C12 Bridge and culvert repair

C12.1.6 Field exams

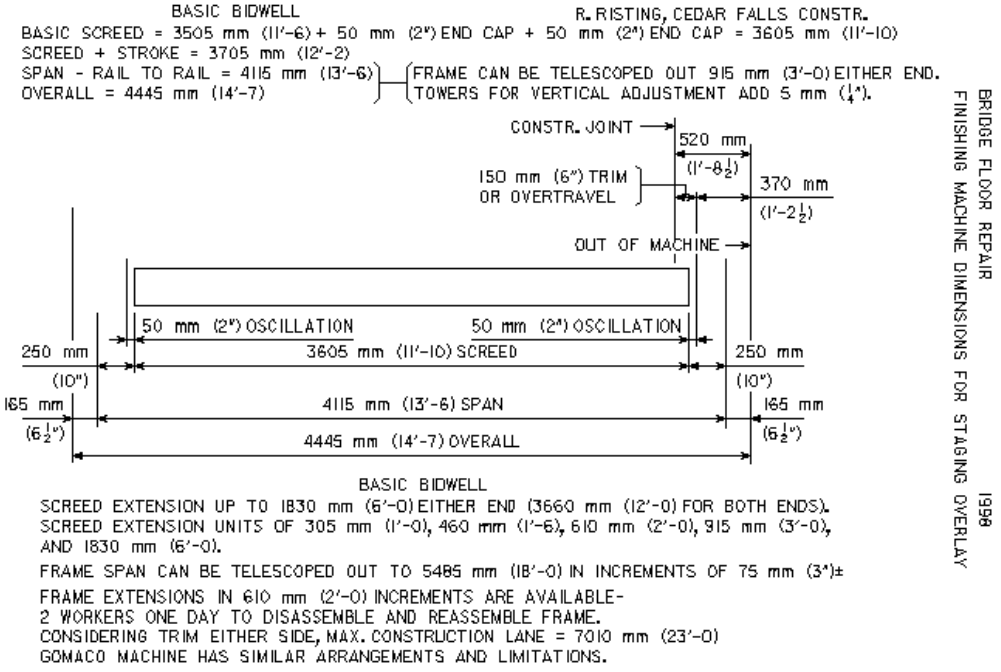
2011 ~ Pedestrian and Bicyclist Access During Repair Projects

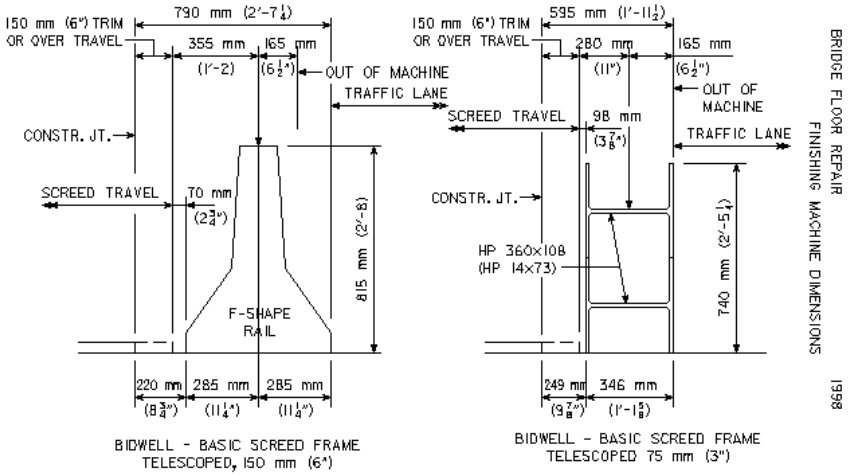
Unless a bridge can be closed during a repair project, vehicular access on the bridge must be maintained, but the bridge repair designer also needs to consider the needs of other users, including pedestrians and bicyclists on bridges with existing sidewalks, bicycle lanes, or shared use paths. For pedestrian 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 Design Bureau and, in complex situations, also with the Traffic and Safety Bureau. Along with pedestrian access the designer will need to address Americans with Disabilities Act (ADA) requirements. Although the Design Bureau intends to consider all users and ADA when developing traffic control plans for work zones [DB DM 9A-1 and 9A-5] the bridge repair designer needs to be aware of the issues and consult with the Design Bureau 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





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 Design Bureau and, in complex situations, also with the Traffic and Safety Bureau. Along with pedestrian access the designer will need to address Americans with Disabilities Act (ADA) requirements. Although the Design Bureau intends to consider all users and ADA when developing traffic control plans for work zones [DB DM 9A-1 and 9A-5] the bridge repair designer needs to be aware of the issues and consult with the Design Bureau as soon as possible in special situations.

1998 ~ Example TBR layouts

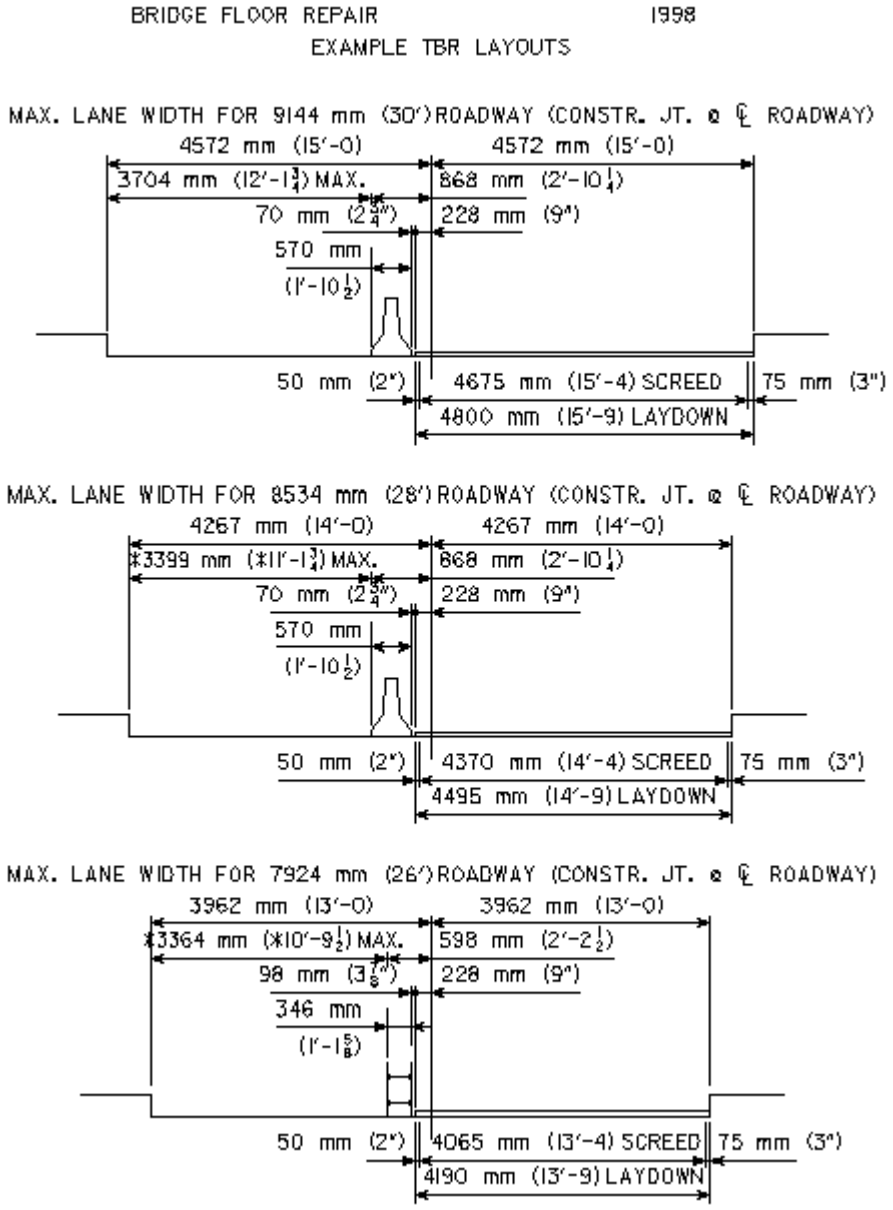


Figure note: All cases illustrated above require special signing because the roadway width is less than 14.50 feet between barriers. If the lane width is less than 10.50 feet the Traffic and Safety Bureau also will need to review the TBR design. See the manual text [BDM 12.1.8.3].

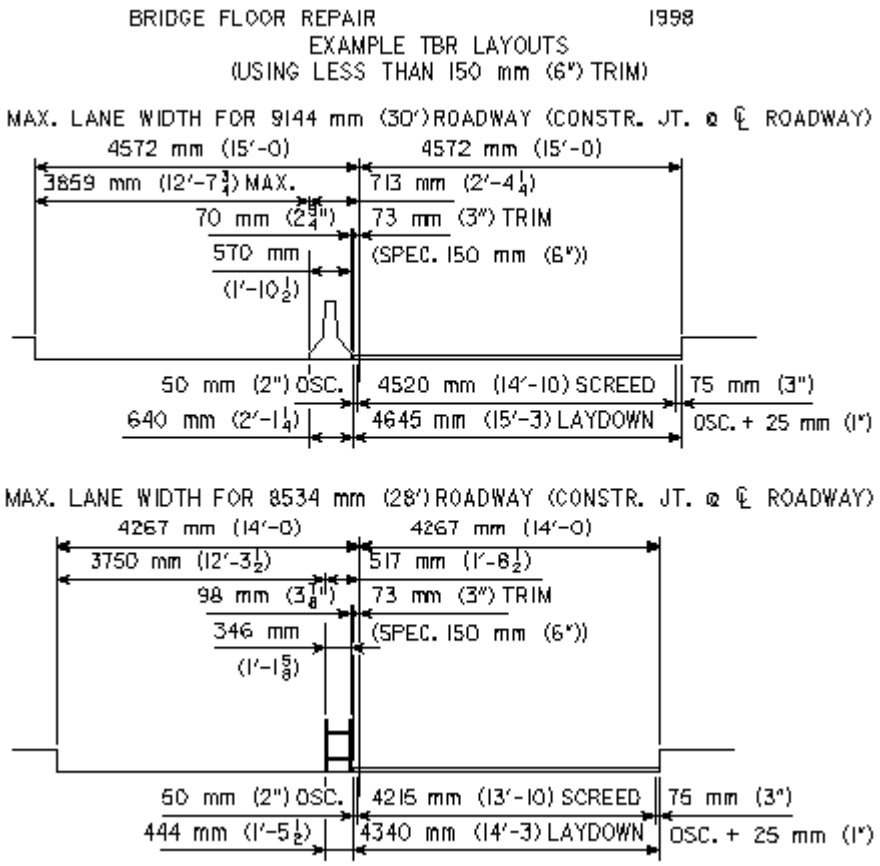


Figure notes: When less trim is used than required by the Standard Specifications, include deck repair note E432 [BDM 13.5.2]. Reduce trim only when needed to maximize roadway width.

All cases illustrated above require special signing because the roadway width is less than 14.50 feet between barriers. If the width is less than 10.50 feet the Traffic and Safety Bureau also will need to review the TBR design. See the manual text [BDM 12.8.1.3].

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:

4-inch embedment depth

Bar type	Plain No. 6	Epoxy-coated No. 6

Test result	15,100 lb	12,750 lb
		11,000 lb
		10,100 lb
Average test result	15,100 lb	11,312 lb
With factor of safety of 4	3,775 lb	2,828 lb

6-inch embedment depth

Bar type	Plain No. 6	Epoxy-coated No. 6
Test result	20,000 lb	16,000 lb
		15,750 lb
		13,150 lb
Average test result	20,000 lb	14,975 lb
With factor of safety of 4	5,000 lb	3,744 lb

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 Design Bureau.

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.

Reference: Klaiber, F.W., D.J. Dedic, K.F. Dunker, and W.W. Sanders, Jr. (1983). *Strengthening of Existing Single Span Steel Beam and Concrete Deck Bridges, Final Report Part I.* Engineering Research Institute, Iowa State University, Ames, Iowa. (Available on the Iowa DOT web site at:

https://iowadot.gov/research/reports/Year/2003andolder/fullreports/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, Location and Environment Bureau, 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

Form 000021wd
4-96

IOWA DEPARTMENT OF TRANSPORTATION

To Office	District X	Date	January 1, 2007
Attention	<District Maintenance Manager>	Ref No.	<County> County <Project Number>
From	<Bridge Design Engineer>		PIN <PIN> Design No(s). <Design #>
Office	Bridges and Structures		File No. <File #> FHWA No. <FHWA #>

Subject <Revised> Concept for Bridge <Floor Overlay or Repair> of <Bridge size and type>
Bridge Maintenance No. 0000.0X000

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:

	QUANTITY	UNIT	RATE	AMOUNT
Removal of Existing PC Overlay	1002	sy	$10	$10,020
Bridge Floor Overlay	1002	sy	$50	$50,100
Class A Bridge Floor Repair	26	sy	$100	$2,600
Removals (joint and rails)	1	LS	$10,000	$10,000
Retrofit Concrete Barrier Rail	670	ft	$40	$26,800
Concrete Repair (abut. footing, curb)	5	sf	$1000	$5,000
Steel Extrusion Joint with Neoprene	82	ft	$100	$8,200
Structural Concrete (joint repair)	10	cy	$500	$5,000
Flowable Mortar and Earth Fill	1	LS	$2,000	$2,000
Removal of Approach Pavement	136	sy	$4	$544
Reinforced Bridge Approach Section	136	sy	$85	$11,560
Guardrail	250	ft	$16	$4,000
RE-76 End Sections	4	ea	$1,000	$4,000
Temporary Flood Lighting	2	ea	$1,580	$3,160
Temporary Traffic Signals	2	ea	$7,250	$14,500
TBR	1250	ft	$15	$18,750
Traffic Control	1	LS	$5,000	$5,000
Mobilization & Contingencies (15%)	1	LS	$24,000	$24,000
			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.