

SECTION 1031—TIMBER STRUCTURES

1031.1 DESCRIPTION—This work is the construction of all timber structures except hardwood glue-laminated (glulam) structures.

1031.2 MATERIAL—

(a) Structural Timber. Douglas Fir-Larch, Hem-Fir, Southern Pine, Beech, Birch, Hickory, Mixed Maple, Red Maple, Northern Red Oak, Red Oak, Mixed Oak, White Oak, and Yellow Poplar. Provide Select Structural, No. 1 or No. 2 grade lumber and timber. Provide sawn lumber and timber conforming to the Specifications for Structural Timber, Lumber and Piling, AASHTO M 168. Certify as specified in [Section 106.03\(b\)3](#).

All material to be well manufactured. Accept only pieces consisting of sound wood, free from decay. Avoid boxed heart timber.

Use structural timber complying with the American Softwood Lumber (ASL) Standard PS 20-70 for manufacture of dressed-sized lumber and timber products. Grade Douglas Fir-Larch and Hem-Fir using West Coast Lumber Inspection Bureau (WCLIB) or Western Wood Products Association (WWPA) inspection rules. Grade Douglas Fir-Larch (North) and Hem-Fir (North) using National Lumber Grades Authority (NLGA) inspection rules. Grade Southern Pine according to Southern Pine Inspection Bureau (SPIB) inspection rules. Grade Beech-Birch-Hickory, Mixed Maple, Red Maple, Northern Red Oak, Red Oak, Mixed Oak, and White Oak according to Northeast Lumber Manufacturer's Association (NELMA) grade rules. Grade Yellow Poplar according to Northern Softwood Lumber Bureau (NSLB) rules.

Adequately protect structural timber during transport.

Accept only kiln dried dimension lumber at 15% average moisture content, and 19% maximum moisture content.

Accept only solid sawn timbers that have been air seasoned or dried to an average moisture content not exceeding 19%.

Accept only softwood glue-laminated timbers with a maximum 16% moisture content.

Preservative treat lumber and timber by pressure treatment process according to the AWPAC1, "All Timber Products - Preservative Treatment by Pressure Processes."

Treat structural timbers for highway/bridge construction according to AWPAC14, "Wood for Highway Construction - Preservative Treatment by Pressure Processes."

Minimum retention of creosote preservative for wood species not covered under AWPAC14 is 185 kg/m³ (11.6 pounds per cubic foot).

Treat piles as specified in [Section 1005.2\(a\)](#) and according to the AWPAC3, "Piles - Preservative Treatment by Pressure Processes."

Provide treated lumber and timber products with permanent symbol imprints or documentation to identify the treating company, treatment type, year of treatment, and certification of conformance with AWPAC. Certify as specified in [Section 106.03\(b\)3](#).

Accept treated structural timber that conforms to appropriate recommended AWPAC treatment requirements.

(b) Adhesives (Glulam Fabrication). Provide adhesives conforming to ANSI/AITC A190.1, "Structural Glued Laminated Timber," Section 4.4. Provide wet-use adhesives. Certify as specified in [Section 106.03\(b\)3](#).

(c) Hardware. Furnish bolts, nuts, washers, timber connectors, drift pins, dowels, nails, screws, spikes, other metal fasteners, and wire rope as necessary. Provide bolts and nuts as specified in [Section 1105.02\(c\)1](#). Provide machine head bolts and nuts of regular hex series and coarse thread series, Class 6g and 6H (Class 2) tolerances, all conforming to applicable ANSI Standards. Provide cast iron Ogee, malleable iron, plate, or cut washers, as indicated. Galvanize all hardware except cast and malleable iron. Certify as specified in [Section 106.03\(b\)3](#).

(d) Galvanizing. [Section 1105.02\(s\)](#). Galvanize hardware after fabrication.

(e) Structural Steel. [Section 1105.02\(a\)](#)

(f) Painting. Paint all structural steel, except hot-dip galvanized material, as specified in [Section 1060](#).

(g) Laminated Girders and Deck Panels.**1. Fabrication.**

1.a Mechanically Laminated Panels. Perform all possible fabrication of mechanically laminated members before preservative treatment.

Treat mechanically laminated girders and deck panels for highway construction according to AWWA C14.

1.b Glued laminated Members. Fabricate structural glued laminated softwood timber according to ANSI/AITC 190.1, "Structural Glued Laminated Timber," and AITC-117, "Manufacturing, Standard Specifications for Structural Glued Laminated Timber of Softwood Species."

Treat glued laminated timbers for highway construction according to AWWA C14.

2. Tolerances. Provide laminated structural members with net width, depth, and length as indicated on the structural drawings, and with tolerances according to the ANSI/AITC A190.1 (AITC 113, "Standard for Dimensions of Structural Glued Laminated Timber") or tolerances as follows:

- **Width.** ± 1.5 mm ($\pm 1/8$ inch) of the indicated width.
- **Depth.** ± 1 mm per 100 mm ($\pm 1/8$ inch per foot) of indicated depth.
- **Length.** ± 1.5 mm ($\pm 1/8$ inch) up to 6 m (20-foot) length with a ± 1.5 mm ($\pm 1/8$ -inch) allowance for every 6 m (20 feet) of additional length.
- **Squareness.** Provide a cross section for all glued laminated structural members which is square within ± 1 mm per 100 mm ($\pm 1/8$ inch per foot) of depth of member unless a special shape is indicated.
- **Beam Camber.** ± 6 mm ($\pm 1/4$ inch) for lengths up to 6 m (20 feet). Add ± 1.5 mm ($\pm 1/8$ -inch) allowance for each additional 6 m (20-foot) length.

Provide industrial appearance grade glued laminated timbers according to AITC 110, "Standard Appearance Grades for Structural Glued Laminated Timber."

Accept only glued laminated timbers in standard dressed widths according to AITC 113.

(h) Membrane Waterproofing. [Section 680](#)

(i) Bituminous Wearing Course ID-2. [Section 420.2](#)

(j) Timber Piles. [Section 1005.2\(a\)](#)

(k) Cement Concrete. Class A and Class AA. [Section 704](#).

(l) Wood Preservative. AASHTO M 133. Certify as specified in [Section 106.03\(b\)3](#). Use only oil-borne preservatives with hardwood lumber and timber.

1031.3 CONSTRUCTION—

(a) Storing and Handling. Store lumber and timber neatly in piles on skids above ground. Protect from exposure to the elements if stored for prolonged periods of time. Store material so that it can be readily inspected.

Handle in a manner that will avoid injury or breakage. Handle treated lumber with nylon or other non-damaging rope slings. Do not use cant hooks, peaveys, or other sharp instruments in handling treated timber. Provide corner protection for banded material. The Department will reject treated lumber unduly injured in handling.

(b) Workmanship. Cut all lumber and timber accurately, and frame to a close fit, to provide for even bearing of joints over the entire contact surfaces. Make joints without shimming. Field drill only as indicated or as allowed.

1. Bored Holes. Treat all bored, drilled, or reamed holes with approved field treatment according to AWWA M4, “Standard for the Care of Preservative-Treated Wood Products.” Plug unfilled holes, after field treatment, with treated timber plugs.

Bore holes in untreated lumber 2 mm (1/16 inch) in diameter less than the pin or dowel. Bore holes 2 mm (1/16 inch) in diameter larger than the bolt. Bore holes for lag screws not larger than the base of the thread. Bore holes in small timbers with the same diameter as the spike shank when necessary to prevent splitting. Do not field drill or nail, except for railing.

2. Installation of Connectors. Provide one of the following timber connector types, as indicated: split ring, shear plate, or spike grid. Install split ring and shear plate types in precut grooves of dimensions as indicated or as recommended by the manufacturer. Force spike grids into the wood so that timbers will be in firm contact. Use pressure equipment that does not damage the wood. High-strength bolts or rods fitted with low friction ball-bearing washers made for this purpose may be used. Replace the high-strength bolts with specified bolts for the final installation. Embed all connectors of this type at a joint simultaneously and uniformly.

Cut connector grooves in timber concentric with the bolt hole, conforming to the cross-sectional shape of the rings, and providing a snug fit. Supply an inside groove diameter larger than nominal ring diameter so that the ring will expand slightly during installation. (See Table A)

3. Bolts and Washers. Use a washer of the size and type indicated under all bolt heads (except for timber bolts with economy type heads) and nuts that would otherwise come in contact with wood.

After final tightening, lock the nuts of all bolts.

(c) Substructure. Construct as indicated, and as follows:

1. Bent Piles. Drive piles as accurately as possible in the correct location, vertical or to the batter indicated, and as specified in [Section 1005.3](#).

Make cut-offs accurately to ensure uniform bearing between the sills and piles of a bent. Treat cut pile ends according to AWWA M4.

2. Framed Bents. Bed mudsills firmly and evenly upon solid bearing material, and tamp into place. Construct concrete pedestals for the support of framed bents, as specified in the applicable portions of [Section 1001.3](#). Finish pedestals carefully to provide full and even bearing for sills or posts.

Provide for true and even bearing of sills on mudsills, piles, or pedestals. If possible, remove all earth from contact with sills to provide for free air circulation around them.

3. Bearing Sill Caps. Place timber caps to secure an even and uniform bearing over the tops of the supporting posts or piles, and to secure an even alignment of their ends. Secure all sills as indicated. For sills secured using drift bolts, place drift bolts approximately in the center of the post or pile.

4. Bracing. Properly align bents before placing bracing. Bolt the ends of bracing through the pile, post, or cap. Furnish bracing of sufficient length to provide a minimum distance of 200 mm (8 inches) between the outside bolt and the end of the brace.

TABLE A
Typical Dimensions of Timber Connectors
(dimensions in mm (in.))

Split Rings				
Size	65 mm (2 1/2 in.)		100 mm (4 in.)	
Split ring				
Inside diameter at center when closed	65 (2.500)		100 (4.000)	
Thickness of metal at center	4.14 (0.163)		4.90 (0.193)	
Depth of metal (width of ring)	19.05 (0.750)		25.40 (1.000)	
Groove				
Inside diameter	65 (2.56)		105 (4.08)	
Width	4.57 (0.18)		5.33 (0.21)	
Depth	9.53 (0.375)		12.70 (0.50)	
Bolt diameter	12.7 (1/2)		19.1 (3/4)	
Bolt hole diameter	14.3 (9/16)		20.6 (13/16)	
Washers, standard				
Round, cast or malleable iron, diameter	67 (2 5/8)		75 (3)	
Round, mild steel				
Diameter	35 (1 3/8)		50 (2)	
Thickness	2.30 (3/32)		4.00 (5/32)	
Square plate, mild steel				
Length of side	50 (2)		75 (3)	
Thickness	3 (1/8)		5 (3/16)	
Shear Plates				
Size	65 mm (2 1/2 in.)	65 mm (2 1/2 in.)	100 mm (4 in.)	100 mm (4 in.)
Shear plate material	Pressed steel	Light gage	Malleable	Malleable
Diameter of plate	66.6 (2.62)	66.6 (2.62)	102.4 (4.03)	102.4 (4.03)
Diameter of bolt hole	20.6 (0.81)	20.6 (0.81)	20.6 (0.81)	23.9 (0.94)
Thickness of plate	4.4 (0.172)	3.1 (0.12)	5.1 (0.20)	5.1 (0.20)
Depth of flange	10.7 (0.42)	8.9 (0.35)	16.3 (0.64)	16.3 (0.64)
Use steel straps or shapes, for use with shear plates, designed according to accepted engineering practices.				
Hole diameter in straps or shapes for bolts	22 (13/16)	22 (13/16)	22 (13/16)	24 (15/16)
Circular dap dimensions				
A	66.8 (2.63)	66.8 (2.63)	102.4 (4.03)	102.4 (4.03)
B	—	27.2 (1.07)	39.4 (1.55)	39.4 (1.55)
C	20.6 (0.81)	20.6 (0.81)	20.6 (0.81)	23.9 (0.94)
D	—	16.5 (0.65)	24.6 (0.97)	24.6 (0.97)
E	4.8 (0.19)	3.3 (0.13)	6.9 (0.27)	6.9 (0.27)
F	11.4 (0.45)	9.7 (0.38)	16.3 (0.64)	16.3 (0.64)
G	6.4 (0.25)	3.6 (0.14)	5.6 (0.22)	5.6 (0.22)
H	—	8.6 (0.34)	12.7 (0.50)	12.7 (0.50)
I	57.2 (2.25)	60.2 (2.37)	88.7 (3.49)	88.7 (3.49)
Bolt hole—diameter in timber	22 (13/16)	22 (13/16)	22 (13/16)	24 (15/16)
Washers, standard				
Round, cast or malleable iron, diameter	75 (3)	75 (3)	75 (3)	90 (3 1/2)
Round, medium steel, minimum				
Diameter	50 (2)	50 (2)	50 (2)	55 (2 1/4)
Thickness	4.00 (5/32)	4.00 (5/32)	4.00 (5/32)	4.60 (11/64)
Square plate				
Length of side	75 (3)	75 (3)	75 (3)	75 (3)
Thickness	5 (1/4)	5 (1/4)	5 (1/4)	5 (1/4)

(d) Superstructure. Construct as indicated, and as follows:

1. Timber Stringers. Place stringers for bridge decks better edge down. Provide for even bearing of the floor on the stringers. Use butt joints for outside stringers, centered over caps of floor beams. Lap interior stringers to take bearing over the full width of cap or floor beams at each end.

Frame cross-bridging between stringers neatly and accurately, and fasten securely. Provide for full bearing of each end of cross-bridging members against the sides of stringers. Unless otherwise directed, place cross-bridging at the center of each span and at supports.

2. Glued laminated Timber Stringers. Place stringers according to beam fabricators' "TOP" mark. Provide for even bearing of the deck on all stringers at piers as indicated, but allow no less than 15 mm (1/2 inch) clearance between butt ends to allow for air circulation.

Treat all field drilled holes or reamed holes before installation of hardware according to AWPA M4. Treat all field-drilled holes before installing diaphragms.

Provide for close fit (full bearing) of diaphragm between stringer beams. Place diaphragms or cross bracing as indicated.

3. Wheelguards, Rail, and Barrier. Frame and align wheel guards, rail posts, rails, and barriers accurately and as indicated.

4. Panel-to-Panel Connections. Provide a snug fit for all panel-to-panel connections on interconnected decks. Field drill or ream connections only if directed. Treat all field-drilled or reamed holes according to AWPA M4.

(e) Surface Treatment of Timber. Do not paint wood treated with oil-borne preservatives.

Using pressure process, treat portions of rail posts that are to be embedded in earth or concrete and where faces of timber bulkheads will be in soil contact, with a 190 kg/m³ (11.9 pounds per cubic foot) retention of creosote preservative for softwoods and 185 kg/m³ to 190 kg/m³ (11.6 pounds per cubic foot to 11.9 pounds per cubic foot) retention of creosote for hardwoods.

Apply a two-coat finish sealer to treated structural timber railings where prolonged exposure to direct human contact is likely. Acceptable sealers include latex epoxy, urethane, shellac, or other finishes with effective coating agents that adhere to treated rails.

When framing, cutting, or boring of treated timber is performed after treatment, swab all cuts, daps, and holes thoroughly with two applications of accepted wood preservative treatments according to AWPA M4.

(f) Post-Tensioning. Perform post-tensioning operations as directed.

(g) Bituminous Wearing Surface. Clean the deck of the heavier excretions and surface residues of the treatment solution before constructing the bituminous leveling course.

Spread a blotter of fine material (silt and sandy silt) over the surface. Use a mixture consisting of 20% crushed material passing a 2.36 mm (No. 8) sieve and 80% material passing a 150 µm (No. 100) sieve. Spread at a rate of 5 kg/m² to 8 kg/m² (10 pounds per square yard to 15 pounds per square yard). Broom off the blotter material. Repeat process until the surface is free of exudates.

Construct the bituminous leveling course as indicated and as specified in [Section 420.3](#). Use only non-vibratory rollers for compaction of the bituminous leveling course.

For stressed-laminated timber decks, prepare the bituminous leveling course surface and construct waterproofing membrane as indicated.

Construct the bituminous surface course as specified in [Section 420.3](#). Use only non-vibratory rollers for compaction of the bituminous surface course.

Provide geotextile Class 4 fabric as specified in [Section 735](#), for glued laminated timber decks. No leveling course is necessary for glued laminated decks.

1031.4 MEASUREMENT AND PAYMENT—Lump Sum

- (a) **Fabricated Structural Steel.** [Section 1050.4](#)
- (b) **Structural Timber.** Cubic Meter (Cubic Foot)
- (c) **Membrane Waterproofing.** [Section 680.4](#)
- (d) **Guide Rail.** [Section 620.4](#)
- (e) **Geotextiles, Class 4.** [Section 212.4](#)
- (f) **Piles.** [Section 1005.4](#)
- (g) **Bituminous Wearing Course ID-2.** [Section 420.4](#)
- (h) **Cement Concrete.** [Section 1001.4](#)