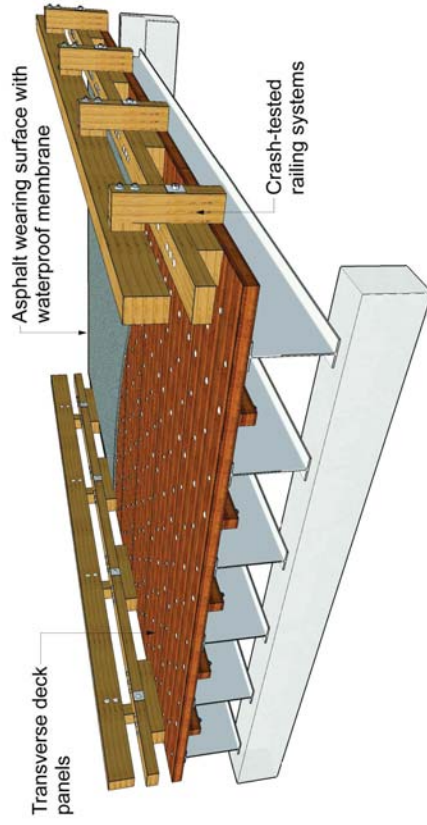


Steel Stringers with a Transverse Glulam Deck



The bridge design information depicted on these drawings was developed under a cooperative research agreement between Minnesota Local Road Research Board (LRRB), Minnesota Department of Transportation, The University of Minnesota Duluth - Natural Resources Research Institute (NRRI), and the USDA Forest Service - Forest Products Laboratory.



Steel Girders and Transverse Glulam Deck

Design Aids For Minnesota Timber Bridges

Perspective Drawing / Photograph View

June 2020

Sheet Number 1

Glulam Deck Design -

Transverse glulam decking consists of glulam deck panels oriented across supporting beams (stringers). Glulam decking has been successfully used with timber, steel, and concrete stringers. The deck is attached to the stringers using specialty connectors available from timber bridge supply companies.

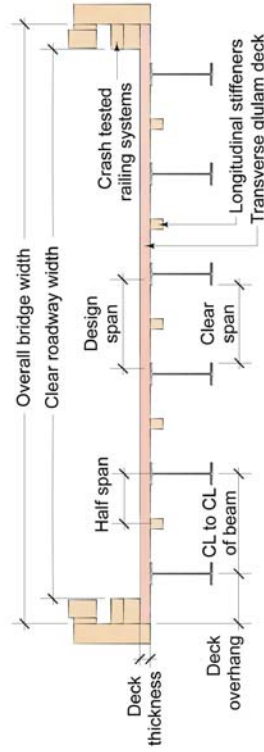
There are two types of transverse glulam decks: interconnected and noninterconnected. Interconnected decks use shear transfer devices between adjacent panels to minimize differential panel deflections. Decks that do not use shear transfer devices are considered to be noninterconnected.

The use of a longitudinal stiffener is recommended as the shear transfer device for both types of decks. The stiffeners are placed midway between stringers. The stiffener is attached to the decking with dome-head bolts and should have slotted holes to allow for transverse movement as the glulam moisture content varies in service.

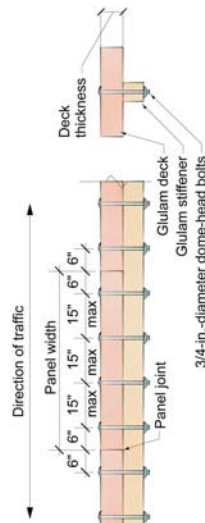
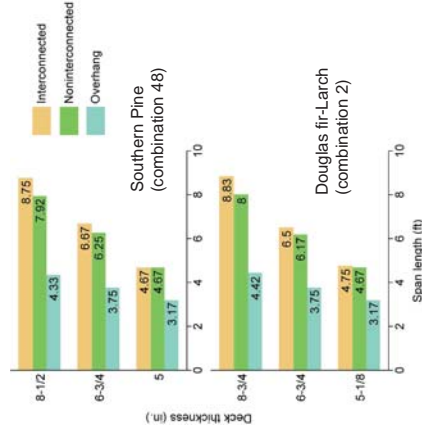
The transverse glulam deck charts show the maximum design span and overhangs for a given deck thickness and species, according to the following design parameters:

- AASHTO-LRFD Bridge Design Specifications (2017)
- HL93 live load
- 6-in. asphalt dead load
- Interconnected and noninterconnected design spans
- L/425 and 0.10-in. deflection limits
- Wet-stress reductions apply to all glulam members

Slots (approximately 2 by 13/16 in.) are provided by the manufacturer in the glulam stiffeners. This allows for movement from any forces caused by panel width changes. AASHTO requires that the minimum E_I value of the stiffener be 80,000 kip-in². Stiffeners must run continuous as far as practical. If need be, they can be butt-jointed at a panel midwidth. Proper fasteners must be used.



Design Span is equal to the clear span plus half width of stringer, but not to exceed clear span plus the deck thickness.
Deck overhang extends from the center of the edge stringer to the outside edge of deck.



Longitudinal Stiffener Detail



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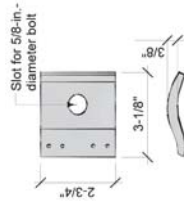
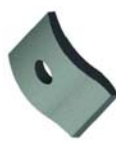
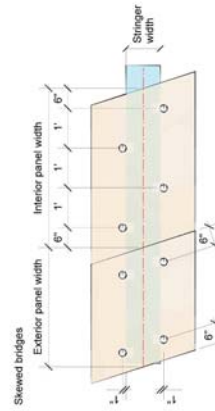
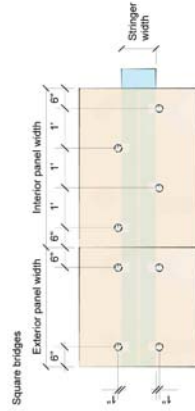
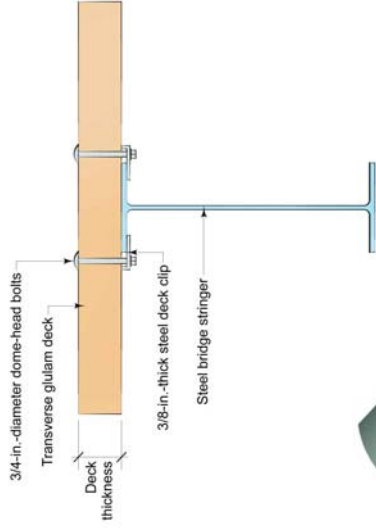
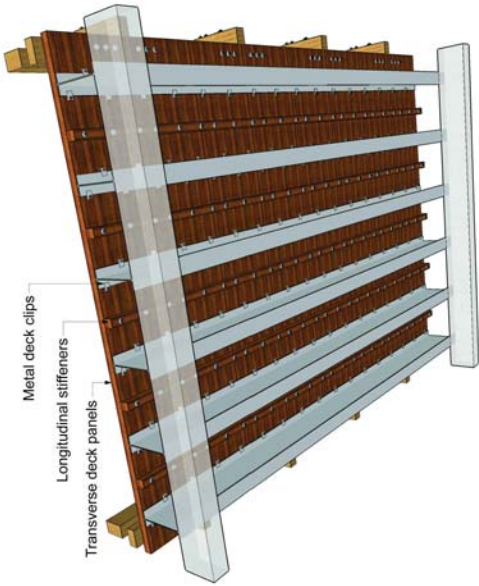
Steel Girders and Transverse Glulam Deck

Design Aids For Minnesota Timber Bridges

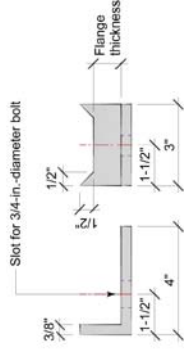
Design Information - Glulam Deck Panels

June 2020

Sheet Number 2



Cast Iron "C" Clips
(for steel flanges with a max. thickness of 3/4 in.)



Steel Deck Clip
(suitable for all steel flange thicknesses)

Thru-Bolted Glulam Deck Clip Layout

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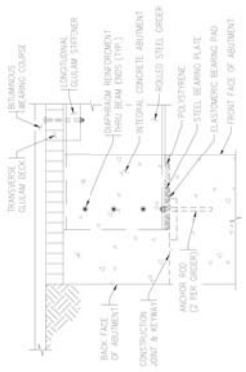
Steel Girders and Transverse Glulam Deck

Glulam Panel-to-Stringer Connections

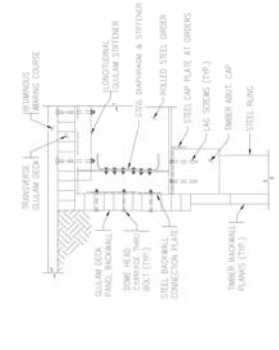
Design Aids For Minnesota Timber Bridges

June 2020

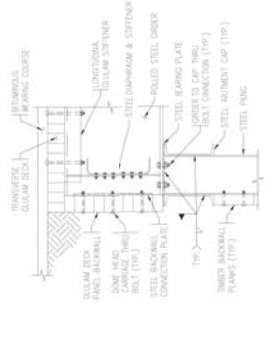
Sheet Number 3



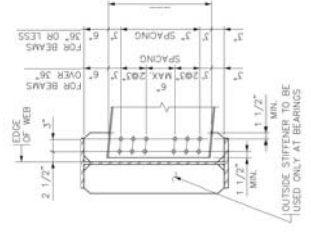
Stringer on Concrete Abutment



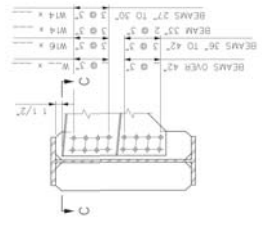
Stringer on Timber Abutment



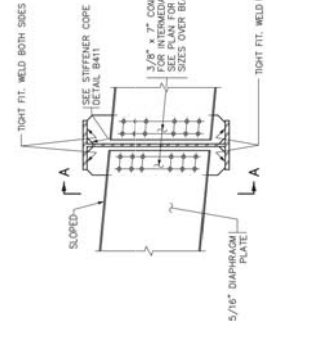
Stringer on Steel Abutment



Fascia Beam

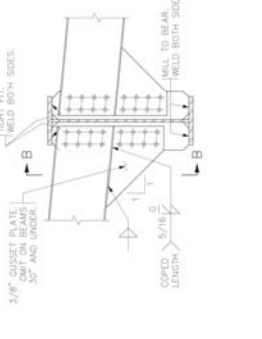


Fascia Beam



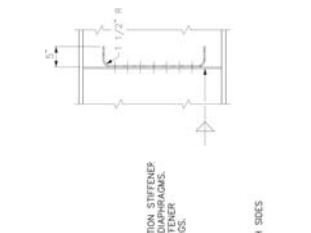
Interior Beam

Intermediate Diaphragm Locations

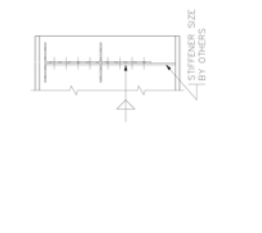


Interior Beam

Abutment Diaphragm Locations



Section A-A



Section A-A

Notes -

- Abutment bearing details shown are for reference only and shall be designed by others based on site specific conditions.
- When a glulam deck panel backwall is used at abutment bearings, a waterproof membrane should be applied to its backside to eliminate soil contact.
- When the concrete abutment is extended up to the top of deck panels, a steel cover plate should be used to prevent asphalt cracking directly over the steel girder abutment bearings.
- Diaphragm topside offset should be sufficient to provide clearance for the glulam stiffener beam attached to the underside of the glulam deck.
- For additional information about bolted diaphragms, refer to Minnesota DOT standard detail B402.



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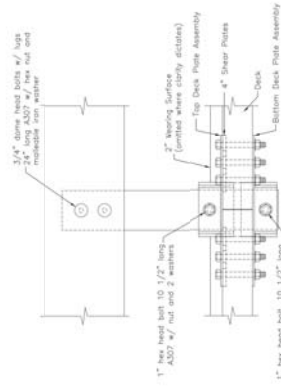
Steel Girders and Transverse Glulam Deck

Girder Diaphragm and Abutment Bearings

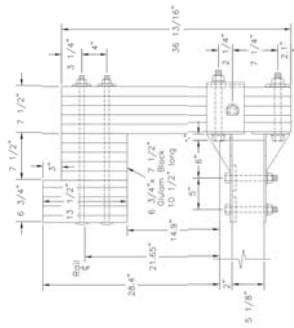
Design Aids For Minnesota Timber Bridges

June 2020

Sheet Number 5

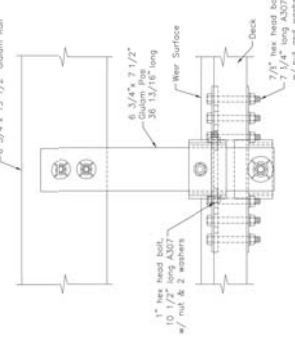


Front View



End View

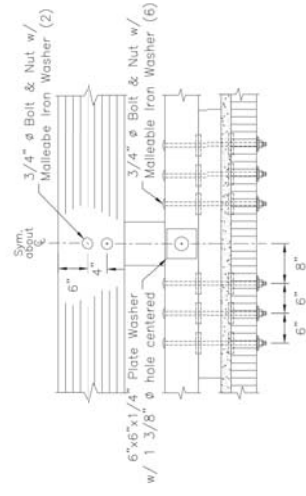
Railpost spacing 8 ft. (Typ.)



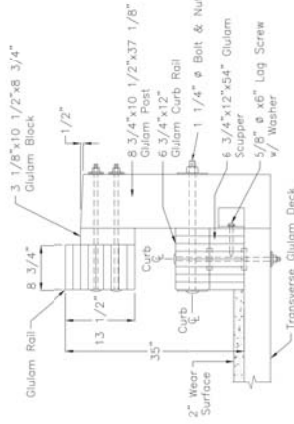
Rear View

Curbside Bridge Rail - Test Level 2 (NCHRP-350)

Note: More information is available in the Transportation Research Record (TRR-1743) journal including steel rail and post systems and transition railings.

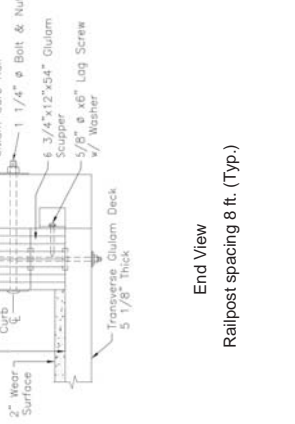


Front View



End View

Railpost spacing 8 ft. (Typ.)



Rear View

Bridge Rail with Curb - Test Level 4 (NCHRP-350)

Note: More information is available in the Transportation Research Record (TRR-1696) journal including steel rail and post systems and transition railings.



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Steel Girders and Transverse Glulam Deck

Design Aids For Minnesota Timber Bridges

Crash-Tested Bridge Rail System

June 2020

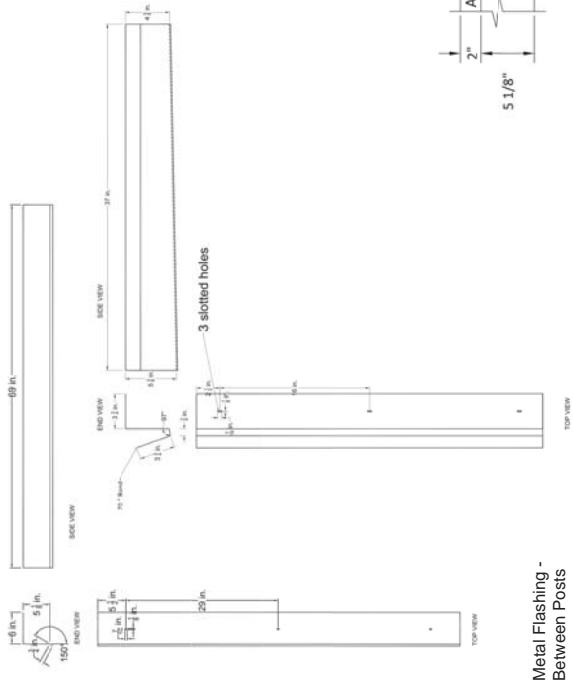
Sheet Number 6



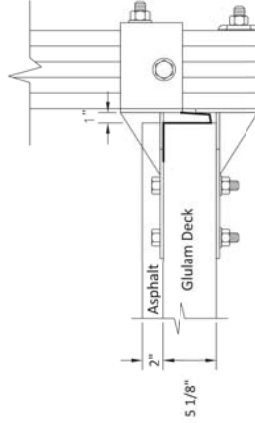
Rendering of Metal Flashing at Post



Protective Railpost Cap

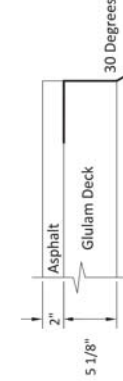


Metal Flashing - Between Posts

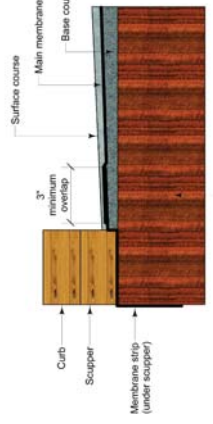


Metal Flashing - Straddling Posts

End View -- Flashing Straddling Posts



End View -- Flashing Between Posts



Asphalt Wearing Surface Recommendation

Durability Detail Notes -

The use of a waterproof geotextile membrane in conjunction with an asphalt wearing surface is recommended for most timber bridge applications. Proper application of a waterproof wearing surface can help to improve the long-term durability of timber bridge decks. The waterproofing membrane should "sandwiched" between base course and finish course of asphalt paving. A membrane strip is first placed along the deck edges, prior to the installation of curbs and scupper blocks, and should be sized to extend the full deck depth (outer edge) and beyond the inside curb face by more than 3-inches. The main membrane sandwiched in between the asphalt paving layers should extend to interior curb faces, providing a minimum membrane overlap.

In some cases, the use of metal flashing in lieu of the membrane strip, may be more beneficial as with curbless bridge railing systems. In this case, the metal flashing is nailed to the top deck edge with roofing nails prior to attachment of rail post hardware assemblies. Metal flashing segments are designed for "straddling post" and "between post" locations, while maintaining a minimum overlap of 5 inches at all joints. Flashing segments at the bridge corners should be sloped to drain away from the bridge abutments.

Post caps are available which shields the timber/glulam post from UV light degradation while sheltering the end grain from weathering at the same time. Post caps should be designed and manufactured to meet the following requirements:

- Manufactured from 1/8" high density polyethylene plastic, color black.
- Cap configuration shall allow for air circulation to the top of timber posts on all four sides.
- Fixing the plastic cap to the post using (stainless or galvanized) steel screws. No screws should be placed into the top of the posts, but rather into the post sides. This will prevent moisture from seeping through connections into topside end-grain of the post.
- Drip edges shall be provided on cap for the post sides and back.
- Water channel on top of cap will facilitate run-off and provide for air circulation beneath cap



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Steel Girders and Transverse Glulam Deck

Design Aids For Minnesota Timber Bridges

Wearing Surface and Durability Details

June 2020

Sheet Number 7

APPENDIX B

GLULAM STRINGERS AND A TRANSVERSE GLULAM DECK