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Standard Plans for Replacement of Historic Wood Bridge Superstructures

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Abstract
These standard bridge plans provide guidance to bridge engineers for replacement of timber bridges along historic U.S. highway routes. They utilize treated glued-laminated timber components for two superstructure design types: (1) longitudinal stringer with a panelized transverse deck and (2) longitudinal deck. Superstructure designs are in conformance with the AASHTO LRFD Bridge Design Specifications, 9th edition.

Keywords: wood, timber, bridge, Douglas-fir, glulam, historic, AASHTO, crash-tested bridge railing, Route 66

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Cover photos
Left: Historic U.S. Highway Route 66 timber bridge in California showing the flexible steel bridge railing detail. Right: Replacement U.S. Highway Route 66 glulam bridge built at Dola Ditch in 2017 in California. Forest Service photos by James P. Wacker.

Acknowledgment
The authors thank the Department of Public Works of San Bernardino County, California, for their assistance and guidance related to the timber bridges along historic Route 66 within their jurisdiction.

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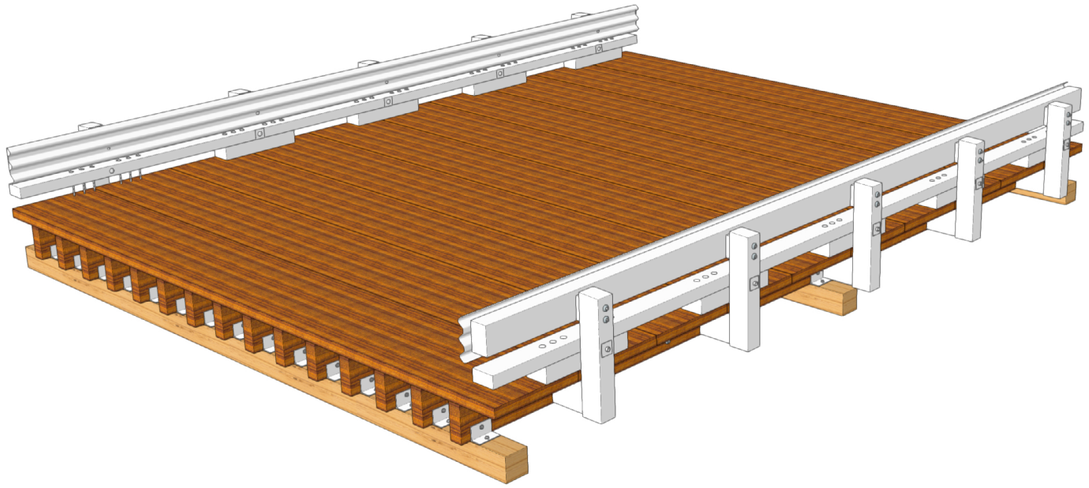
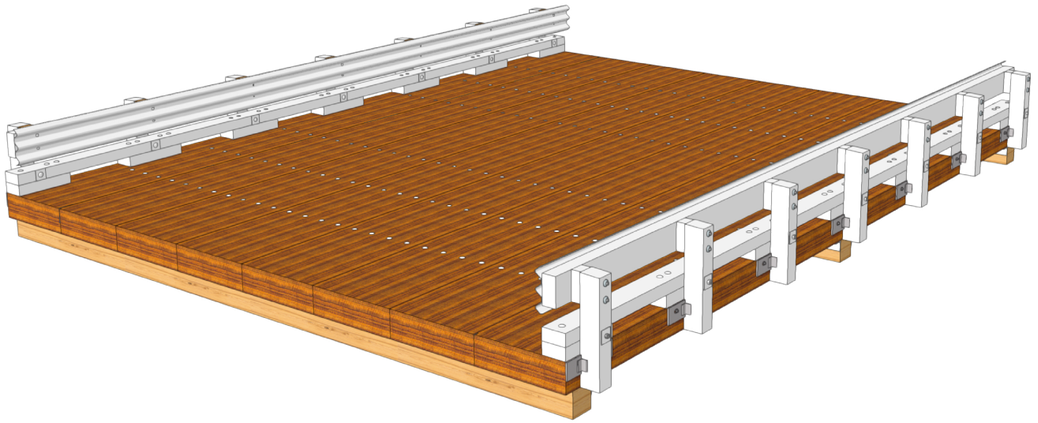
Standard Plans for Replacement of Historic Wood Bridge Superstructures



Stringer Bridge Design



Longitudinal Bridge Design

The bridge design information depicted on these drawings was developed under a cooperative research agreement between Laminated Concepts and the Forest Service, Forest Products Laboratory.

PERSPECTIVE DRAWING VIEWS	TITLE PAGE
STANDARDIZED PLANS FOR THE REPLACEMENT OF HISTORIC WOOD BRIDGE SUPERSTRUCTURES	Sheet Number: 1 of 13

INTRODUCTION

U.S. Highway Route 66 is the iconic road from the original highway system that was established nearly 100 years ago. It extended from Chicago, Illinois, to Santa Monica, California, passing through several states and including 316 miles within California.

In the past decade, several entities in the State of California have joined forces to develop a plan to preserve and enhance historic Route 66 for future generations, focusing their efforts on the corridor between Barstow and Needles, a dry area within the Mojave Desert. This section of the Route 66 roadway has 128 timber bridges that were built more than 80 years ago, and all are displaying the negative impacts of decades of weather, flash floods, truck traffic, erosion, earthquakes, animal life and other factors.

Reconstructing and rehabilitating the aging bridges will reinstate the safety, vitality, historic preservation, and accessibility of one of America's greatest treasures. A decision was made to replace these historic timber bridges with treated glued laminated timber (i.e., glulam) materials, but further technical assistance was needed on the proper design, manufacturing, and construction techniques suitable for durable modern timber bridges.

To provide this needed technical assistance, new standard bridge designs and plans have been developed as a cooperative effort between the USDA Forest Service, Forest Products Laboratory (FPL) and Laminated Concepts (LCI). The scope of this project is for bridge superstructure designs only; it does not include bridge substructure designs which must rely upon site specific conditions. A more complete set of design and construction drawings and specifications for the bridge location should be developed under the supervision of a licensed professional engineer.

The U.S. Department of Agriculture, Forest Service hereby gives notice that the information herein contained shall not create any warranty expressed or implied. The person or organization using this information waives and relinquishes any and all claims against the United States of America, its officers, employees, and project cooperators for any loss, damage, personal injury, or death incident to, or occurring as a consequence of, the use thereof.

DESIGN CONFIGURATIONS

These standards depict two different timber bridge design concepts:

- Glued laminated Timber Stringers with Transverse Decks
- Glued laminated Timber Longitudinal Decks

Both structures were selected and designed to maintain the profile and appearance of the existing timber structures in need of replacement.

Bridge rail systems shown are Federal Highway Administration (FHWA) crash-tested designs for each specific bridge type. Aesthetic modifications have been included to match the historic rail configurations more closely.

For both design concepts, span lengths have been kept to 19 ft (center-to-center of pile caps) matching that of the existing bridge structures with the following considerations:

- The Timber Stringer designs shown are applicable as single span structures with the designer's option of using continuous length stringers for multi-span configurations. (Manufacturing and shipping restrictions may apply.)
- The Longitudinal Deck designs are applicable as single span structures. When multi-span structures are designed, continuous panel lengths shall be used as shown on the design pages. (Manufacturing and shipping restrictions may also apply.) Panel ends should be butt-jointed and staggered on the pier caps across the structure width as shown in the included (plan view) drawings.

DESIGN CONSIDERATIONS

These standards were developed to comply with the American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factored Design (LRFD) Bridge Design Specifications, 9th ed.

Both superstructure configurations were designed using the following criteria:

- AASHTO LRFD HL-93 loading conditions
- 50 pounds per cubic foot (PCF) timber dead load
- Up to 8 in. uniform thickness of asphalt wearing surface (6 in. asphalt with 2 in. future overlay) at 140 PCF
- The AASHTO recommendation of L/425 live load deflection
- Substructure and seismic design considerations have not been accounted for and are beyond the scope of this project. Designers and engineers must take bridge site-specific into account for these considerations.

STANDARD FOR GLUED LAMINATED TIMBER BRIDGES

1. DEFINITIONS AND ABBREVIATIONS

AASHTO: American Association of State Highway and Transportation Officials

AITC: American Institute of Timber Construction

APA: Trademark appears on products manufactured by members of APA–The Engineered Wood Association **AWC**: American Wood Council

AWPA: American Wood Protection Association

GLULAM: Structural glued laminated timber (wood)

STRUCTURAL GLUED LAMINATED TIMBER (WOOD): An engineered stress-rated product of a timber laminating plant, comprising wood laminations bonded together with adhesives. The grains of all laminations are approximately parallel longitudinally. See APA/ANSI A190.1 for a more detailed explanation.

WWPI: Western Wood Preservers Institute

2. QUALIFICATIONS OF FABRICATOR

2.1 The glulam manufacturer shall be a qualified licensee of the AITC or APA.

2.2 All glued laminated timber shall be factory fabricated (as far as practical). This shall include cutting or drilling and other fabrication as shown on shop drawings.

3. CODES AND STANDARDS

In addition to complying with all pertinent codes and regulations, material and installation procedures shall comply with the following standards:

3.1 AASHTO LRFD Bridge Design Specifications, 9th ed.

3.2 ANSI A190.1-2022 Product Standard for Structural Glued Laminated Timber

3.3 ANSI 117-2022: Standard Specification for Structural Glued Laminated Timber of Softwood Species

3.4 AWPA Book of Standards (latest edition)

3.5 WWPI Specifiers Guide: Best Management Practices for the Use of Preserved Wood in Aquatic and Sensitive Environments

4. CERTIFICATIONS

4.1 Certifications required by the laminator: The laminator shall provide an AITC or APA Certificate of Conformance to ANSI A190.1-2022.

4.2 Pressure preservative treatment certification required. A certificate of treatment shall be furnished by a certified AWPA pressure treating facility. The treating certification shall list the identification of job, species of materials, type and retention preservative provided, as well as the AWPA standard used as the guide for pressure treating. In the event treated timber originates from more than one treating facility, certification shall be furnished from each facility providing timber for this project.

5. SUPERSTRUCTURAL DESIGN

The bridge shall be designed in accordance with good engineering practices and in accordance with the standard specifications as adopted by the American Association of State Highway and Transportation Officials (AASHTO).

5.1 The structure shall be designed for the following loads and dimensions:

5.1.1 Dead load (timber 50 PCF)

5.1.2 6 in. asphalt wearing surface with 2 in. allowance for future wearing surface

5.1.3 Live load of AASHTO HL-93

5.1.4 Wet-stress design values shall be used when applicable

5.1.5 Deflection limit of L/425

6. TIMBER MATERIALS

6.1 Lumber intended for glulam production shall be visually or mechanically graded in conformance with accepted standards for LRFD unit stresses (see AASHTO Section 8) and with the AWC National Design Specifications for Wood Construction. The moisture content of lumber shall not exceed 16 percent at the time of bonding.

6.2 Glulam members shall be finished to Industrial Appearance Grade as per AITC 110-2001.

6.3 All lumber for deck, caps and stiffeners utilized in these standards shall be Incised Douglas-fir. All lumber for railing elements shall be Southern Yellow Pine.

6.4 All glulam members, excepting rail members slated to be painted, shall be factory fabricated (e.g., holes, cuts, etc.) prior to preservative treatment. Some minor fabrication and adjustments may be required in the field. If so, field treat all exposed cuts, holes, etc. with an approved preservative field treatment as per AWPA M4.

7. PRESERVATIVE TREATMENT

All timber to be treated with the following preservatives in accordance with AASHTO Material Standards M133 and M168 and shall conform to the AWPA's 2024 Book of Standards, specifically the Use Category System Standards (U1) and the Preservatives/Protectants Standards (P).

7.1 0.20 PCF DCOI or 0.075 PCF copper naphthenate, in Hydrocarbon Solvent Type A, treated after gluing for Douglas-fir members conforming to AWPA's Standards UC4B, P39, and P36 respectively. Treatments prior to gluing for Douglas-fir glulam members are not acceptable. All Douglas-fir shall be factory incised prior to treatments.

7.2 0.40 PCF (min.) CCA -C treated before gluing for Southern Yellow Pine railing members only, conforming to AWPA's Standards UC4A and P23.

7.3 All preservative treatments shall be applied in accordance with the WPPI Specifier's Guide: Best Management Practices for the Use of Preserved Wood in Aquatic and Sensitive Environments. Third-party inspections and certifications shall be at the discretion on the designer.

7.4 AWPA Treatment Specification References:

- AWPA M2 Inspection of Treated Timber Products
- AWPA M4 Care of Preservative Treated Timber Products

8. HARDWARE

8.1 All fasteners shall be galvanized (ASTM A-123) steel A307 as indicated. Washers to be cast iron or malleable iron, timber type.

8.2 All steel plates and shapes to be galvanized (ASTM A-153) steel A36.

8.3 Deck brackets shall be aluminum alloy 356.

8.4 High strength rods shall be galvanized (ASTM A-123) steel A722.

8.5 Hardware specification references:

AASHTO. 2017. Standard Specifications for Transportation Materials and Methods of Sampling and Testing

- M111 Zinc (Hot-Dip Galvanized) Coatings for Iron and Steel Products
- M232 Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM. Annual Book of Standards (latest edition)

ASTM A36 Standard Specification for Carbon Structural Steel

ASME B18.2.1: Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

8.6 All bolted connections to be wrench tightened with care taken not to overtighten and cause crushing of the exterior wood fibers.

9. BEARING PADS

9.1 Fabricator shall provide plain elastomeric bearing pads in areas shown on the plans.

9.2 The durometer hardness shall be between 50 and 60 and shall have a minimum strength of 800 PSI.

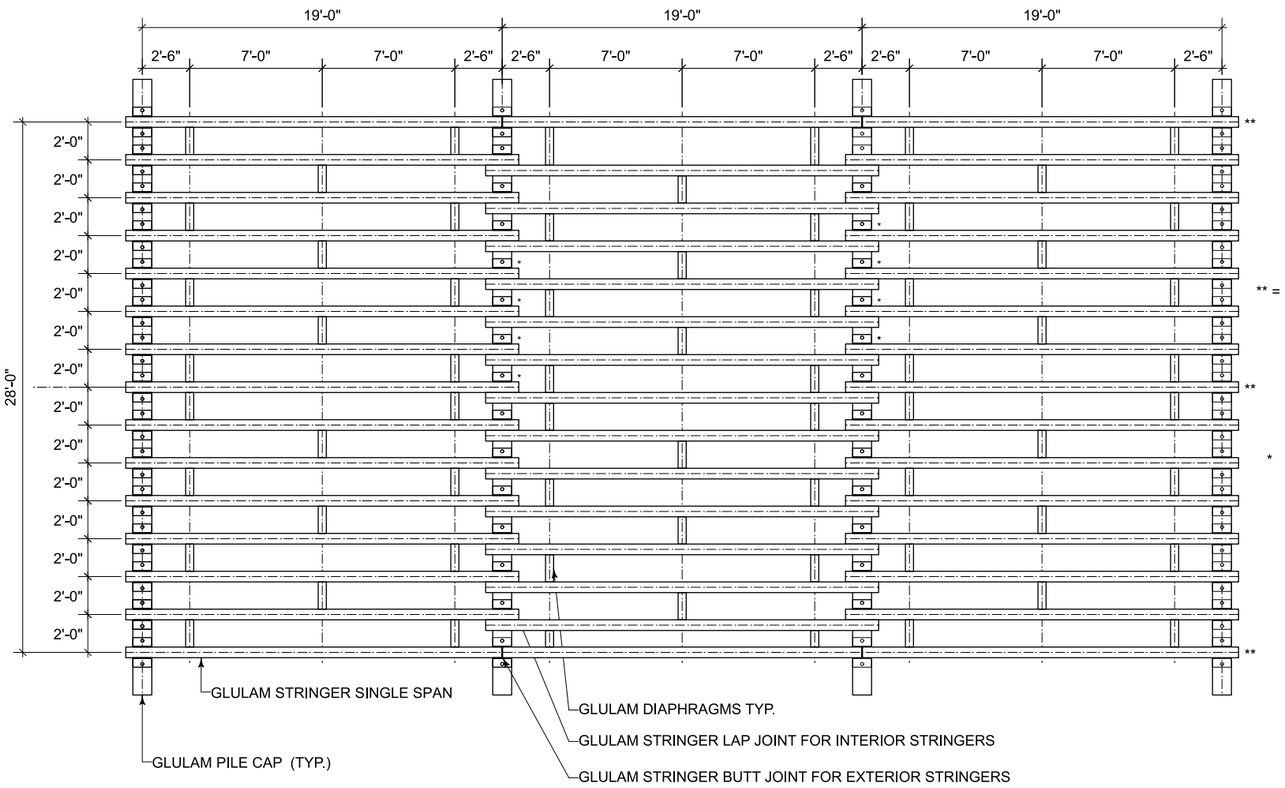
9.3 Elastomeric bearing pads are (not) designed for seismic load combinations or seismic isolation.

10 MATERIAL: DELIVERY, STORAGE, AND HANDLING

10.1 Special care shall be taken for all materials required for the project. Shipping, storage, and erection practices shall be in accordance with AITC 111-2005 industry standard.

10.2 For wearing surface information, see Sheet 13 and refer to Weyers et al. (see References).

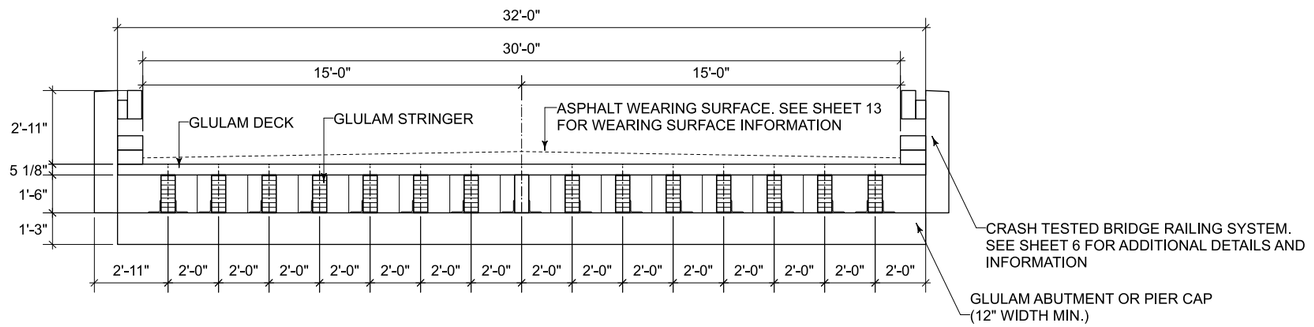
The bridge design information depicted on these drawings was developed under a cooperative research agreement between Laminated Concepts and the Forest Service, Forest Products Laboratory.



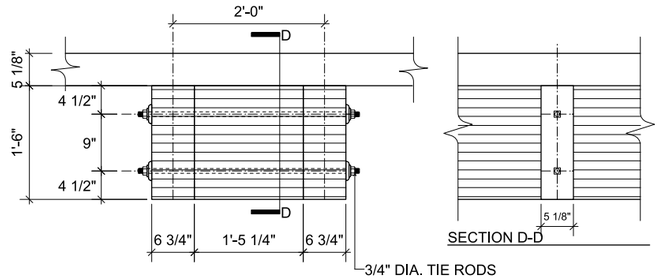
** = BEARING ANGLE EACH SIDE OF STRINGER @ ABUTMENTS

* = BEARING ANGLE ONE SIDE OF STRINGER ONLY @ INTERIOR STRINGERS

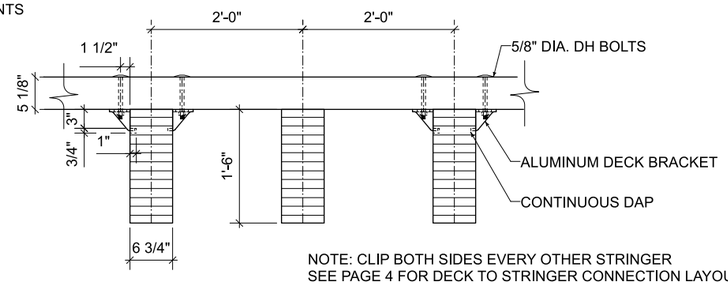
STRINGER AND DIAPHRAGM PLAN - 3 SPAN CONFIGURATION SHOWN



BRIDGE SECTION

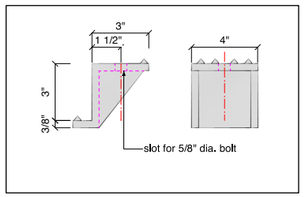


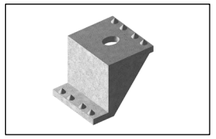
DIAPHRAGM TO STRINGER DETAIL

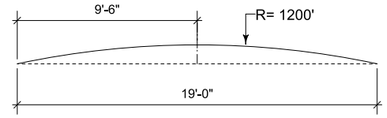


NOTE: CLIP BOTH SIDES EVERY OTHER STRINGER
SEE PAGE 4 FOR DECK TO STRINGER CONNECTION LAYOUT

DECK TO STRINGER DETAIL







CAMBER RADIUS FOR SINGLE SPAN STRINGERS

NOTES:

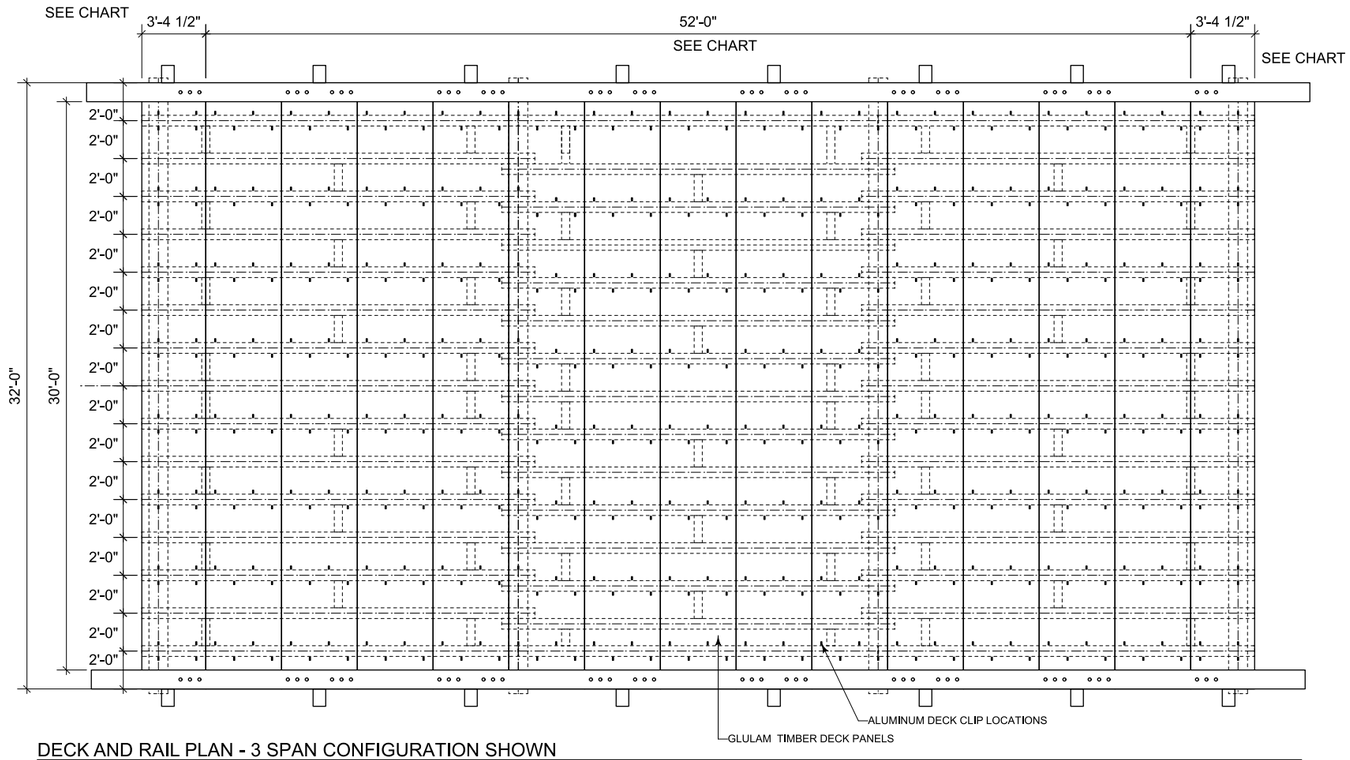
1) FOR ALL CONDITIONS, CENTER TO CENTER OF NEW PILE CAP SHALL BE 19'-0.
2) FOR MULTI SPAN STRUCTURES, CONTINUOUS LENGTH STRINGERS MAY BE USED AT DESIGNERS DISGRESSION
4) GLUED LAMINATED STRINGERS SHALL BE DOUGLAS-FIR SPECIES, LAMINATED TO COMB. 24F-V8
5) GLUED LAMINATED DECK AND DIAPHRAGMS SHALL BE DOUGLAS-FIR SPECIES, LAMINATED TO COMB. 2
6) SEE SHEET 6 FOR ADDITIONAL STRINGER BRIDGE CONSTRUCTION DETAILS

The bridge design information depicted on these drawings was developed under a cooperative research agreement between Laminated Concepts and the Forest Service, Forest Products Laboratory.

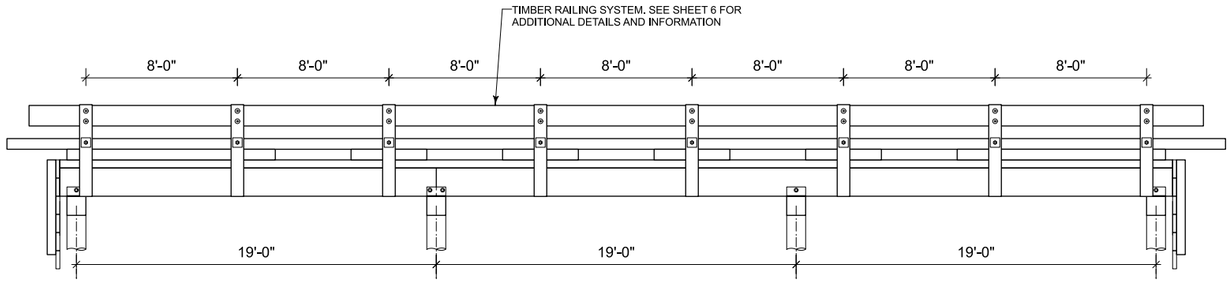
STRINGER DESIGN STANDARDS

STANDARDIZED PLANS FOR THE REPLACEMENT OF HISTORIC WOOD BRIDGE SUPERSTRUCTURES

STRINGER AND DIAPHRAGM LAYOUT AND DETAILS



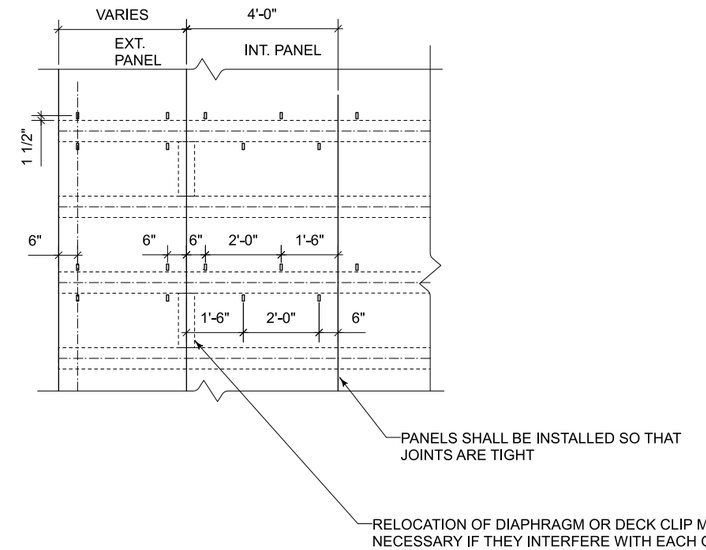
DECK AND RAIL PLAN - 3 SPAN CONFIGURATION SHOWN



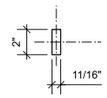
BRIDGE ELEVATION

# OF SPANS	# OF 48" WIDE INT. PANELS	WIDTH EXT. PANELS (A)
1	3	52 1/2"
2	8	46 1/2"
3	13	40 1/2"
4	18	34 1/2"
5	22	52 1/2"

A : BASED UPON A 12" WIDE PILE CAP



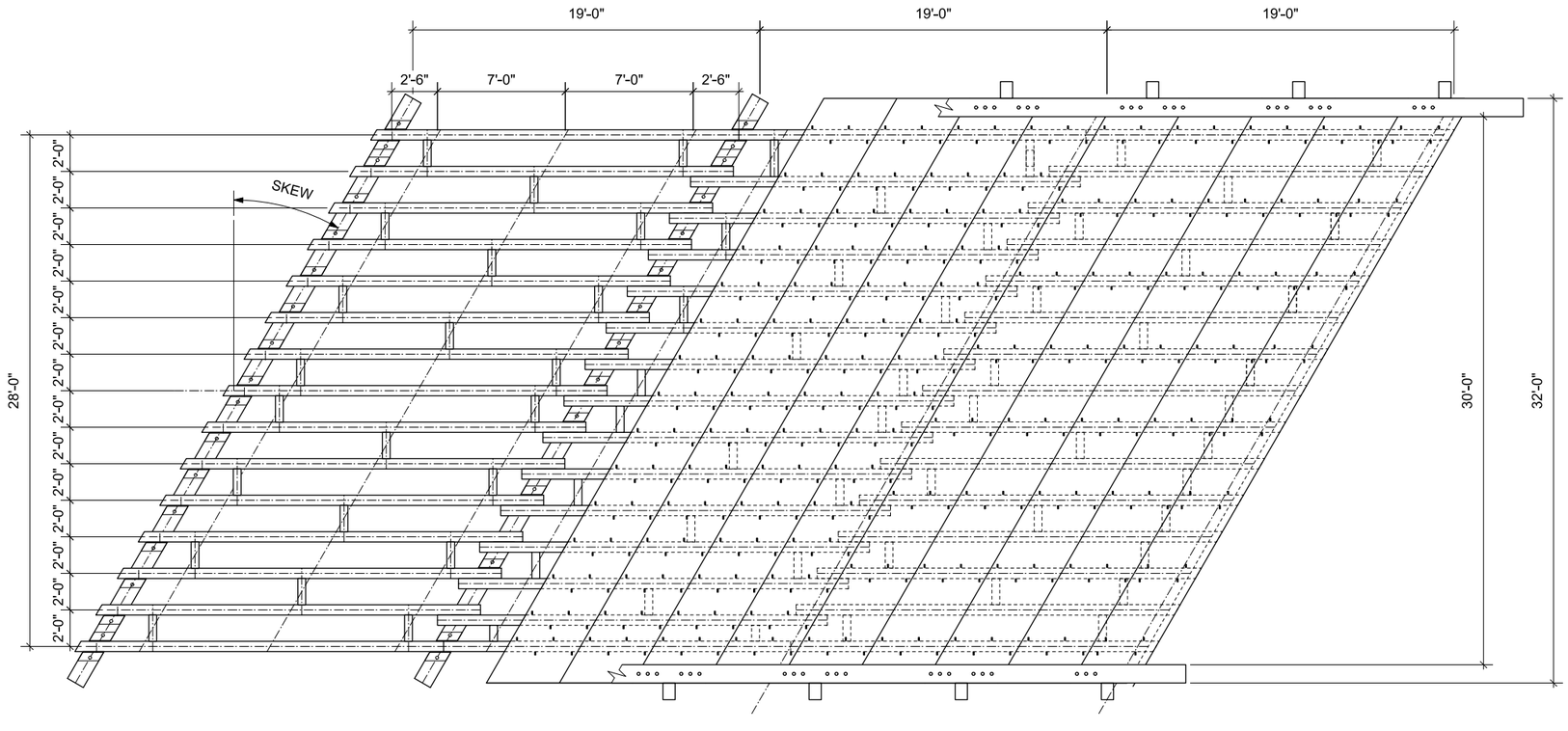
DECK TO STRINGER - ALUMINUM DECK CLIP ATTACHMENT LAYOUT



SLOT DETAIL FOR DECK PANELS

The bridge design information depicted on these drawings was developed under a cooperative research agreement between Laminated Concepts and the Forest Service, Forest Products Laboratory.

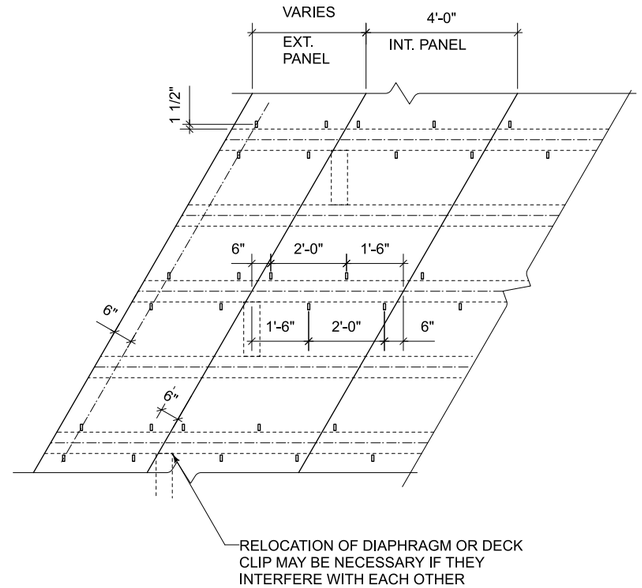
STRINGER DESIGN STANDARDS	STRINGER DECK AND RAIL LAYOUT DETAILS
STANDARDIZED PLANS FOR THE REPLACEMENT OF HISTORIC WOOD BRIDGE SUPERSTRUCTURES	Sheet Number: 4 of 13



TYPICAL SKEW PLAN LAYOUT - 3 SPAN CONFIGURATION SHOWN

# OF SPANS	# OF 48" WIDE INT. PANELS	WIDTH EXT. PANELS (A)
1	3	52 1/2"
2	8	46 1/2"
3	13	40 1/2"
4	18	34 1/2"
5	22	52 1/2"

A : BASED UPON A 12" WIDE PILE CAP



DECK TO STRINGER - ALUMINUM DECK CLIP ATTACHMENT SKEWED LAYOUT

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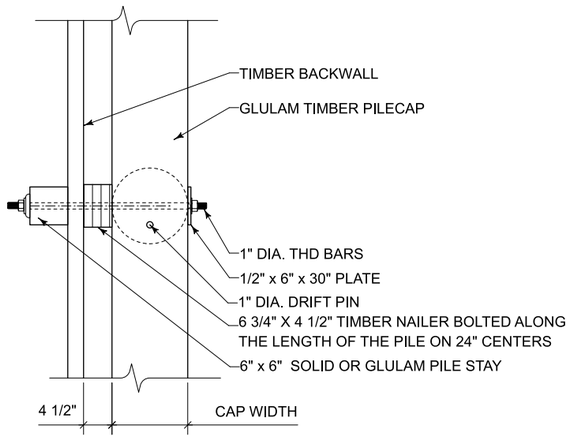
STRINGER DESIGN STANDARDS

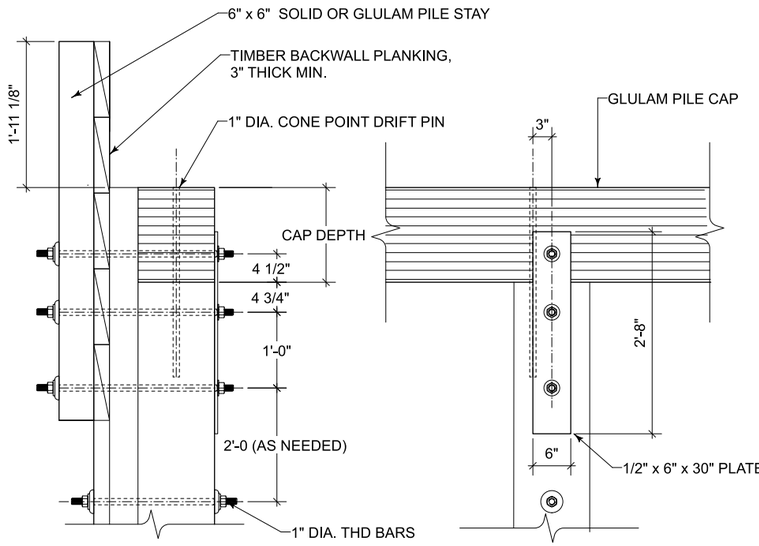
STANDARDIZED PLANS FOR THE REPLACEMENT OF HISTORIC WOOD BRIDGE SUPERSTRUCTURES

SKEWED STRINGER LAYOUT AND DETAILS

Sheet Number

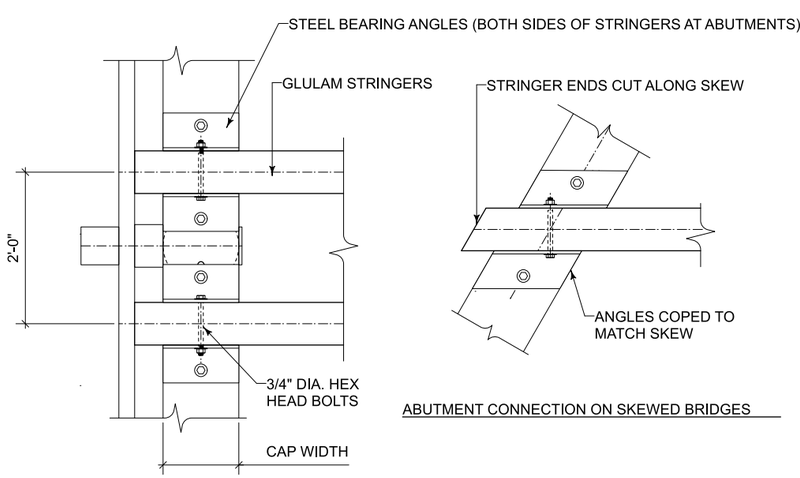


PLAN VIEW



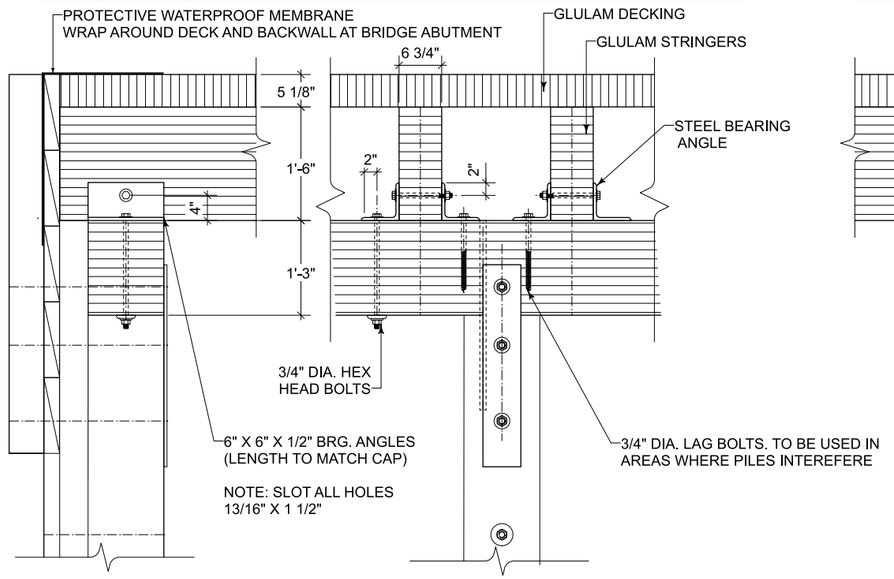
SECTION VIEW ELEVATION VIEW

PILE CAP ATTACHMENT DETAIL



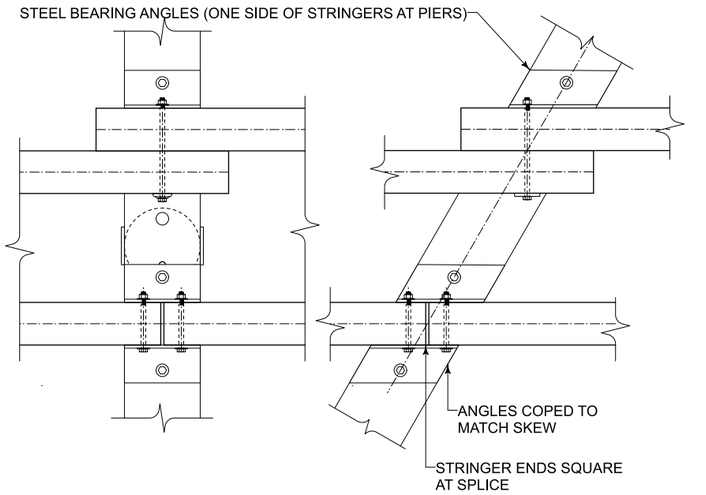
ABUTMENT CONNECTION ON SKEWED BRIDGES

PLAN VIEW



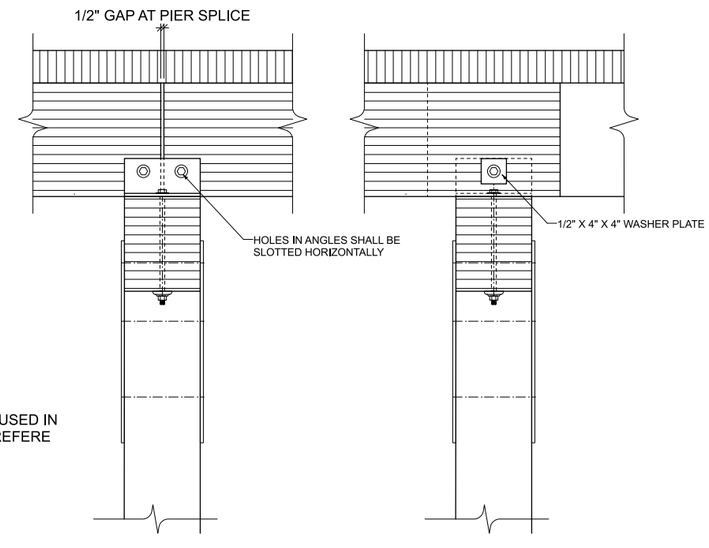
SECTION VIEW ELEVATION VIEW

STRINGER TO ABUTMENT CAP ATTACHMENT DETAIL



SPLICE AT PIER ON SKEWED BRIDGES

PLAN VIEW



ELEVATION VIEW (EXTERIOR STRINGER LINE) ELEVATION VIEW (INTERIOR STRINGER LINES)

STRINGER TO PIER CAP AND SPLICE ATTACHMENT DETAIL

PLEASE NOTE THAT ALL SUBSTRUCTURE DETAILS ARE RECOMMENDED DETAILS YET THE ACTUAL DESIGN OF SUBSTRUCTRE ELEMENTS ARE NOT PART OF THESE STANDARDS AND SHOULD BE PERFORMED BY A QUALIFIED P.E. ON A JOB TO JOB BASIS

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USDA FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE LCI

STRINGER DESIGN STANDARDS

STRINGER ABUTMENT AND BEARING DETAILS

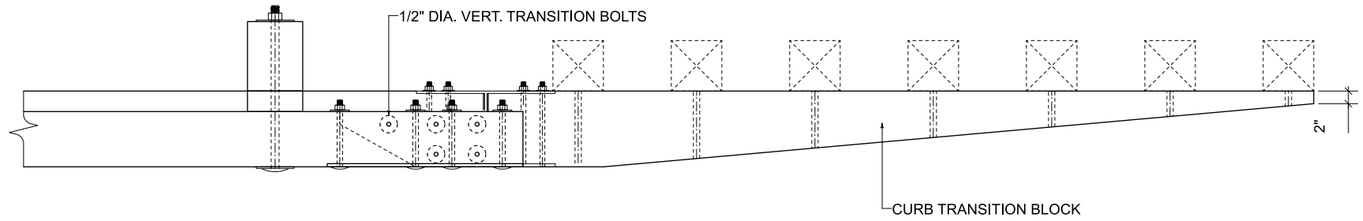
STANDARDIZED PLANS FOR THE REPLACEMENT
OF HISTORIC WOOD BRIDGE SUPERSTRUCTURES

Sheet Number 6 of 13

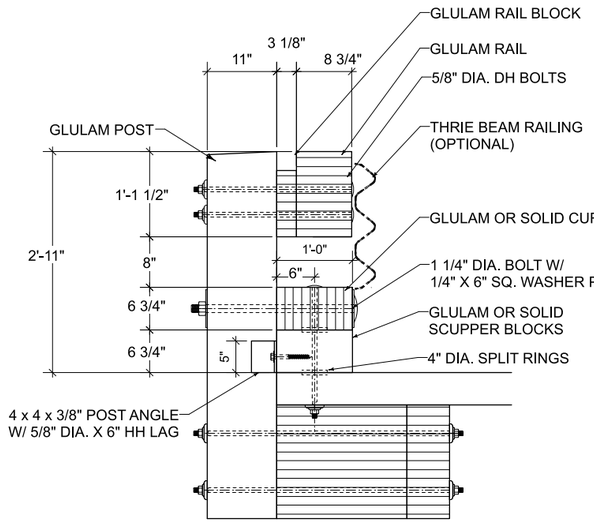
Crash Tested On Bridge Railing Design Notes:

1. This bridge rail was successfully crashed tested to the requirements for Test Level 4 (TL-4), as outlined in NCHRP Report 350. Rail geometry and material specifications shall not be changed.
2. Dimensions given for glued laminated timber rails are actual dimensions.
3. Dimensions for wood post and scuppers are given as nominal dimensions. Actual dimensions may be a maximum of 1/2 inch less than the stated nominal dimensions depending on material surfacing. Dimensions for spacer block depth are actual dimensions.
4. Curb and rail splices shall be located so that the curb and rail members are continuous over not less than 2 posts.

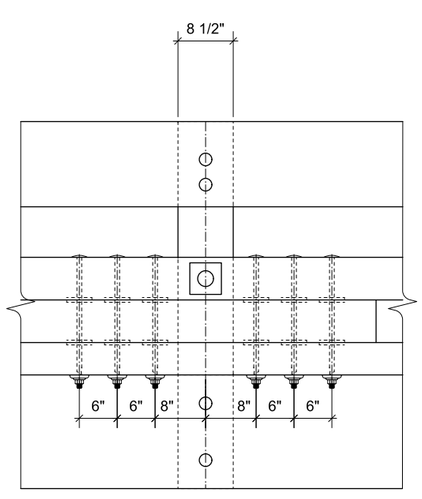
THRIE BEAM RAILING AND RAILING END SECTIONS NOT SHOWN FOR CLARITY



PLAN VIEW @ APPROACH RAIL TRANSITION



SECTION VIEW



ELEVATION VIEW

ELEVATION VIEW @ APPROACH RAIL TRANSITION

CRASH TESTED BRIDGE RAIL DETAIL

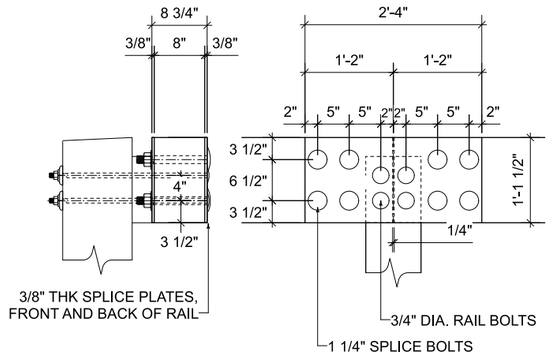
The bridge design information depicted on these drawings was developed under a cooperative research agreement between Laminated Concepts and the Forest Service, Forest Products Laboratory.

Supplemental Material Specifications:

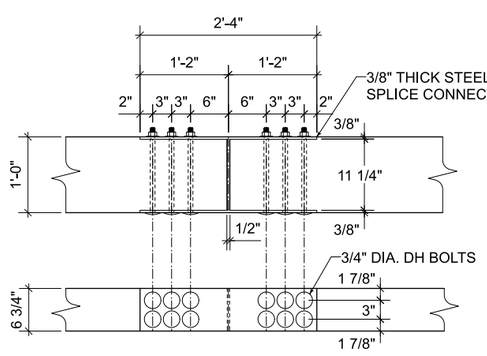
1. Sawn lumber and glued laminated timber shall comply with the requirements of AASHTO M168 and shall be pressure treated with wood preservative in accordance with AASHTO M133.
2. The bridge rail shall be horizontally glued laminated timber, visually graded, Southern Pine Combination #48.
3. Posts and spacer blocks may be sawn lumber or glued laminated timber. When sawn lumber is used, materials shall be visually graded #1 Southern Pine. Glued laminated timbers minimum tabulated values shall not be less than the following: Fb = 1,800 PSI : E= 1,800,000 PSI.
4. Glued laminated timber shall be treated before gluing with Copper Chromated Arsenate (CCA) to a minimum retention of 0.40 PCF and shall be in accordance with AWPA UC4A and P23.
5. When painting of the wood members is desireable, the following specifications shall be used:
   Wood primer must be latex based paint suitable for priming unpainted wood or exterior woodwork. Wood primer must comply with the MPI detailed performance standards for exterior wood primers and be listed on the MPI approved product list #6 for primer, latex for exterior wood.
   Latex based paint for exterior wood must comply with the MPI detailed performance standards for exterior latex paint and must be listed on one of the MPI approved products lists as shown in the following table:

MPI List No.	Category Name
10	Latex, exterior flat (MPI gloss level 1)
11	Latex, exterior semi-gloss (MPI gloss level 5)
119	Latex, exterior gloss (MPI gloss level 6)

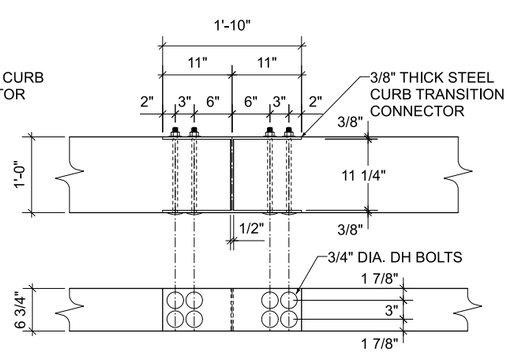
6. Steel plates and shapes shall comply with the requirements of ASTM A36.
7. Bolts shall comply with the requirements ASTM 307, Grade 2 and should preferably be dome head timber bolts.
8. Split rings shall be manufactured from SAE 1010 hot rolled carbon steel. Shear plates shall be malleable iron manufactured according to ASTM A-47, grade 32510.
9. All steel components and fasteners shall be galvanized in accordance with AASHTO M111 or AASHTO M232. Galvanized steel components after welding. If desired, steel componets may be painted in the field to match the painted rail. Follow manufacturer's recommendations for painting.
10. When field fabrication of wood is required or if wood is damaged, all cuts, bored holes and damage shall be immediately field treated with wood preservative in acc ordance with AASHTO M133.
11. Unless noted, malleable iron washers shall be provided under bolt heads and under nuts that are in contact with wood. Washers may be omitted under heads of dome head timber bolts when the size and strength of the head is sufficient to develop connection strength without wood crushing.



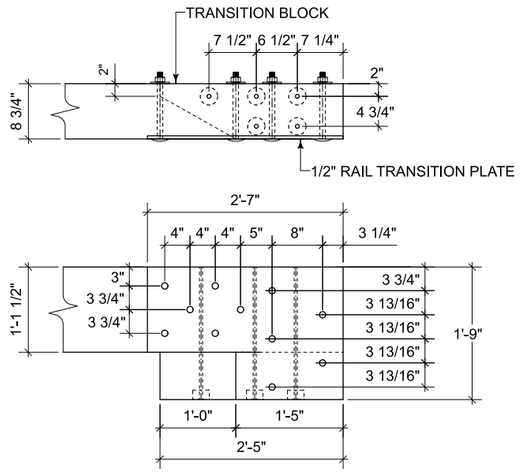
RAIL SPLICE DETAIL



CURB SPLICE DETAIL



CURB TRANSITION DETAIL

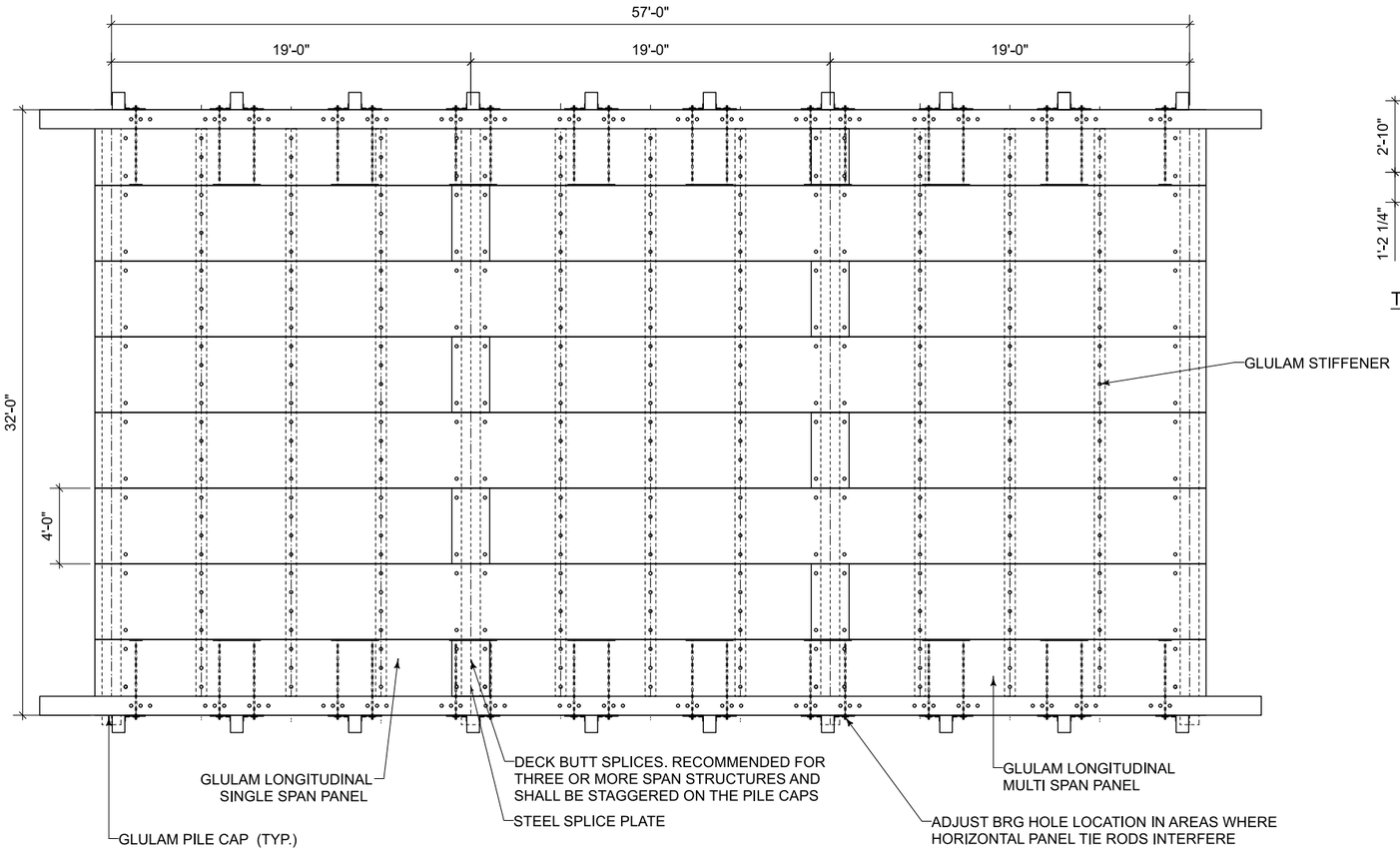


RAIL TRANSITION DETAIL

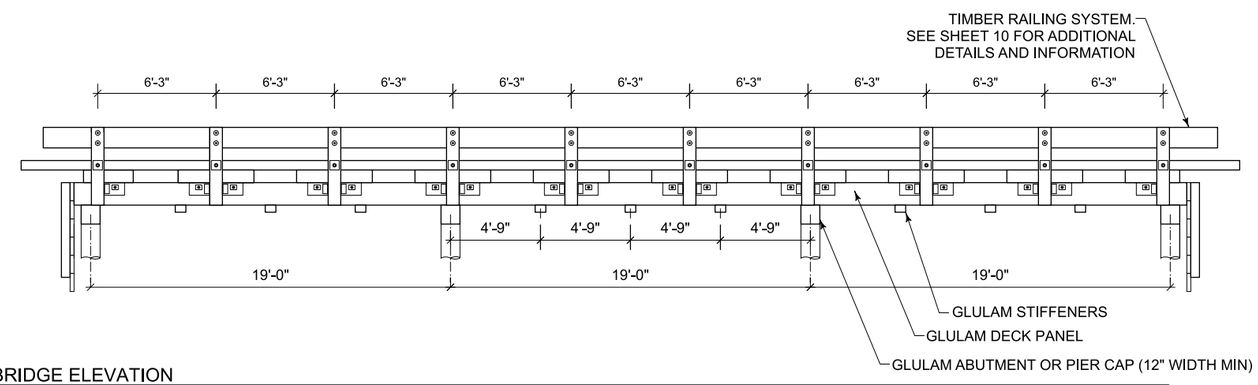
The bridge design information depicted on these drawings was developed under a cooperative research agreement between Laminated Concepts and the Forest Service, Forest Products Laboratory.

USDA FOREST SERVICE US DEPARTMENT OF AGRICULTURE LCI

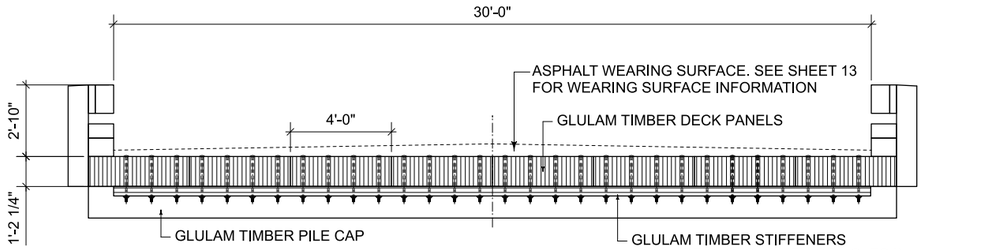
STRINGER DESIGN STANDARDS	TRANSVERSE DECK RAILING DESIGN AND DETAILS
STANDARDIZED PLANS FOR THE REPLACEMENT OF HISTORIC WOOD BRIDGE SUPERSTRUCTURES	Sheet Number: 8 of 13



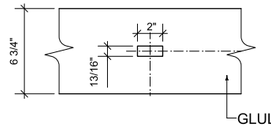
BRIDGE DECK AND RAIL PLAN



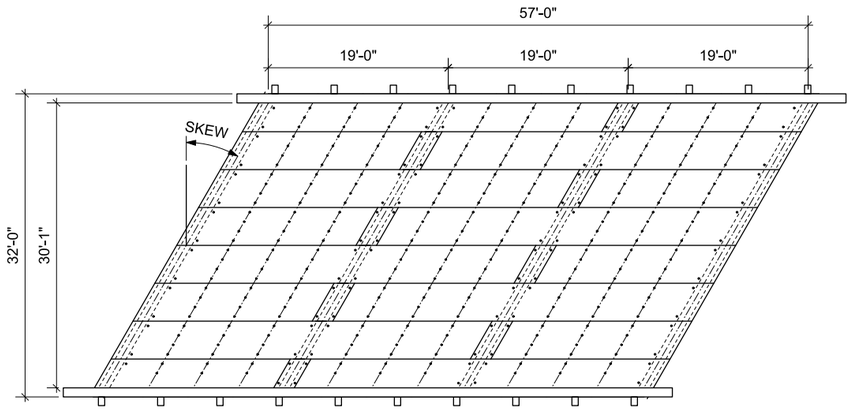
BRIDGE ELEVATION



TYPICAL SECTION THRU BRIDGE



SLOT DETAIL FOR DECK PANELS



SKEWED DECK PLAN LAYOUT

NOTES:

1) FOR ALL CONDITIONS, CENTER TO CENTER OF PILE CAP SHALL BE 19'-0.
2) FOR SINGLE AND TWO SPAN STRUCTURES, CONTINUOUS LENGTH PANELS SHALL BE USED.
3) FOR THREE OR MORE SPAN STRUCTURES, IT IS RECOMMENDED THAT PANEL END JOINTS SHALL BE STAGGARED ON THE PILE CAPS ACROSS THE STRUCTURE WIDTH AS SHOWN IN THE PLAN VIEWS. CONTINUOUS, FULL LENGTH PANELS MAY BE USED FOR ANY STRUCTURE. CHECK WITH MANUFACTURES FOR LENGTH RESTRICTIONS PRIOR TO SPECIFING.
4) IT IS RECOMMENDED TO SET THE CENTER TWO INTERIOR DECK PANES AND THEN WORK OUT TO THE EDGE ON BOTH SIDES. TRANSVERSE STIFFENERS CAN BE LOOSELY INSTALLED UNDER THE PANELS AS THE REST ARE BEING SET.
5) TRANSVERSE STIFFENERS SHALL BE FABRICATED WITH SLOTS (2" x 13/16" RECOMMENDED) IN LIEU OF HOLES TO FACILITATE INSTALLATION.
6) LONGITUDINAL DECK PANELS AND TRANSVERSE STIFFENERS SHALL BE GLUED LAMINATED DF, MANUFACTURED TO COMB. 3 LAYUP.
7) SEE SHEETS 9 & 10 FOR ADDITIONAL LONGITUDINAL BRIDGE DETAILS.

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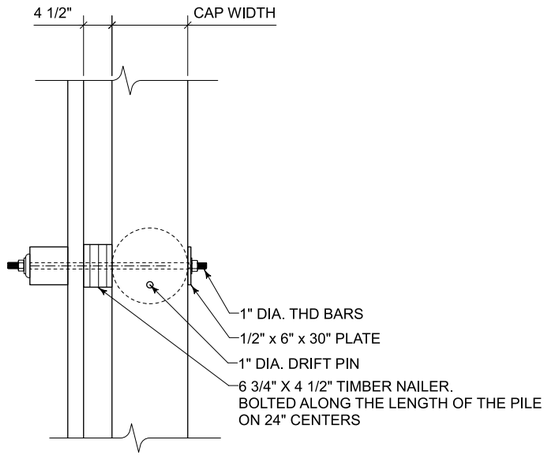
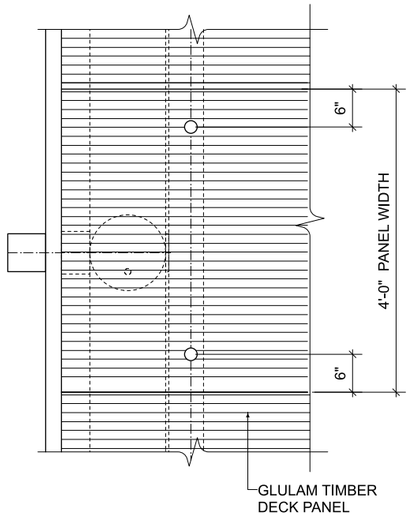
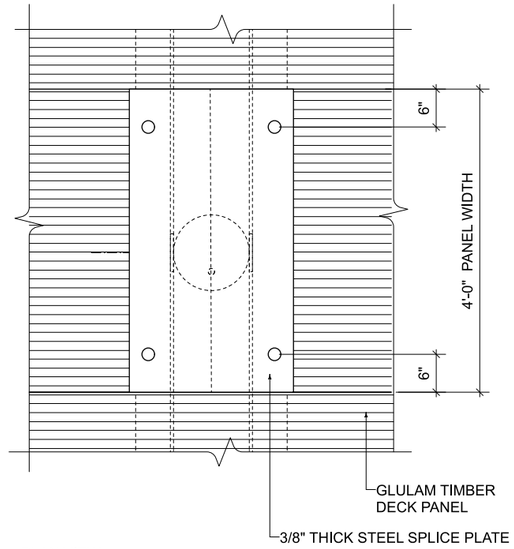


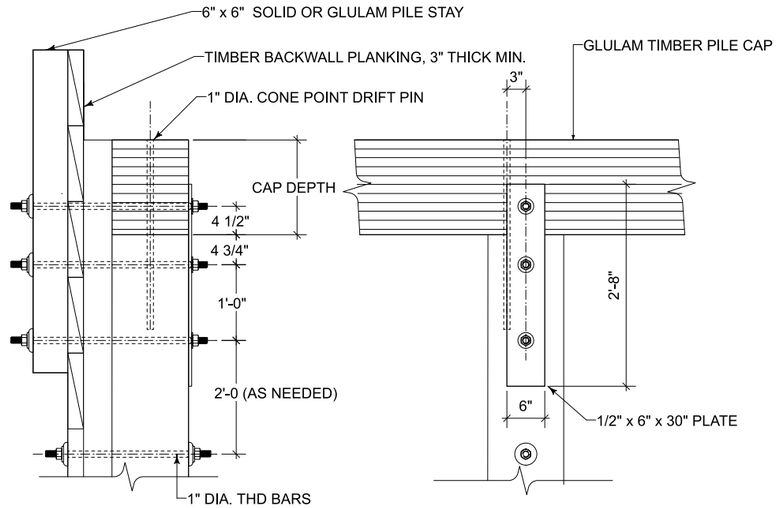
PLAN VIEW



PLAN VIEW



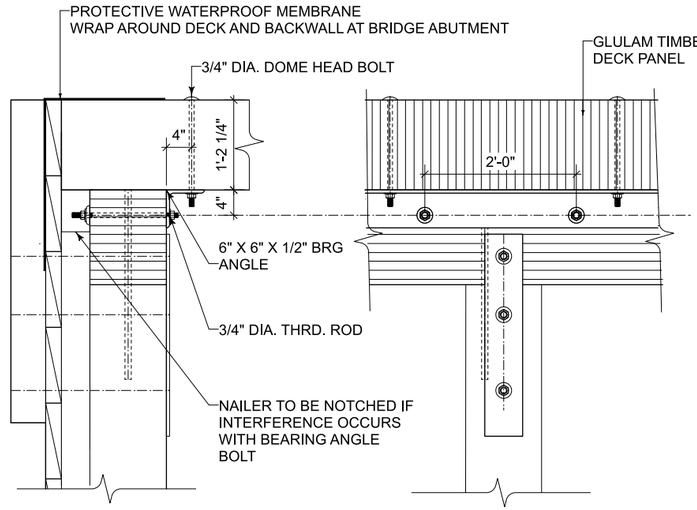
PLAN VIEW



SECTION VIEW

ELEVATION VIEW

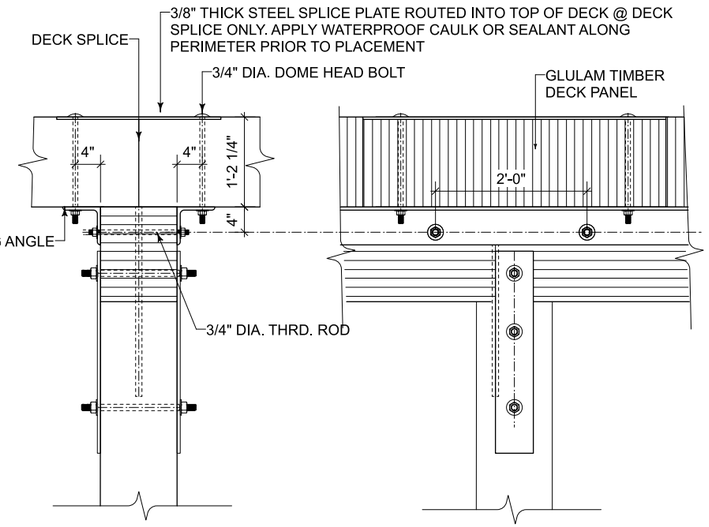
PILE CAP ATTACHMENT DETAIL



SECTION VIEW

ELEVATION VIEW

DECK TO ABUTMENT CAP ATTACHMENT DETAIL



SECTION VIEW

ELEVATION VIEW

DECK TO PIER CAP AND SPLICE ATTACHMENT DETAIL

PLEASE NOTE THAT ALL SUBSTRUCTURE DETAILS ARE RECOMMENDED DETAILS YET THE ACTUAL DESIGN OF SUBSTRUCTRE ELEMENTS ARE NOT PART OF THESE STANDARDS AND SHOULD BE PERFORMED BY A QUALIFIED P.E. ON A JOB TO JOB BASIS

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LONGITUDINAL DESIGN STANDARDS

LONGITUDINAL ABUTMENT AND BEARING DETAILS

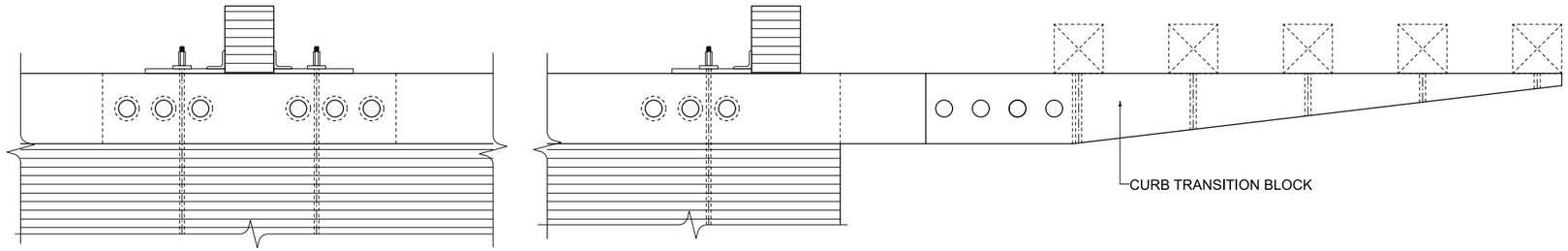
STANDARDIZED PLANS FOR THE REPLACEMENT
OF HISTORIC WOOD BRIDGE SUPERSTRUCTURES

Sheet Number

Crash Tested On Bridge Railing Design Notes:

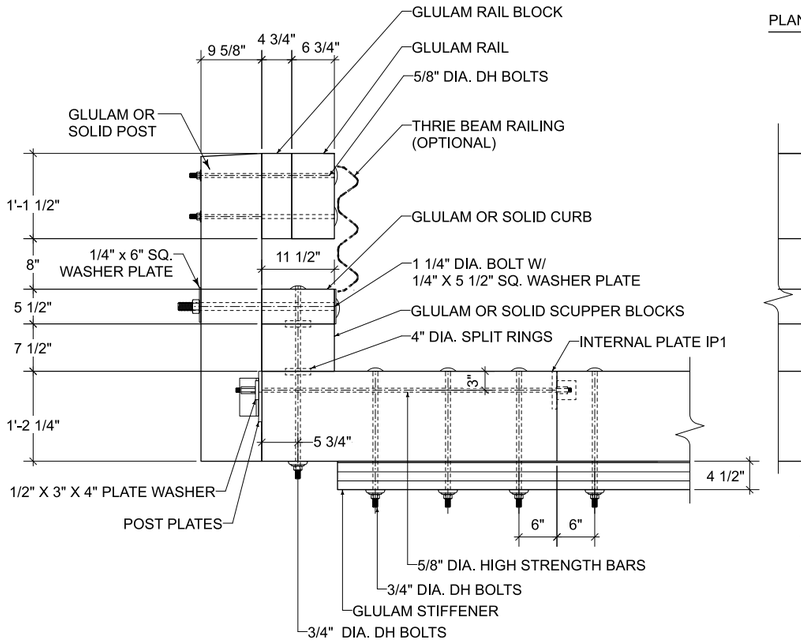
1. This bridge rail was successfully crashed tested to the requirements for Test Level 4 (TL-4), as outlined in NCHRP Report 350. In addition, the bridge rail met crash test requirements for Performance Level 2 (PL-2) as outlined in the 1989 AASHTO Guide Specifications for Bridge Railings. Rail geometry and material specifications shall not be changed.
2. Dimensions given for glued laminated timber rails are actual dimensions.
3. Dimensions for wood post and scuppers are given as nominal dimensions. Actual dimensions may be a maximum of 1/2 inch less than the stated nominal dimensions depending on material surfacing. Dimensions for spacer block depth are actual dimensions.
4. Steel deck reinforcing bars shall be 5/8" diameter, hot dipped galvanived, ASTM A722 bars.
5. Curb and rail splices shall be located so that the curb and rail members are continuous over not less than 2 posts.

THRIE BEAM RAILING AND RAILING END SECTIONS NOT SHOWN FOR CLARITY

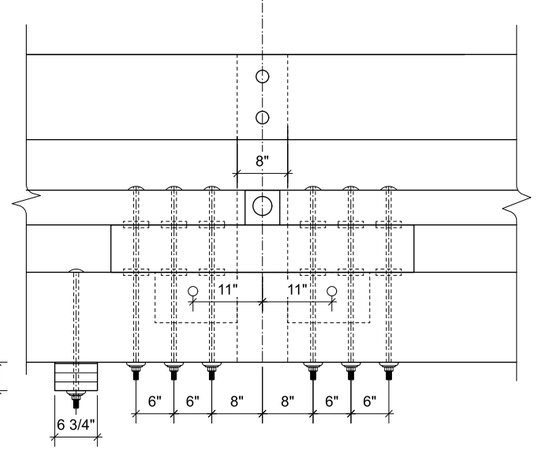


PLAN VIEW

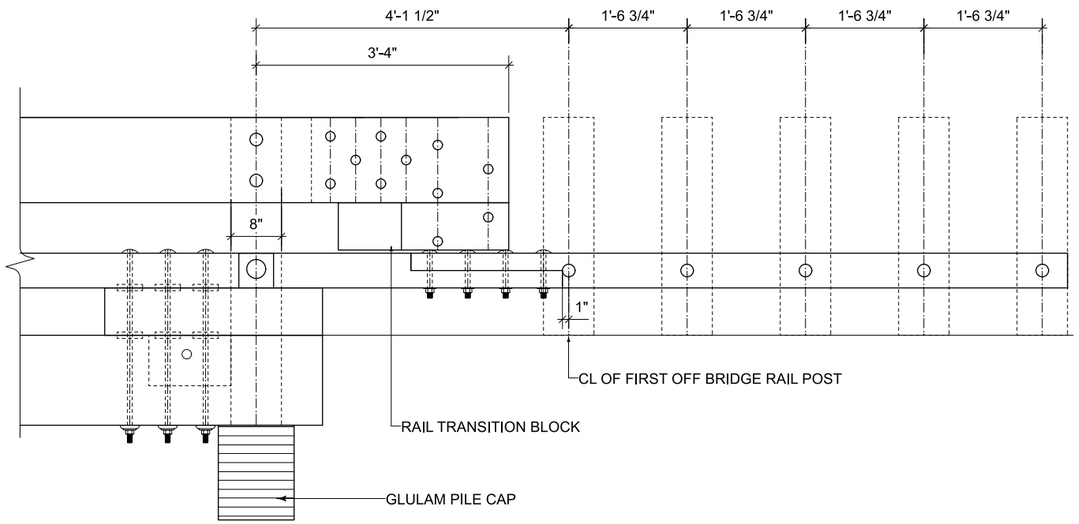
PLAN VIEW @ APPROACH RAIL TRANSITION



SECTION VIEW



ELEVATION VIEW



ELEVATION VIEW @ APPROACH RAIL TRANSITION

GUIDE RAIL DETAIL

The bridge design information depicted on these drawings was developed under a cooperative research agreement between Laminated Concepts and the Forest Service, Forest Products Laboratory.

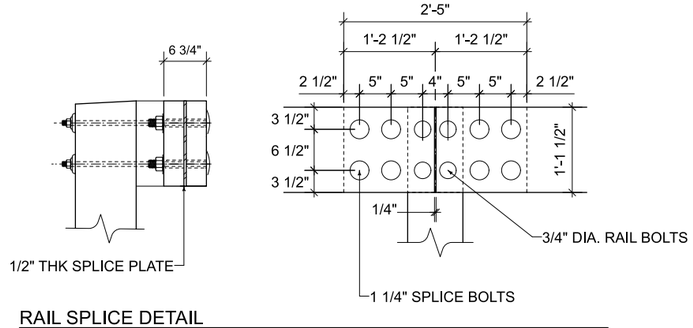
LONGITUDINAL DESIGN STANDARDS	LONGITUDINAL RAILING DESIGN AND DETAILS
STANDARDIZED PLANS FOR THE REPLACEMENT OF HISTORIC WOOD BRIDGE SUPERSTRUCTURES	Sheet Number: 11 of 13

Supplemental Material Specifications:

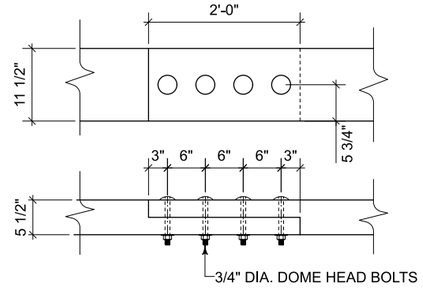
1. Sawn lumber and glued laminated timber shall comply with the requirements of AASHTO M168 and shall be pressure treated with wood preservative in accordance with AASHTO M133.
2. The bridge rail shall be horizontally glued laminated timber, visually graded, Southern Pine Combination #48.
3. Posts and spacer blocks may be sawn lumber or glued laminated timber. When sawn lumber is used, materials shall be visually graded #1 Southern Pine. Glued laminated timbers minimum tabulated values shall not be less than the following: Fb = 1,800 PSI : E= 1,800,000 PSI.
4. Glued laminated timber shall be treated before gluing with Copper Chromated Arsenate (CCA) to a minimum retention of 0.40 PCF and shall be in accordance with AWPA UC4A and P23.
5. When painting of the wood members is desireable, the following specifications shall be used:
   Wood primer must be latex based paint suitable for priming unpainted wood or exterior woodwork. Wood primer must comply with the MPI detailed performance standards for exterior wood primers and be listed on the MPI approved product list #6 for primer, latex for exterior wood.
   Latex based paint for exterior wood must comply with the MPI detailed performance standards for exterior latex paint and must be listed on one of the MPI approved products lists as shown in the following table:

MPI List No.	Category Name
10	Latex, exterior flat (MPI gloss level 1)
11	Latex, exterior semi-gloss (MPI gloss level 5)
119	Latex, exterior gloss (MPI gloss level 6)

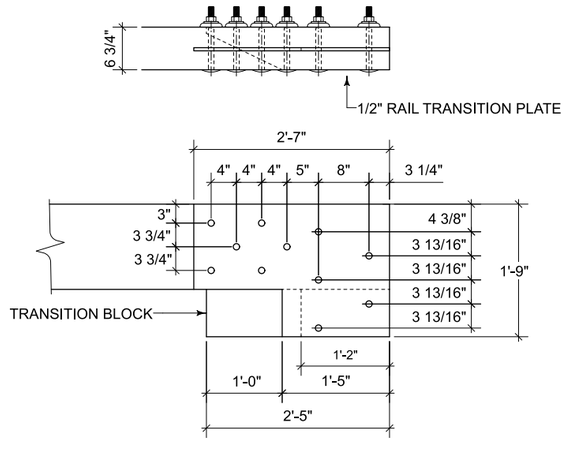
6. Steel plates and shapes shall comply with the requirements of ASTM A36.
7. Bolts shall comply with the requirements ASTM 307, Grade 2 and should preferably be dome head timber bolts.
8. Split rings shall be manufactured from SAE 1010 hot rolled carbon steel. Shear plates shall be malleable iron manufactured according to ASTM A-47, grade 32510.
9. All steel components and fasteners shall be galvanized in accordance with AASHTO M111 or AASHTO M232. Galvanizing of high strength steel bars shall follow the recommendations of the bar manufacturer so as not to adversely affect the mechanical properties of the steel. All steel assemblies to be galvanized after welding.
10. When field fabrication of wood is required or if wood is damaged, all cuts, bored holes and damage shall be immediatelly field treated with wood preservative in accordance with AASHTO M133.
11. Unless noted, malleable iron washers shall be provided under bold heads and under nuts that are in contact with wood. Washers may be omitted under heads of dome head timber bolts when the size and strength of the head is sufficient to develop connection strength without wood crushing.



RAIL SPLICE DETAIL



CURB SPLICE AND TRANSITION DETAIL



RAIL TRANSITION DETAIL

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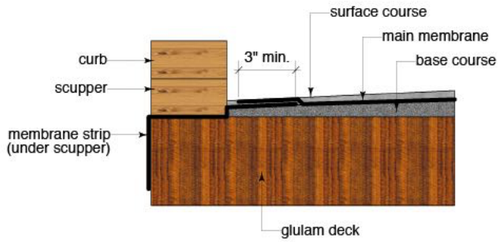
LONGITUDINAL DESIGN STANDARDS

LONGITUDINAL RAILING DETAILS

STANDARDIZED PLANS FOR THE REPLACEMENT OF HISTORIC WOOD BRIDGE SUPERSTRUCTURES

Sheet Number



Guidelines for Design, Installation and Maintenance of a Waterproof Wearing Surface for Timber Bridge Decks
(Post and rails omitted for clarity)

1. This asphalt wearing surface detail is recommended for most applications involving the timber bridge superstructures within these drawings. A crowned asphalt wearing surface, when used in combination with a waterproof asphalt layer or membrane, will shelter the bridge from moisture and potential deterioration.

Additional information about wearing surfaces for timber bridges is included in the following USDA Forest Service publications (see References):

- Ritter, M.A., 1990, Timber Bridges: Design, Construction, Inspection, and Maintenance
- Weyers et al., 2001, Guidelines for Design, Installation, and Maintenance of a Waterproof Wearing Surface for Timber Bridge Decks

2. Bituminous asphalt should be dense graded and is typically the same mix design specified by state and federal agencies with responsibilities for road paving and maintenance. The asphalt should be placed and compacted to a minimum thickness of 1¾ in. at the roadway edge, and slope ¼ in. per ft. minimum to centerline of roadway.

3. For proper wearing surface bonding and performance, the surface of the timber deck should be clean, dry, and free of excess wood preservative. Excess preservative is normally not present when the treating specifications and procedures recommended in these drawings are followed. If there are accumulations of preservatives on the deck surface, applying a surface blotter before paving can greatly improve geotextile and asphalt bonding. The blotter should be removed from the deck prior to paving. Leaving the deck unpaved for a period of 30 to 45 days will also help remove excess preservative and solvent from the deck surface.

4. Preformed waterproof paving membranes are typically a geotextile fabric or mesh embedded in rubberized asphalt and should be installed according to the manufacturer's recommendations. Prior to selecting a membrane, compatibility of the membrane material with the wood preservative used for the bridge deck should be verified. Paving membranes should never be used in direct contact with pentachlorophenol treated wood. Improved performance may result when the membrane is placed between two asphalt layers. This is typically accomplished by placing an initial asphalt layer that is crowned as required. The membrane is placed on this initial layer and a final 1- to 1 ¾-in.-thick uniform asphalt layer is placed on the membrane.

5. Preformed waterproof membranes may not adhere well to oil-borne preservative treated timber bridge decks, and the rubber may be incompatible with treatment chemicals. A waterproof layer can be created using asphalt cement or polymer modified asphalt emulsion in combination with a paving fabric and asphalt hot mix. Performance-graded asphalt cement and paving fabric should be applied in accordance with AASHTO M288, Section 9, and Appendix AB. Polymer modified asphalt emulsions may also be used if residual asphalt content meets the residual application rate recommended by the fabric manufacturer. Sufficient time must be allowed and appropriate weather conditions must exist for emulsions to cure prior to the application of fabric. Asphalt cement will normally be applied at a rate of 0.25 gallons per square yard before placing fabric. Polymer-modified asphalt emulsion would be applied at a rate of 0.37 gallons per square yard to obtain the same asphalt residual. The emulsion must cure until the water has evaporated before placing the fabric. Asphalt hot mix would then be placed and compacted between 250° and 320° F. Polymer modified asphalt emulsions should not be used in direct contact with oil-borne treated wood.

References

AASHTO. 2002. Standard specifications for highway bridges, 17th ed. Washington, DC: American Association of State and Highway Transportation Officials.

AASHTO. 2017. Standard specifications for transportation materials and methods of sampling and testing. Washington, DC: American Association of State and Highway Transportation Officials.
M 111 Zinc (hot-dip galvanized) coatings for iron and steel products
M 133 Standard specification for preservatives and pressure treatment processes for timber
M 168 Standard specifications for wood products
M 232 Zinc coating (hot-dip) on iron and steel hardware
M 275 Standard specification for uncoated high-strength steel bar for prestressing concrete
M 288 Standard Specification for Geosynthetic Specification for Highway Applications

AASHTO. 2020. AASHTO LRFD bridge design specifications. 9th ed. (with 2021 interims). Washington, DC: American Association of State and Highway Transportation Officials.

AITC. 2001. AITC 110-2001: Standard appearance grades for structural glued laminated timber. https://plib.org/aitc/ (accessed 13 August 2025).

AITC. 2005. AITC 111-2005: Recommended practice for protection of structural glued laminated timber during transit, storage, and erection. https://plib.org/aitc/ (accessed 13 August 2025).

APA–The Engineered Wood Association. 2022. ANSI 190.1-2022 Product standard for structural glued laminated timber. https://www.apawood.org/ansi-a190-1 (accessed 13 August 2025).

ASME. 2012. ASME B18.2.1: Square, hex, heavy hex, and askew head bolts and hex, heavy hex, hex flange, lobed head, and lag screws (inch series). New York: American Society of Mechanical Engineers.

ASTM. 2025 Annual book of standards. West Conshohocken, PA: ASTM International.
A36 Standard specification for carbon structural steel
A123 Standard specification for zinc (hot-dip galvanized) coatings on iron and steel products
A153 Standard specification for zinc coating (hot-dip) on iron and steel hardware
A307 Standard specification for carbon steel bolts, studs, and threaded rod of 60,000 psi tensile strength
A722 Standard specification for uncoated, high-strength steel bar for prestressing concrete

AWC. 2024. National design specifications (NDS) for wood construction. Leesburg, VA: American Wood Council.

AWPA. 2024. AWPA book of standards. Birmingham, AL: American Wood Protection Association.
M2 Standard for the inspection of preservative treated products for industrial use
M4 Standard for the care of preservative-treated wood products
P23 Standard for waterborne preservative
P36 Standard for oil-borne copper naphthenate, Hydrocarbon Solvent Type A
P39 Standard for oil-borne DCOI, Hydrocarbon Solvent Type A

AWPA. 2024. U1. Use category system: user specification for treated wood. https://awpa.com/images/standards/U1excerpt.pdf (accessed 13 August 2025).

Faller, R.K.; Ritter, M.A.; Rosson, B.T.; Fowler, M.D.; Duwadi, S.R. 2000. Two test level 4 bridge railing and transition systems for transverse timber deck bridges. Transportation Research Record 1696. Paper No. 5B0110. Washington, DC: National Academy Press: 334–351. https://research.fs.usda.gov/treesearch/5727.

Ritter, M.A. 1990, Timber bridges: design, construction, inspection, and maintenance. U.S. Washington, DC: U.S. Department of Agriculture, Forest Service. 944 p.

Ritter, M.A.; Faller, R.K.; Bunnell, S.; Lee, P.D. Hilbrich; Rosson, B.T., Jr. 1998a. Plans for crash-tested bridge railings for longitudinal wood decks on low-volume roads. Gen. Tech. Rep. FPL-GTR-107. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 11 p . https://doi.org/10.2737/FPL-GTR-107.

Ritter, M.A.; Faller, R.K.; Lee, P.D. Hilbrich; Rosson, B.T.; Duwadi, S.R. 1998b. Plans for crash-tested wood bridge railings for concrete decks. Gen. Tech. Rep. FPL-GTR-108. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 11 p. https://doi.org/10.2737/FPL-GTR-108.

Ritter, M.; Lee, P. 1996. Recommended construction practices for stress-laminated wood bridge decks. In: Gopu, V.K.A., ed. Proceedings of the international wood engineering conference. Baton Rouge, LA: Louisiana State University: 237–244. Vol. 1.

Wacker, J.P.; Smith, S. 2001. Standard plans for timber bridge superstructures. Gen. Tech. Rep. FPL-GTR-125. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 53 p. https://doi.org/10.2737/FPL-GTR-125.

Weyers, R.E.; Loferski, J.R.; Dolan, J.; Hramis, D.; Howard, J.E.; Hislop, L. 2001. Guidelines for design, installation, and maintenance of a waterproof wearing surface for timber bridge decks. Gen. Tech. Rep. FPL-GTR-123. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 15 p. https://doi.org/10.2737/FPL-GTR-123.

WWPI. 2012. Best Management Practices for the Use of Preserved Wood in Aquatic and Sensitive Environments. Vancouver, WA: Western Wood Preservers Institute. https://preservedwood.org/wp-content/uploads/BMP_Specifiers_Guide.pdf (accessed 13 August 2025).

The bridge design information depicted on these drawings was developed under a cooperative research agreement between Laminated Concepts and the Forest Service, Forest Products Laboratory.

PROTECTING BRIDGE DECK FROM MOISTURE

ASPHALT WEARING SURFACE GUIDELINES

STANDARDIZED PLANS FOR THE REPLACEMENT OF HISTORIC WOOD BRIDGE SUPERSTRUCTURES

Sheet Number

FOREST PRODUCTS LABORATORY

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