C12 Bridge and culvert repair

C12.1.6 Field exams

2011 ~ Pedestrian and Bicyclist Access During Repair Projects
Unless a bridge can be closed during a repair project, vehicular access on the bridge must be maintained, but the bridge repair designer also needs to consider the needs of other users, including pedestrians and bicyclists on bridges with existing sidewalks, bicycle lanes, or shared use paths. For pedestrian and bicyclist access the designer cannot use the suggested temporary barrier rail layouts given in the Bridge and Culvert Repair section commentary [BDM C12.1.8.3] when developing a traffic control plan and should consult with the Office of Design and, in complex situations, also with the Office of Traffic and Safety. Along with pedestrian access the designer will need to address Americans with Disabilities Act (ADA) requirements. Although the Office of Design intends to consider all users and ADA when developing traffic control plans for work zones [OD DM 9A-1 and 9A-5] the bridge repair designer needs to be aware of the issues and consult with the Office of Design as soon as possible in special situations.

C12.1.8 Staging

C12.1.8.2 Construction considerations
1998 ~ Finishing machine dimensions for overlay and barrier rail

BASIC SCREED 3605 mm (11'-10") SORCED + 50 mm (2") END CAP + 50 mm (2") END CAP = 3605 mm (11'-10")
Screed + Stroke = 3705 mm (12'-2")
Span = Rail to Rail = 415 mm (13'-5") FRAME CAN BE TELESCOPED OUT 95 mm (3'-1") EITHER END,
OVERALL = 4445 mm (14'-7")
CONSTR. JOIINT 375 mm (12'-1")
OUT OF MACHINE
150 mm (5") trim
260 mm (8'-6")
165 mm (5'-5")
3605 mm (11'-10")
50 mm (2") OSCILLATION
50 mm (2") OSCILLATION
260 mm (8'-6")
165 mm (5'-5")
OUT OF MACHINE
150 mm (5") TRIM
260 mm (8'-6")
165 mm (5'-5")
3605 mm (11'-10")
260 mm (8'-6")
165 mm (5'-5")
415 mm (13'-5") SPAN
415 mm (13'-5") SPAN

BASIC SCREED EXTENSION UP TO 1830 mm (6'-0") EITHER END (3660 mm (12'-0") FOR BOTH ENDS),
Screed Extension Units of 260 mm (8'-6"), 460 mm (1'-6"), 610 mm (2'-0"), 815 mm (2'-8")
AND 1300 mm (4'-3")
Frame span can be telescoped out to 5465 mm (17'-10") in increments of 75 mm (3")
Frame extensions in 50 mm (2") increments are available.
2 workers one day to disassemble and reassemble frame.
Considering trim either side, 96" construction lane = 70"0 mm (23'-0")
GOMACO machine has similar arrangements and limitations.
C12.1.8.3 Temporary barrier rail

2011 ~ Pedestrian and Bicyclist Access During Repair Projects

Unless a bridge can be closed during a repair project, vehicular access on the bridge must be maintained, but the bridge repair designer also needs to consider the needs of other users, including pedestrians and bicyclists on bridges with existing sidewalks, bicycle lanes, or shared use paths. For pedestrian and bicyclist access the designer cannot use the suggested temporary barrier rail layouts given in the Bridge and Culvert Repair section commentary [BDM C12.1.8.3] when developing a traffic control plan and should consult with the Office of Design and, in complex situations, also with the Office of Traffic and Safety. Along with pedestrian access the designer will need to address Americans with Disabilities Act (ADA) requirements. Although the Office of Design intends to consider all users and ADA when developing traffic control plans for work zones [OD DM 9A-1 and 9A-5] the bridge repair designer needs to be aware of the issues and consult with the Office of Design as soon as possible in special situations.

1998 ~ Example TBR layouts
Figure note: All cases illustrated above require special signing because the roadway width is less than 14.50 feet between barriers. If the lane width is less than 10.50 feet the Office of Traffic and Safety also will need to review the TBR design. See the manual text [BDM 12.1.8.3].

C12.1.9.2 Retrofit

C12.1.9.2.1 Doweled bars

Prior to 25 August 1993 ~ Iowa DOT Pullout Test Results

Plain and epoxy coated No.6 rebars were installed in 7/8" diameter holes in 4000 psi concrete at 4-inch and 6-inch depths, and pull-out loads were determined after a seven day epoxy cure. Results are as follows:

<table>
<thead>
<tr>
<th>4-inch embedment depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar type</td>
</tr>
</tbody>
</table>

January 2019
### Test results

<table>
<thead>
<tr>
<th></th>
<th>Plain No. 6</th>
<th>Epoxy-coated No. 6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test result</strong></td>
<td>20,000 lb</td>
<td>16,000 lb</td>
</tr>
<tr>
<td><strong>Average test result</strong></td>
<td>20,000 lb</td>
<td>14,975 lb</td>
</tr>
<tr>
<td><strong>With factor of safety of 4</strong></td>
<td>5,000 lb</td>
<td>3,744 lb</td>
</tr>
</tbody>
</table>

### 6-inch embedment depth

<table>
<thead>
<tr>
<th>Bar type</th>
<th>Plain No. 6</th>
<th>Epoxy-coated No. 6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test result</strong></td>
<td>15,100 lb</td>
<td>12,750 lb</td>
</tr>
<tr>
<td></td>
<td>11,000 lb</td>
<td>10,100 lb</td>
</tr>
<tr>
<td><strong>Average test result</strong></td>
<td>15,100 lb</td>
<td>11,312 lb</td>
</tr>
<tr>
<td><strong>With factor of safety of 4</strong></td>
<td>3,775 lb</td>
<td>2,828 lb</td>
</tr>
</tbody>
</table>

### C12.1.9.2.2 TL-4 barrier rails

### C12.1.9.2.2.2 End sections

#### May 2013 ~ Sloped transitions for rigid barrier rail

The following information is from University of Nebraska via the Office of Design.

When transitioning the height of a rigid barrier, a taper rate of 10:1 is preferred. Where a more aggressive rate is needed, apply the following:

- Where the height of the lower barrier is less than 32 inches, use a maximum taper rate of 8:1.
- Where the height of the lower barrier is 32 inches or greater, use a maximum taper rate of 6:1.

### C12.1.9.4.2 Decks

#### 2011 ~ Deck replacement

As the inventory of Iowa bridges ages, a deck overlay is not always sufficient for repair of a deteriorated deck, and the deck may need to be replaced. Generally deck replacements are the responsibility of final design, but the preliminary designer needs to be involved in projects that include significant bridge widening. There have been problems with deck replacement projects when bridges settled in service. Without surveys of the existing decks, the project plans showed deck elevations that would have resulted in very thick decks. Therefore the final designer needs to request a deck survey and base the deck elevations on the survey rather than on the original bridge plans.

A second issue with deck replacements is the resistance of existing angle-plus-bar shear lugs that were used in composite steel beam-deck design from about 1947 to about 1970. The ultimate strength (nominal resistance) of those lugs can be determined approximately from a modified AASHTO Standard Specifications channel connector formula. The formula is mentioned (but not given) in Part I of the final report for Iowa Highway Research Board project HR-238 and is as follows:

\[ S_u = (550) (1.5 t) (W) (f'_c)^{0.5} \]

- \( S_u \) = ultimate strength (nominal resistance), pounds
- \( t \) = angle thickness, inches
- \( W \) = angle width perpendicular to centerline of beam, inches
- \( f'_c \) = 28-day strength of concrete in the new deck, psi

Shear resistance may be augmented with new shear studs if the existing angle-plus-bar lugs are insufficient based on design computations.
In addition, because the existing lugs and top flanges may be damaged during deck removal, there should be a field inspection to determine damage to the lugs and flanges. Any cracks in lugs above tension flanges need to be ground out so that cracks do not progress into the flanges. Also, gouges, nicks, and cuts in the tension flanges need to be repaired. After all damage has been addressed new shear studs need to be added to replace any shear resistance lost due to damage and repair of damage.

There is no specific information available for fatigue resistance of angle-plus-bar shear lugs.

During design the designer also needs to address potential lateral buckling of steel beams in superstructures with integral abutments. During service conditions the closely spaced shear connections to the deck prevent lateral buckling of beams in compression but, when the deck is removed, the lateral support is widely spaced at diaphragms only. In another state, the summer sun increased temperature in the steel beams, the beams expanded, pushed against the integral abutments, were unable to move the abutments back into the approach fills, and buckled laterally between diaphragms.


http://www.iowadot.gov/operationsresearch/reports/reports_pdf/hr_and_tr/reports/HR-238.pdf)

C12.1.9.5.2 Cleaning and painting

1 November 2005 ~ Removal of Hazardous Paint (Comments regarding EPA number from Brad Azeltine, Office of Location and Environment, edited and added 27 December 2005)

Brad Azeltine’s clarification on the timing of obtaining the EPA ID number: We need to wait until the painting contractor has generated some blast waste so it can be sampled and analyzed before we request a generator ID number from EPA (to confirm we have a hazardous waste). We also need the contractor to provide the quantity of waste expected to be generated, the estimated time period of the waste generation, and the expected number and timing of waste shipments. In other words, we typically won't have an ID number until the work is actually in progress. However, this is a moot point for those bridges that already have an EPA ID number (e.g. US20 J.D. Bridge, Allamakee IA9 over the Mississippi, Pottawattamie I-80 over the Missouri, etc.) In those cases, the ID number could be placed on the plans.)

C12.1.11 Concept statements

16 March 2007 ~ Concept Repair
The bridge on <Route> over <Route, River, RR, etc.> has been <scheduled or programmed> for <an overlay or a repair> to be let on <letting date>. <It is currently not in the five year program.> The <estimated or programmed> cost estimate is <estimated or programmed cost estimate>. I inspected the bridge on <Date> with <Bridge employees, other than yourself> of the Office of Bridges and Structures, and <Other personnel>, <Position> of <Office or consultant>.

EXISTING CONDITIONS

<Description of Bridge condition found from maint. report and inspection. Mention only conditions needing attention. Include rail type.>

<Description of Approach type and condition from maint. report, include guardrail type>

RECOMMENDATIONS

It is recommended that the following repairs be made:

1. <Be specific, a plan will be prepared based on this information>

2. Traffic control will involve <TBR, Shoulder strengthening, traffic signals, floodlighting, etc.>

The District should provide a site survey of the utilities.

All recipients of this letter should review this concept of work to be accomplished and advise the Office of Bridges and Structures of any comments you have by <Date(approx. 3 weeks from date sent)>. After this time period, the concept will be considered approved or will be revised according to concerns.

Estimated cost of repairs is as follows:
<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>UNIT</th>
<th>RATE</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removal of Existing PC Overlay</td>
<td>1002 sy</td>
<td>$10</td>
<td>$10,020</td>
</tr>
<tr>
<td>Bridge Floor Overlay</td>
<td>1002 sy</td>
<td>$50</td>
<td>$50,100</td>
</tr>
<tr>
<td>Class A Bridge Floor Repair</td>
<td>26 sy</td>
<td>$100</td>
<td>$2,600</td>
</tr>
<tr>
<td>Removals (joint and rails)</td>
<td>1 LS</td>
<td>$10,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>Retrofit Concrete Barrier Rail</td>
<td>670 ft</td>
<td>$40</td>
<td>$26,800</td>
</tr>
<tr>
<td>Concrete Repair (abut. footing, curb)</td>
<td>5 sf</td>
<td>$1000</td>
<td>$5,000</td>
</tr>
<tr>
<td>Steel Extrusion Joint with Neoprene</td>
<td>82 ft</td>
<td>$100</td>
<td>$8,200</td>
</tr>
<tr>
<td>Structural Concrete (joint repair)</td>
<td>10 cy</td>
<td>$500</td>
<td>$5,000</td>
</tr>
<tr>
<td>Flowable Mortar and Earth Fill</td>
<td>1 LS</td>
<td>$2,000</td>
<td>$2,000</td>
</tr>
<tr>
<td>Removal of Approach Pavement</td>
<td>136 sy</td>
<td>$85</td>
<td>$11,560</td>
</tr>
<tr>
<td>Guardrail</td>
<td>250 ft</td>
<td>$16</td>
<td>$4,000</td>
</tr>
<tr>
<td>RE-76 End Sections</td>
<td>4 ea</td>
<td>$1,000</td>
<td>$4,000</td>
</tr>
<tr>
<td>Temporary Flood Lighting</td>
<td>2 ea</td>
<td>$1,580</td>
<td>$3,160</td>
</tr>
<tr>
<td>Temporary Traffic Signals</td>
<td>2 ea</td>
<td>$7,250</td>
<td>$14,500</td>
</tr>
<tr>
<td>TBR</td>
<td>1250 ft</td>
<td>$15</td>
<td>$18,750</td>
</tr>
<tr>
<td>Traffic Control</td>
<td>1 LS</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>Mobilization &amp; Contingencies (15%)</td>
<td>1 LS</td>
<td>$24,000</td>
<td>$24,000</td>
</tr>
</tbody>
</table>

TOTAL $205,234

<Bridge Design Engineer's Initials(CAPITALS)>/baj
cc:  <District Engineer>, <District>
     <Asst. District Engineer>, <District>
     <District Construction Engineer>, <District>
     <District Operations Manager>, District Operations Manager, <City>
     <Bridge Crew Leader>, Bridge Crew Leader, <District>
     M. Kennerly, Design
     <Design Section Leader>, Design
     J. Ranney, Program Management
     M. Swenson, Project Scheduling
     J. Smith, Contracts
     K. Mahoney, Highway Division
     M. Dillavou, Engineering Bureau
     D. Newell, Location and Environment
     B. Brakke
     N. McDonald
     G. Novey
     <Bridge Design Section Leader>
     W. Sunday, Construction

File
Add to cc: if on Interstate:
   C. Monk, FHWA
Add to cc: if RR is involved:
   S. Banks, Rail Transportation
Add to cc: if consultant project:
   <Consultant contact>, <Consultant>
   R. Meyer
Note: Place a copy in the File envelope.

**C12.1.12.1 Drawings**

**29 September 1997 ~ CADD Users Guidelines for CADD Delamtect Sheet**

Please have CADD users follow these guidelines when preparing the CADD delamtect sheet for deck repairs to provide consistency.

1. If there are additional spalls sent in from the field (hand drawn areas) these will need to be added to the delamtect sheet. These areas should be added in CADD, on level 2 with the appropriate line weight, color and drawn with the shape command with the fill turned off.

2. A text line stating the total area of these additional spalls should be added under the text line given for the delamtect area. No adjustment will be made for overlapping areas.

Note: The delamtect areas are on level 3 with a color of red. In the event that additional repair areas need to be added to the delamtect plot, the delamtect areas can be shut off when adding the additional repair areas.

The delamtect files will be named h______.dec initially. The file extension should be changed by the user to an ".S??" extension as appropriate.