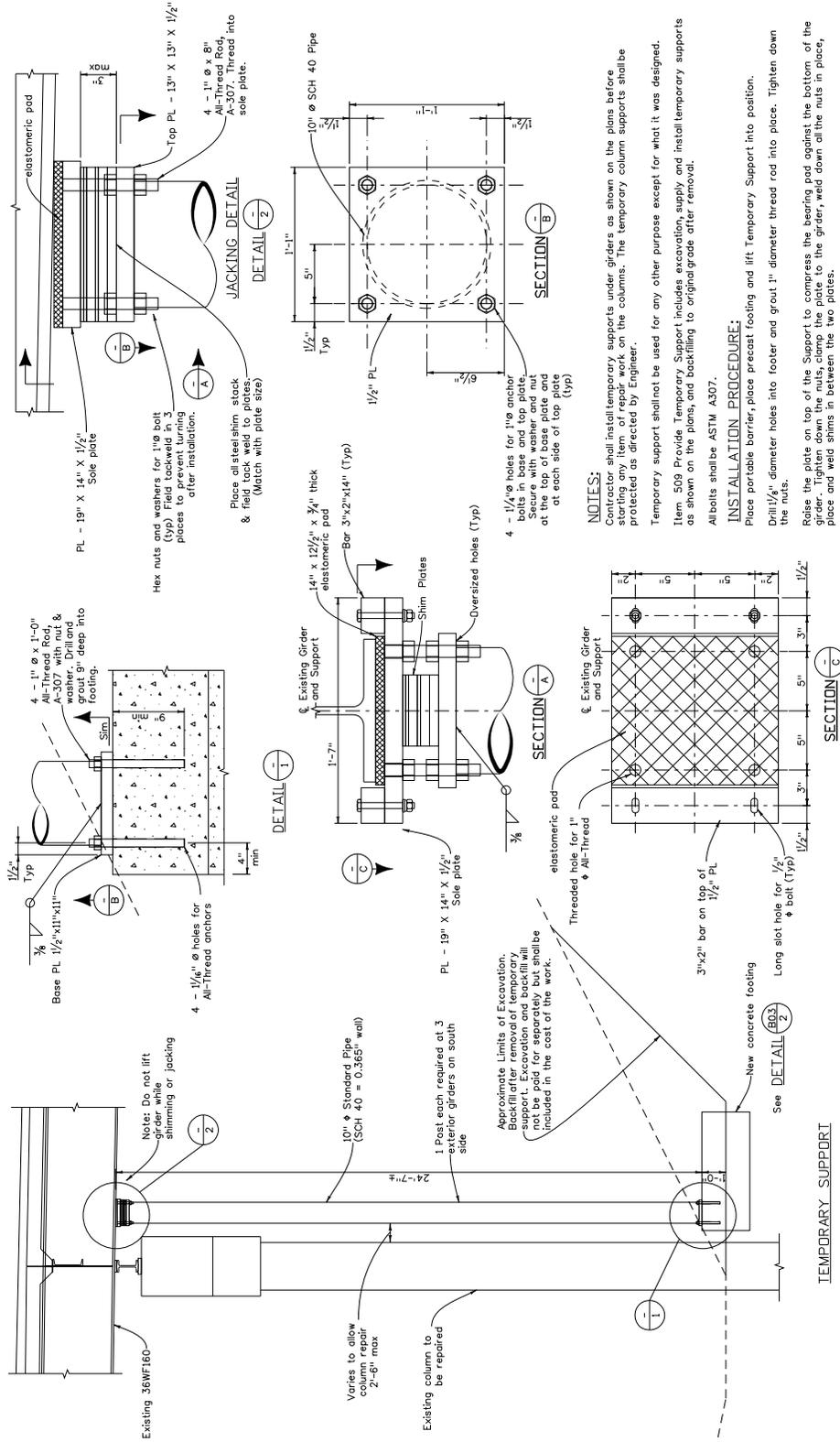


Fig. 16.12(I)-4 Sample Details for Falsework to Support a Steel Girder

J) **Wall Repair** – These repairs typically include the strengthening or repairing of existing walls where replacement is not practical.

Check Items:

The following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. A field visit should be made prior to FOR to verify as-built locations and conflicts. If the wall does not have a structure number, one shall be obtained from CDOT Bridge Asset Management.

- 1) Location and extent of repair
- 2) Utility conflicts, etc. that will affect the work
- 3) Phasing as required
- 4) Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, bridge constraints, etc.
- 5) Work Description and Construction Sequence
- 6) Bridge and/or Wall Description

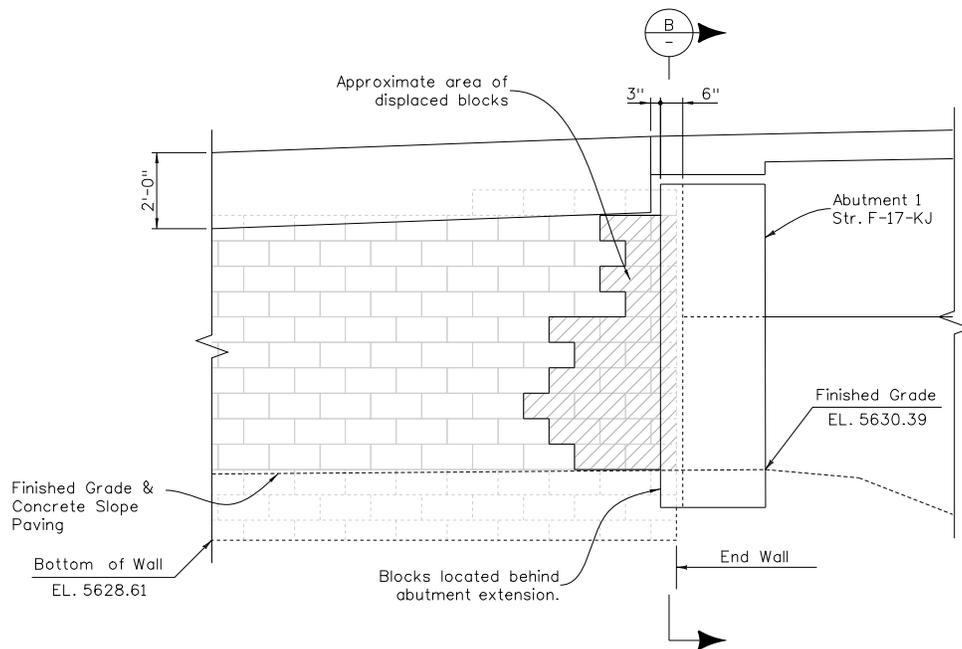


Fig. 16.12(J)-1 Sample Elevation of Area to be repaired on a MSE Wall

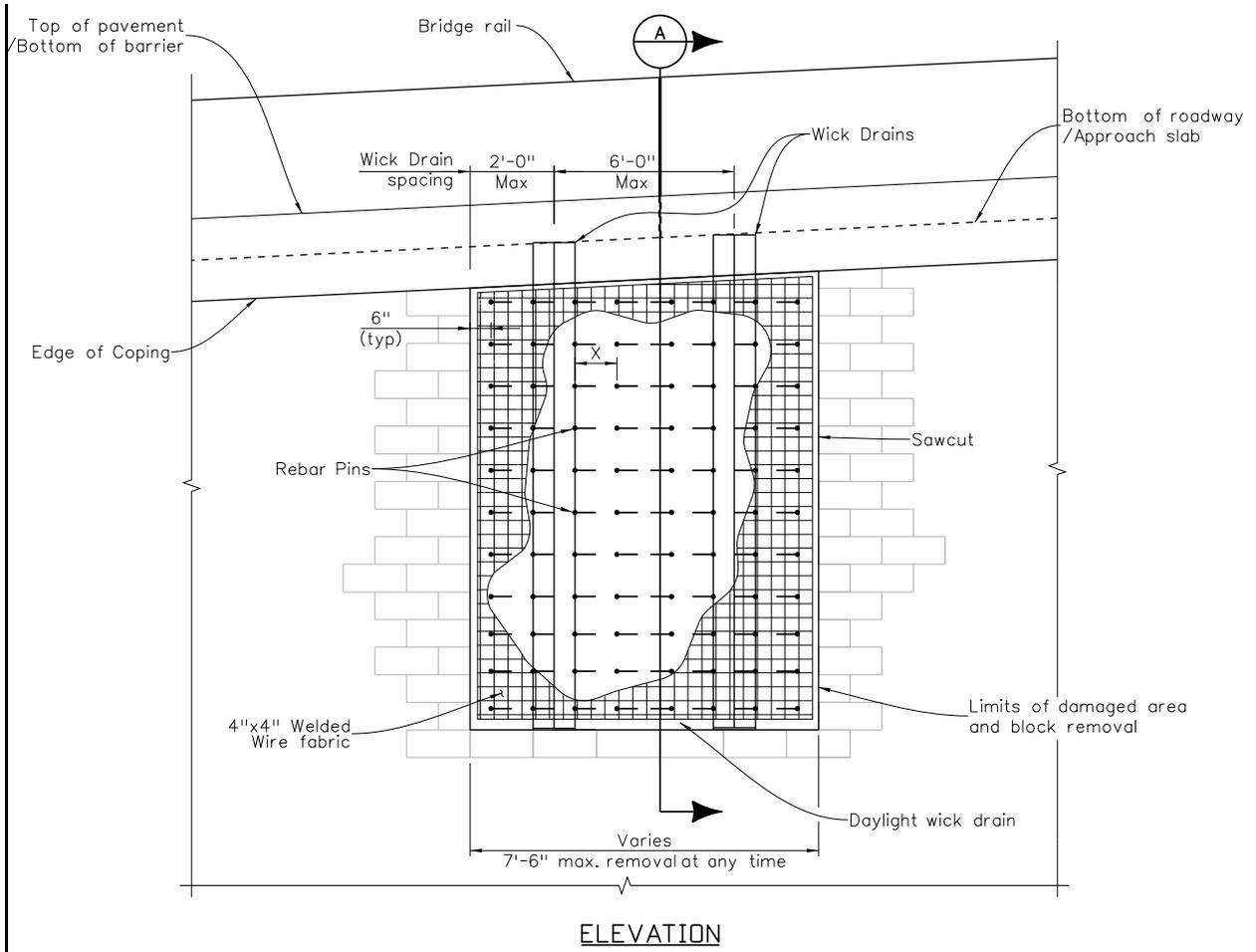


Fig. 16.12(J)-2 Sample Details on Block MSE Repair

LEGEND

-  Shotcrete wall
-  Polystyrene

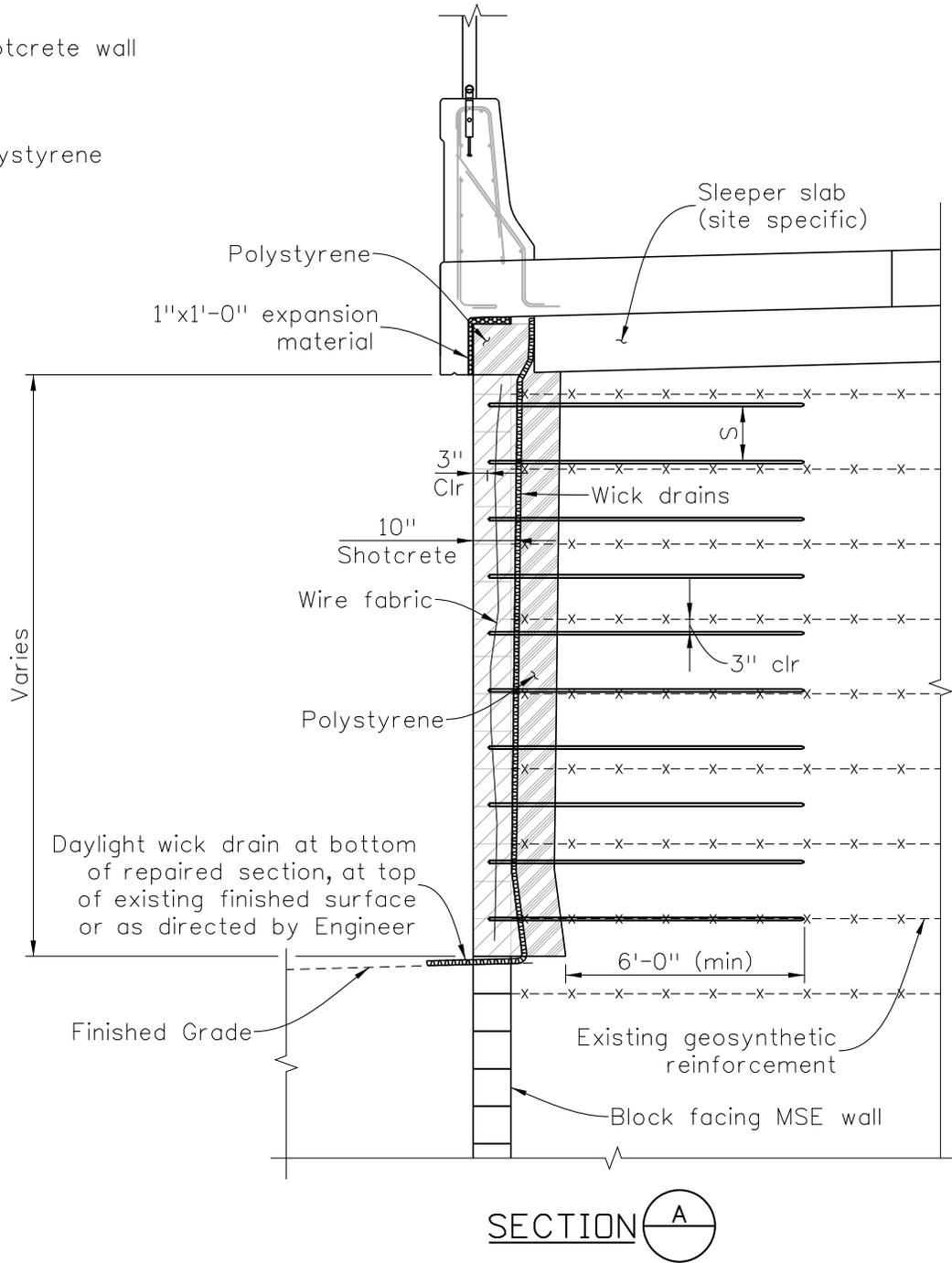


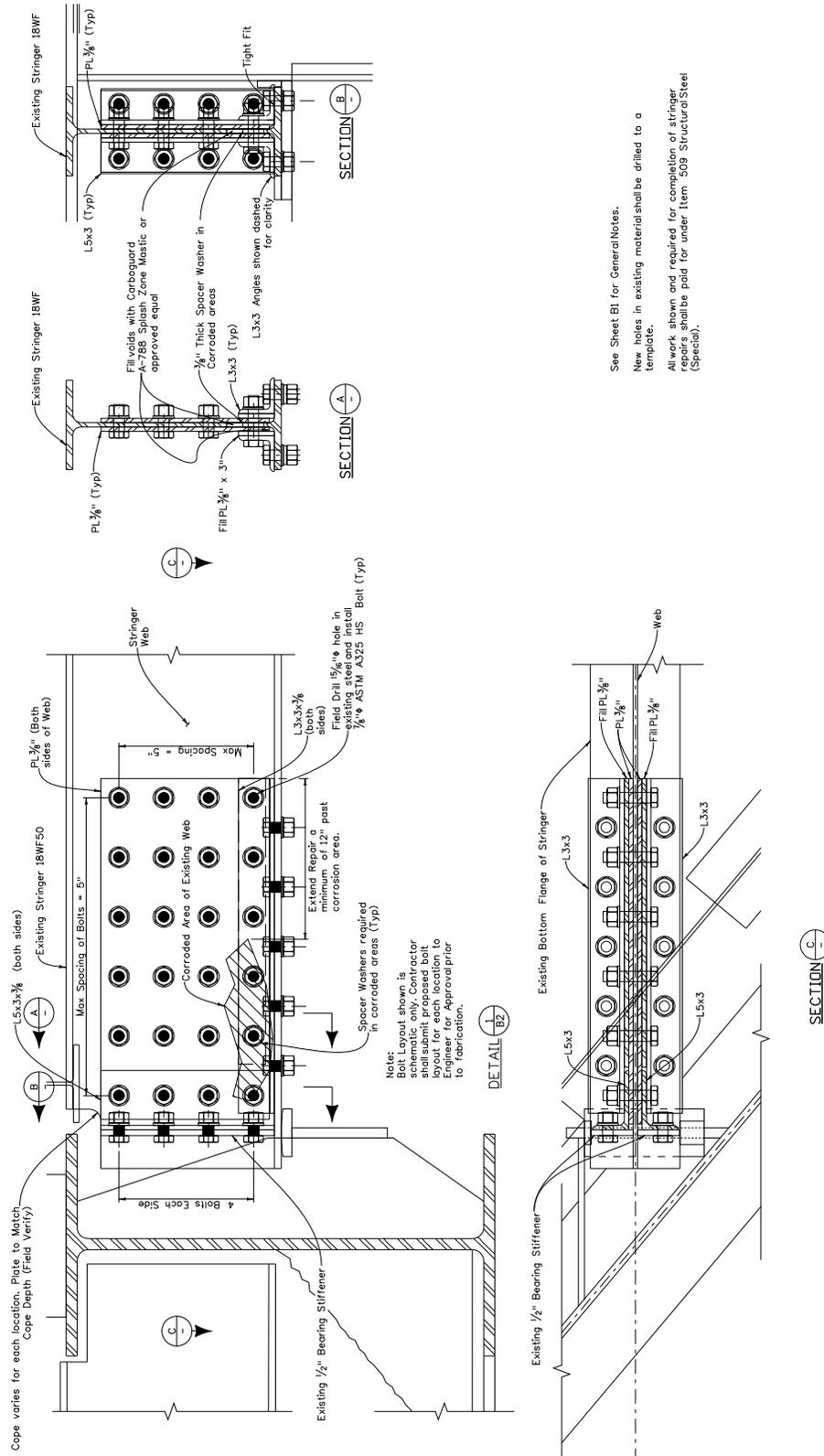
Fig. 16.12(J)-3 Sample Section for block MSE Repair

K) **Steel Corrosion/Fatigue Repair** – These repairs typically include adding additional steel plates or rewelding problem structures. Lead based paints or coatings should be addressed in the repair details. Provide appropriate specifications for dealing with the lead based coatings prior to the repair. Some repairs can be accomplished with a written description or welding procedure.

Check Items:

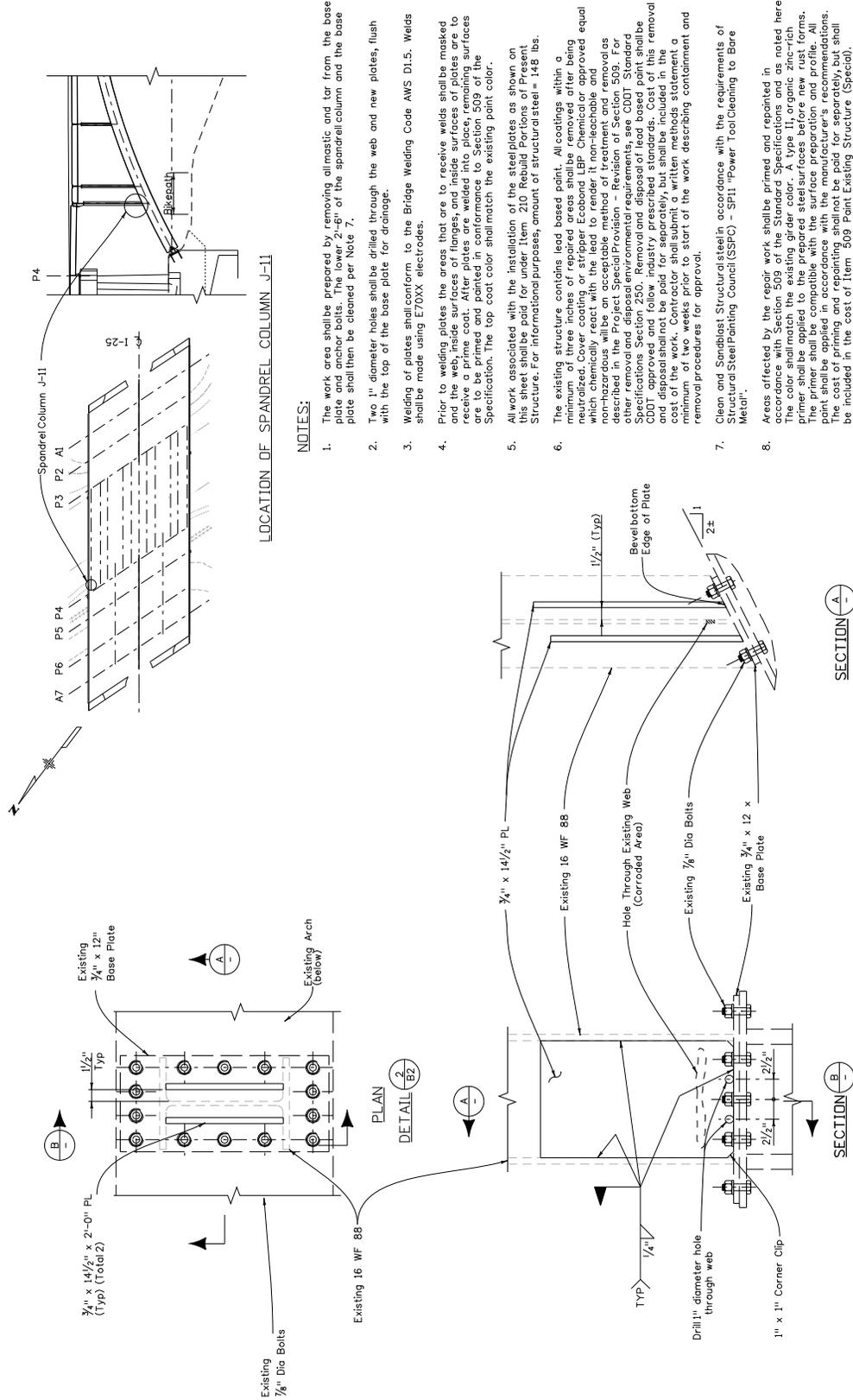
The following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. A field visit should be made prior to FOR to verify as-built locations and conflicts and to confirm applicability.

- 1) Location and extent of repair
- 2) Welding design and procedure per AWS D1.5 and/or D1.1
- 3) Location of damaged areas
- 4) Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, etc.
- 5) Specifications for Hazardous Coatings
- 6) Work Description
- 7) Bridge Description



See Sheet B1 for General Notes.
New holes in existing material shall be drilled to a template.
All work shown and required for completion of stringer repairs shall be paid for under Item 505 Structural Steel (Specify).

Fig. 16.12(K)-1 Sample Details for Adding Steel Plates to a Corroded Girder



LOCATION OF SPANDREL COLUMN J-11

NOTES:

1. The work area shall be prepared by removing all mastic and tar from the base plate and anchor bolts. The lower 2'-6" of the spandrel column and the base plate shall then be cleaned per Note 7.
2. Two 1" diameter holes shall be drilled through the web and new plates, flush with the top of the base plate for drainage.
3. Welding of plates shall conform to the Bridge Welding Code AWS D1.5. Welds shall be made using E70XX electrodes.
4. Prior to welding plates the areas that are to receive welds shall be masked and the web, inside surfaces of flanges, and inside surfaces of plates are to receive a prime coat. After plates are welded into place, remaining surfaces are to be primed and painted in conformance to Section 509 of the Specification. The top coat color shall match the existing paint color.
5. All work associated with the installation of the steel plates as shown on this sheet shall be paid for under Item 210 Rebuild Portions of Present Structure. For informational purposes, amount of structural steel = 148 lbs.
6. The existing structure contains lead based paint. All coatings within a 10' radius of the work area shall be removed by sandblasting and then be neutralized. Cover coating or stripper Ecobond LBP Chemical or approved equal which chemically react with the lead to render it non-leachable and non-hazardous will be an acceptable method of treatment and removal as described in the Project Special Provision - Revision of Section 509. For other removal and disposal environmental requirements, see CDDI - Standard Specifications for Bridge Structures, Appendix 100.01. The cost of this removal and disposal shall not be paid for separately, but shall be included in the cost of the work. Contractor shall submit a written methods statement a minimum of two weeks prior to start of the work describing containment and removal procedures for approval.
7. Clean and Sandblast Structural steel in accordance with the requirements of Structural Steel Painting Council (SSPC) - SP11 "Power Tool Cleaning to Bare Metal".
8. Areas affected by the repair work shall be primed and repainted in accordance with Section 509 of the Standard Specifications and as noted herein. The primer shall be applied to the prepared steel surfaces before new rust forms. The primer shall be compatible with the surface preparation and profile. All paint shall be applied in accordance with the manufacturer's recommendations. The cost of priming and repainting shall not be paid for separately, but shall be included in the cost of Item 509 Paint Existing Structure (Special).

Fig. 16.12(K)-2 Sample Details for Repairing/Strengthening a Corroded column

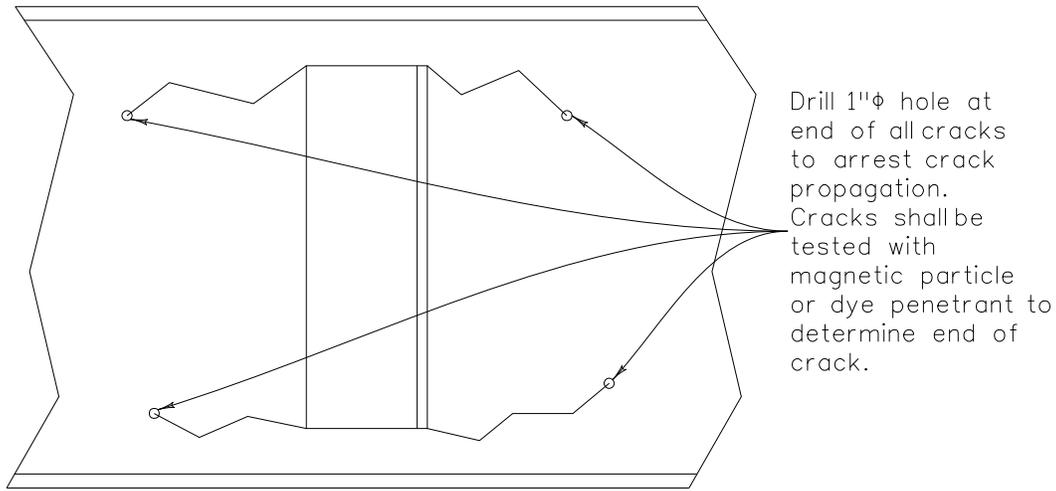


Fig. 16.12(K)-3 Sample Detail of Drilling Holes at the end of Fatigue Cracks

Repair procedure welding, testing, and inspection shall be in accordance with AWS D1.1. Welding shall be performed by a Certified Welder in accordance with AWS D1.1, and inspection performed by an AWS CWI (Certified Welding Inspector). An acceptance report shall be submitted by the CWI upon completion of the work.

Remove the weld cracks at the repair location by grinding. Test the affected area using Magnetic Particle (MT) to determine if any of the crack remains. If part of the crack is still present, excavate and repeat the MT testing until the crack is gone.

- (1) Prepare the base metal; grind the affected areas to be re-welded to bright sound metal, removing any zinc or paint coating.
- (2) If the pipe wall is penetrated, provide backing if possible.
- (3) Grind smooth any rough metal edges to be welded.
- (4) Preheat the base metal to a minimum of 100 degrees Fahrenheit.
- (5) The deposited fillet weld shall match the original fillet weld size.
- (6) Deposit filler metal per the attached W.P.S i7'CDOT 08-03, (Welding Procedure Specification).
- (7) Allow the repair weld and base metal to cool to ambient temperature.
- (8) Visually inspect the weld, and MT test.
- (9) Apply a zinc rich primer paint.

Fig. 16.12(K)-4 Sample Welding Repair Procedure

ANNEX E

AWS D1.1/D1.1M:2002

WELDING PROCEDURE SPECIFICATION (WPS) Yes
PREQUALIFIED QUALIFIED BY TESTING _____
or PROCEDURE QUALIFICATION RECORDS (PQR) Yes

Identification # CDOT 08-03
 Revision N/A Date 12/10/08 By M. STADIG
 Authorized by M. STADIG Date 12/10/08
 Type—Manual Semi-Automatic
 Machine Automatic

Company Name C.D.O.T.
 Welding Process(es) SMAW
 Supporting PQR No.(s) N/A

JOINT DESIGN USED
 Type: CORNER
 Single Double Weld
 Backing: Yes No
 Backing Material: _____
 Root Opening _____ Root Face Dimension _____
 Groove Angle: _____ Radius (J-U) _____
 Back Gouging: Yes No Method _____

BASE METALS
 Material Spec. ASTM A709-36
 Type or Grade 36
 Thickness: Groove _____ Fillet 1/2"
 Diameter (Pipe) _____

FILLER METALS
 AWS Specification A5.1
 AWS Classification E7018

SHIELDING
 Flux Gas _____
 Composition _____
 Electrode-Flux (Class) _____ Flow Rate _____
 Gas Cup Size _____

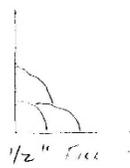
PREHEAT
 Preheat Temp., Min 100° MINIMUM
 Interpass Temp., Min 150° Max 460°

POSITION
 Position of Groove: _____ Fillet: 3F
 Vertical Progression: Up Down

ELECTRICAL CHARACTERISTICS
SMAW
 Transfer Mode (GMAW) Short-Circuiting N/A
 Globular Spray
 Current: AC DCEP DCEN Pulsed
 Other _____
 Tungsten Electrode (GTAW) _____
 Size: N/A
 Type: _____

TECHNIQUE
 Stringer or Weave Bead: STRINGER
 Multi-pass or Single Pass (per side) _____
 Number of Electrodes 1
 Electrode Spacing N/A Longitudinal _____
 Lateral _____
 Angle _____
 Contact Tube to Work Distance N/A
 Peening _____
 Interpass Cleaning: GRINDER, HAMMER, WIRE BRUSH
 POSTWELD HEAT TREATMENT N/A
 Temp. _____
 Time _____

WELDING PROCEDURE

Pass or Weld Layer(s)	Process	Filler Metals		Current		Volts	Travel Speed	Joint Details
		Class	Diam.	Type & Polarity	Amps or Wire Feed Speed			
<u>> 5/16"</u> <u>MULTI-PASS</u>	<u>SMAW</u>	<u>E7018</u>	<u>1/8"</u>	<u>DC</u>	<u>140-220</u>	<u>20-25</u>	<u>N/A</u>	

Form E-1 (Front)

Fig. 16.12(K)-5 Sample of Welding Repair Information

- L) **Culvert Repair** – These repairs typically include the strengthening or repairing of existing culverts where replacement is not practical.

Check Items:

The following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. A field visit should be made prior to FOR to verify as-built locations and conflicts.

- 1) Location and extent of repair, utility conflicts, etc. that will affect the work
- 2) Typical section, elevation and pertinent details (flow direction, etc.)
- 3) Work Description and Construction Sequence
- 4) Culvert Description

INDEX OF DRAWINGS

B01. General Information, Summary of Quantities, Repair Details

SUMMARY OF QUANTITIES

ITEM NO.	DESCRIPTION	UNITS	Q25A145120BL Bottom slab
202-00453	Removal of Portions of Present Structure (Class 2)	SY	417
211-03005	Dewatering	LS	1
601-03000	Concrete Class D	CY	104
602-00210	Welded Wire Fabric	SY	373

GENERAL NOTES

- The work on this sheet repairs the eroded bottom slab of this CBC.
- Others will be providing plans to extend this box on both ends to correct the erosion problems.
- All longitudinal and transversal dimensions are measured horizontally and include no correction for grade.
- Welded wire fabric (WWF) shall conform to ASTM A185 with $f_y = 65,000$ psi. It shall be provided in 13'-6" by 3'-8" sheets and shall be galvanized after being cut to size.
- Concrete shall be Class D with $f_c = 4,500$ psi.

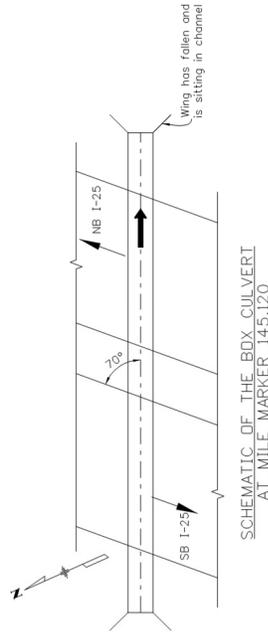
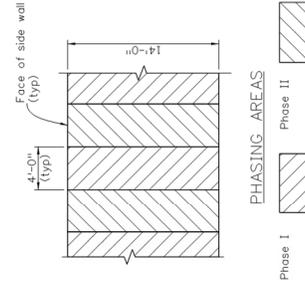
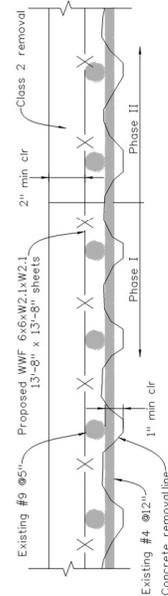


PHOTO 1 - Concrete Class 2 removal and replacement



BRIDGE DESCRIPTION:

Single Concrete Box Culvert (14'-0" x 12'-0" x 268'-0") built in 1959 with over 10' of fill cover; carries I-25 over unnamed drainage; 186.5' Roadway, 20° skew.

WORK DESCRIPTION:

The bottom slab of the box culvert must be dry and sediment free before work begins. The contractor shall provide sand bags to block the normal flow and a pipe to convey the water through the culvert during the work. The pipe shall be placed in the culvert from the upstream side. The contractor shall patch the bottom slab to allow the removal and patching work to be done. Pipe and all anchors shall be removed from the culvert sidewall at the completion of the work. Holes from anchors shall be patched.

Saw cut from wall to wall to a depth of 3/4" minimum at a spacing of 4'-0". Cut locations may be adjusted to avoid damaging reinforcing steel.

Perform Class 2 Removal on the 4'-0" wide Phase 1 areas. Removal of Portions of Present Structure (Class 2) shall consist of removing concrete from the top slab and bottom slab. The contractor shall remove the concrete directed by the Engineer. Class 2 removal shall begin at the surface of the existing concrete and extend to sound concrete, but not less than 1 inch below the top transverse reinforcing steel.

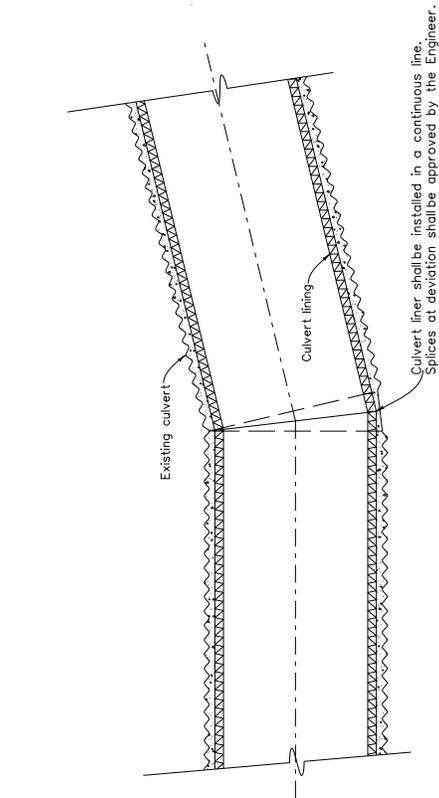
Pneumatic hammers heavier than nominal 15 lb. class shall not be used in removing concrete from the bottom slab. Pneumatic chipping tools shall not be used on the surface of the slab. Such tools may be started in the vertical position but must be immediately tilted to 60° operating angle. Care shall be taken so as not to fracture sound concrete below the top main reinforcing. Hand tools such as un-banded concrete. Only short, one-handed hammers with a maximum head weight of 5 pounds will be allowed. Any bars damaged by the Contractor's operations shall be repaired or replaced at the Contractor's expense. Payment shall be made under Removal of Portions of Present Structure (Class 2, Square Yards).

Following the Class 2 concrete removal, all exposed reinforcing steel shall be cleaned to sound steel by sandblasting. Sound steel is defined as free of oil, dirt, concrete fragments, or laitance, loose rust scale, and other coatings of any character that would destroy or inhibit the bond with the new concrete. Concrete shall be sandblasted at the Contractor's expense. Sandblasting reinforcing steel will not be measured and paid for separately, but it shall be included in the cost of the work.

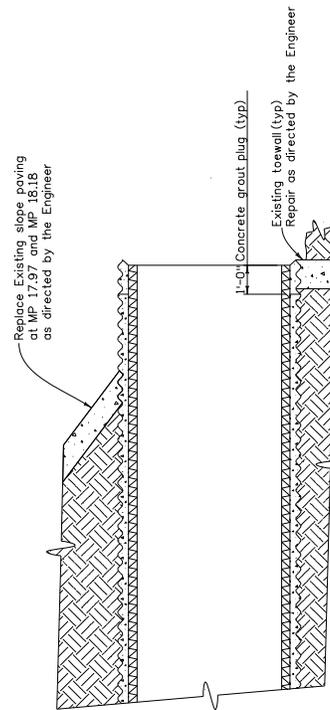
All removed concrete, sandblasting sludge, water and any other construction debris shall be collected and disposed of off-site in accordance with all applicable Federal, State and Local Regulations at no additional cost to the project. Under no circumstances shall such materials be allowed to enter any natural or man-made waterway or storm drain. The cost of removing debris shall be included in the work.

Form edges of Phase 1 pour. Place galvanized welded wire fabric (WWF) sheets flush with the existing reinforcing steelmat and tie securely in place. Pour Concrete Class D in Phase 1 areas. Clearance over welded wire fabric shall be 2". Remove forms.

Repeat these steps for Phase 2 areas. Phase 2 areas need not be formed but can use the Phase 1 areas to control edges and finished surface grade.



SECTION
SITES "A" AND "B"

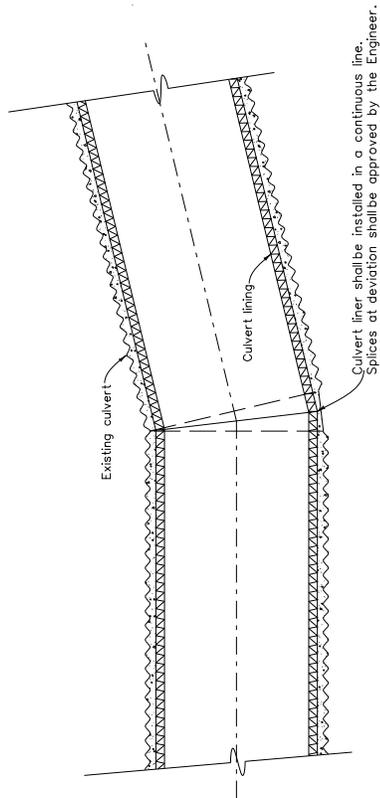


EXISTING TOEWALL (TYP.)
REPAIR AS DIRECTED BY THE ENGINEER

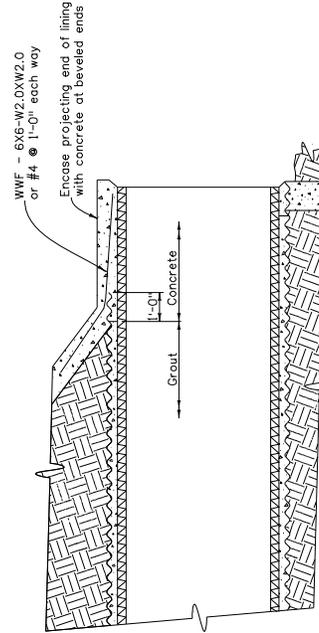
CONCRETE GROUT PLUG (TYP.)

SECTION
SITES "A" AND "B"

Fig. 16.12(L)-2 Sample Details for Repairing a circular culvert by slip-lining



BEND DETAIL
SITE "A"



SITE "A" ● MP 17.97
SITE "B" ● MP 18.18

M) **Bearing Replacement** – These repairs typically include the details required for replacement of pot or other style bearings.

Check Items:

The following is a list of information to be shown on the drawings, as applicable. Additional information may be shown as required. A field visit should be made prior to FOR to verify as-built locations and conflicts.

- 1) Location and extent of repair
- 2) Utility conflicts, etc. that will affect the work
- 3) Typical section, bridge elevation and pier sections and details to depict access and construction restrictions such as high water level, traffic, bridge constraints, etc.
- 4) Work description and construction sequence
- 5) Jacking requirements and restrictions
- 6) Limiting dimensions for new bearing (individual existing dimensions may not need to be matched, provide minimum dimensions available as needed to meet the design requirements). These should be field verified by Designer or Contractor.
- 7) Information required for the replacement of the existing bearing, such as: existing bearing rotation/position, movement, sole plate slope (if any), if the existing anchor rods / grout pad / sole plate will be replaced

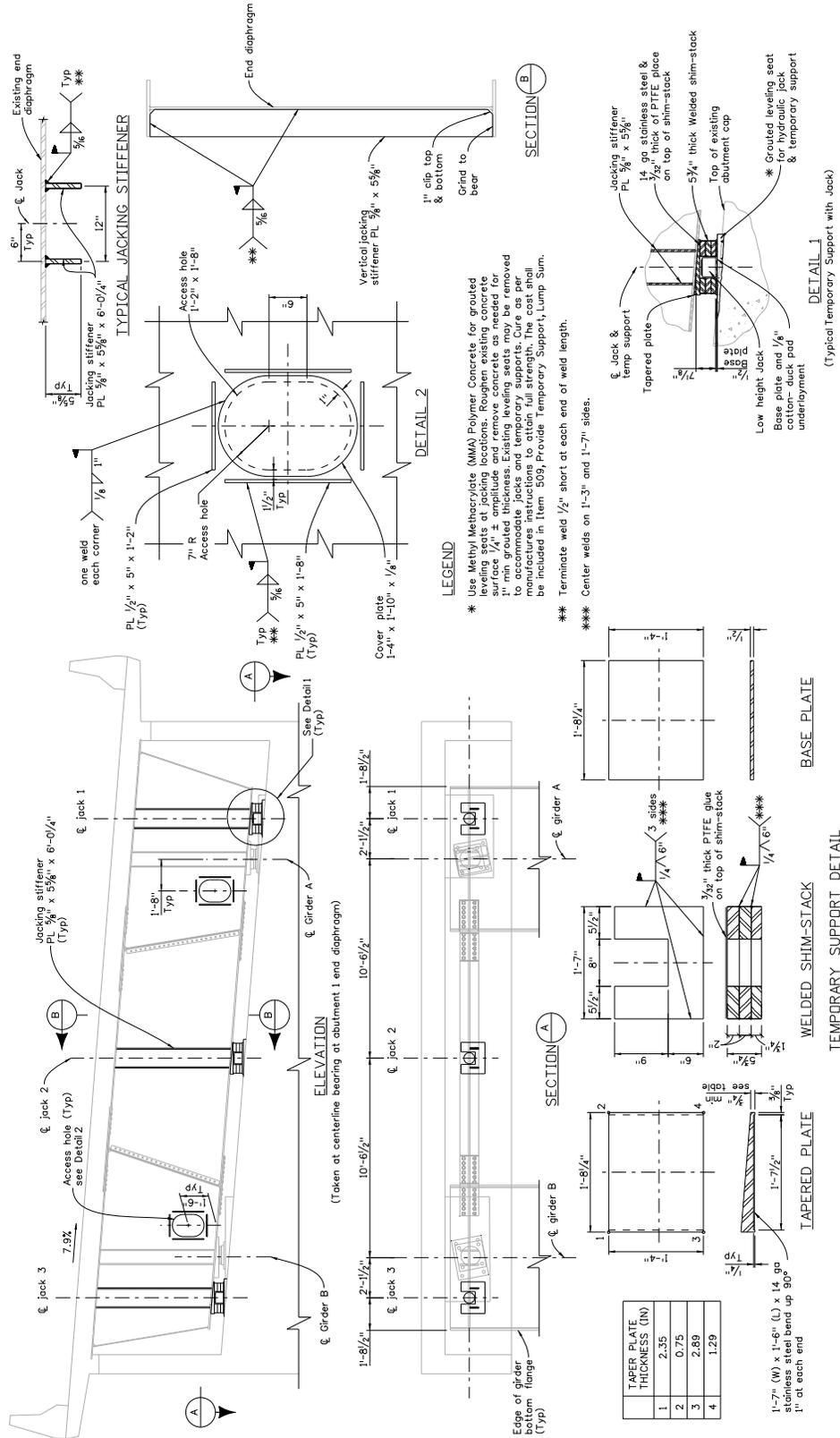
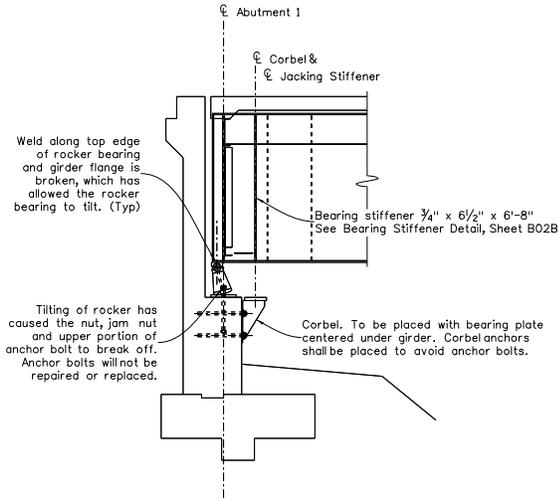
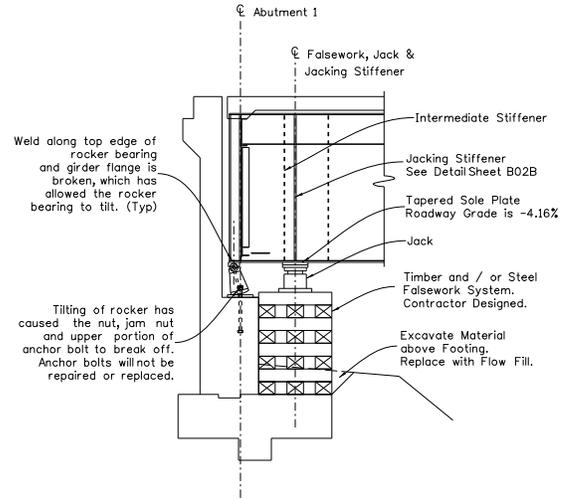


Fig. 16.12(M)-2 Sample Temporary Support Details for Bearing replacement



TYPICAL SECTION - OPTION 1
Existing condition of rocker bearing shown.



TYPICAL SECTION - OPTION 2
Existing condition of rocker bearing shown.

Fig. 16.12(M)-4 Sample Details for Jacking and Bearing Resetting

