Laminated Wood Structures

View to dining bridge at dusk; photography by Timothy Hursley. Courtesy of Crystal Bridges Museum of American Art, Bentonville, Arkansas.
The pioneer in glued wood technology, Arkansas Laminating, LLC offers full service capabilities in design, engineering, fabrication, and installation of glued-laminated structural systems.

Strong, attractive, and economical, Arkansas Laminating, LLC’s glued-laminated arches, beams, columns, and lighting standards provide architects, engineers, and contractors opportunities for aesthetic expression, design flexibility, and functional efficiencies in commercial, recreational, religious, educational and industrial structures.

Seven decades of manufacturing know how provide Arkansas Laminating, LLC the expertise to fabricate complex laminated wood designs with a standard of craftsmanship unmatched in the industry.

Material in Arkansas Laminating, LLC’s beams and arches are designed and manufactured in accordance with the quality control standards of the West Coast Lumber Inspection Bureau/American Institute of Timber Construction and the American National Standards Institute as defined by ANSI National Standard A190.1. Our material is subjected to quality testing and inspection.

Our Reputation

We are a network of trained company salesmen, sales representatives, and sales analysts plus a staff of registered professional engineers who are ready to assist architects and engineers with design development of laminated wood structural systems.

Typical Connection Details for Laminated Wood

**Beam Connections**

**SIMPLE BEAM ANCORAGE CLEARANCE DETAIL**
For beams with depths 24 in. and less. Resists uplift and small horizontal forces. Bearing plate or moisture barrier recommended.

**WELDED AND BENT STRAP TYPE PURLIN HANGER**
For moderate and heavy loads. Provides uniform fit where good appearance is desired. Purlins can be raised above top of beam to allow sheathing to clear straps.

**Arch Connections**

**ARCH PEAK**
This connection transfers both vertical and horizontal forces. It consists of two shear plates back-to-back and a through bolt or threaded rod with washers counterbored into the arch.

**ARCH SHOE WITH CONCEALED ANCHOR BOLTS**
Daps are provided in arch base for anchor bolt heads.

**Column Connections**

**CLIP ANGLE ANCHORAGE TO CONCRETE BASE**
Recommended for industrial buildings and warehouses to resist both horizontal forces and uplift. Bearing plate or moisture barrier is recommended.

**BEAMS TO GLULAM COLUMN T-PLATE**
Steel T-plate is bolted to abutting Glulam beams and to Glulam column. Loose bearing plate may be used where column cross-sectional area is insufficient to provide bearing for beams in compression perpendicular to grain.
Arkansas Laminating, LLC's Section Properties

Arkansas Laminating, LLC can furnish beams and arches of many other sizes to suit countless requirements. Only the most common conditions have been presented in these tables.

Symbol Identification
A = Area = in²
S = Section Modulus = in³
I = Moment of Inertia = in⁴

NOTE: To determine per lineal foot weight in pounds of southern pine laminated cross-sections, divide the area of section shown by 4. ANSI Standard A 190.1 for Structural Glued-Laminated timber permits the use of industry width or depth for sizes. Arkansas Laminating, LLC's standard finished cross-sections are based on 1 3/8” actual lamination thickness, widths as tabulated above. Tudor arches are fabricated from “boards” (vs. dimension lumber) and staggered layup for such tapered sections doesn’t warrant sizing on a 3/4” (or 15/16”) thick lamination increment basis.

<table>
<thead>
<tr>
<th>Depth (In.)</th>
<th>No. Lams</th>
<th>3” (4” Nom.)</th>
<th>6” (6” Nom.)</th>
<th>6 3/8” (8” Nom.)</th>
<th>8 1/2” (10” Nom.)</th>
<th>10 1/2” (12” Nom.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 1/2</td>
<td>4</td>
<td>16.5</td>
<td>27.5</td>
<td>46.4</td>
<td>70.1</td>
<td>93.5</td>
</tr>
<tr>
<td>6 7/8</td>
<td>5</td>
<td>20.6</td>
<td>34.4</td>
<td>55.7</td>
<td>75.1</td>
<td>93.5</td>
</tr>
<tr>
<td>8</td>
<td>6</td>
<td>24.8</td>
<td>41.3</td>
<td>55.7</td>
<td>75.1</td>
<td>93.5</td>
</tr>
<tr>
<td>9 1/4</td>
<td>7</td>
<td>28.9</td>
<td>48.1</td>
<td>60.0</td>
<td>81.8</td>
<td>101.1</td>
</tr>
<tr>
<td>11 1/8</td>
<td>8</td>
<td>33.0</td>
<td>55.0</td>
<td>74.3</td>
<td>93.5</td>
<td>115.5</td>
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</tbody>
</table>

12 3/8

13 3/4

15 5/8

16 7/8

18 7/8

19 1/4

20 1/2

22 1/2

23 3/8

24 3/4

26 1/8

27 3/8

28 3/4

29 1/2

30 1/2

31 3/8

33

34 5/8

35 5/8

36

37 1/2

38 1/2

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40 1/2

41 1/2

42 1/2

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45 1/8

46 3/4

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49 3/8

50 3/8

51 3/8

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56 3/8

57 3/4

59 5/8

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Arkansas Laminating, LLC’s Laminated Roof Beams

The beam tables are applicable only for straight, simply-supported beams which are laterally supported by decking, joists or purlins, etc. Also, the ends of beams must be restrained against rotation.

Roofs should have a minimum slope of 1/4 inch per foot for drainage to help avoid ponding of water. The allowable loads shown are for applied loading in pounds per lineal foot and include the beam weights.

Allowable stresses (dry conditions of use):

a. Bending stresses, $F_b = 2400$ psi (adjusted by the effect of beam size)
b. Shear stress, $F_v = 200$ psi
c. Modules of elasticity, $E = 1,800,000$ psi
d. Allowable stresses $F_b$ and $F_v$ have been increased 15% for two months duration of loads.
e. Deflections are limited to 1/180 span for total load.

These ratings only apply with the beams oriented properly. Look for “top” markings on member and install accordingly. If beams are used for conditions other than simple spans, special lumber combinations may be required.
### Preliminary Design Tables

<table>
<thead>
<tr>
<th>Span = 30”</th>
<th>Span = 40”</th>
<th>Span = 50”</th>
<th>Span = 60”</th>
<th>Span = 70”</th>
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<tbody>
<tr>
<td><strong>Loading</strong></td>
<td><strong>Real Pitch</strong></td>
<td><strong>Wall Height</strong></td>
<td><strong>Base, (a)</strong></td>
<td><strong>Lower Tangent</strong></td>
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<tr>
<td>10</td>
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<td>7.25</td>
<td>10.4</td>
<td>9.6</td>
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<td>7.25</td>
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<td>7.25</td>
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<td>11.0</td>
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<tr>
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<td>24</td>
<td>5</td>
<td>7.25</td>
<td>17.6</td>
<td>16.0</td>
</tr>
</tbody>
</table>

Table Specifications

1. Sizes are for arches manufactured with southern pine lumber using a 8’6” haunch radius and based on the following design criteria:
   - Bending stress, $F_b = 2400$ psi
   - Shear stress, $F_v = 200$ psi
   - Compression parallel to grain, $F_c = 1700$ psi
   - Modulus of elasticity, $E = 1,700,000$ psi
   - Allowable bending stresses are increased 15% for two month duration of snow or live loads.
2. Vertical arch legs are laterally supported.
3. Vertical dead loads and live loads are assumed to be uniform on the horizontal projection of the arch.
4. No lateral loads are considered. Final design must consider wind and earthquake loads.
5. Please note many building codes require special loadings for arches, such as:
   - Full unbalanced live loads.
   - Simultaneous application of dead, live, and wind loads.
   - Different components of wind loads to be applied to windward wall, windward slope, leeward wall and leeward slope, depending on arch geometry. Unique loading requirements, different arch geometries or special deflection controls must be checked by a competent designer.
6. Obviously, there are many arch configurations other than those tabulated that can be utilized. Haunch radii larger than 8’6” are sometimes used, even to the point of permitting slightly lesser tangent depths.
Arkansas Laminating, LLC's Guide Specifications for Glued Laminated Wood Construction

Division 6
Glued-Laminated Timber

General:
1. Code and Reference Standards:
   “National Design Specifications for Stress-Grade Lumber and Its Fastenings”.
   American Wood Preservers Association AITC standards referenced this sheet.

2. Description of Work:
The extent of glued-laminated timber work is shown on drawings, either by terminology used in this specification or by the abbreviations as indicated.

3. Quality Assurance:
   Standards:
   Manufacturer:
   Provide factory-glued timber units, produced by an AITC licensed firm, qualified to issue the AITC “Quality Inspected” Mark. Factory mark each piece of glued-laminated timber with AITC Quality Inspected Mark. Place AITC Mark on timber surfaces which will not be exposed in completed work.
   Manufacture of glued-laminated timber shall be by:
   Arkansas Laminating, LLC
   PO Box 669
   Magnolia, AR 71754-0669

4. Submittals:
   Product Data:
   Submit certification, indicating glued-laminated timbers comply with requirements of ANSI A190.1-latest edition.
   Shop Drawings:
   Submit shop drawings showing full dimensions of each member. Indicate species and stress grade of lumber, type of glue, and other variables in required work. Arkansas Laminating, LLC shall furnish four (4) sets of shop drawings for architect’s approval prior to fabrication.
   The contractor shall verify dimensions and be responsible for coordinating same.

5. Materials:
   Lumber:
   Comply with ANSI A190.1 and applicable lumber association standards cited there-in for grades required to achieve glued-laminated timber requirements for allowable stress, appearance, fabrication limitations and species.
   Preservative Treatment:
   Where preservative treatment is specified or shown on plans, pressure treat lumber prior to gluing with Pentachlorophenol in mineral spirits in accordance with AITC 108 “Standard for Preservative Treatment of Structural Glued-Laminated Timber.”
   Lumber Species:
   Southern Pine
   Adhesive:
   Adhesives shall be wet-use (waterproof) complying with ANSI A190.1.

6. Timber Design:
   General:
   Provide sizes and shapes shown on plans. Final cross sections will be based on manufacturer’s standard widths and depths. Manufacturer to provide design values (stresses) to fulfill structural demand in accordance with applicable provisions of AITC 117 “Design, Standard Specifications for Structural Glued-Laminated Timber of Softwood Species.”
   Camber:
   Except as otherwise indicated, fabricate horizontal load-bearing members, which are shown as straight members with a camber as shown on the drawings.
   Steel connections:
   Provide fabricated steel connections to join laminated to laminated, and laminated to support exclusive of items embedded in concrete or welded to structural steel or connected to stud walls.
   A. Steel work to conform to A.I.S.C. Specifications.
   B. Steel shall conform to Mild Steel M-1020.
   C. Bolts shall conform to ASTM A-307.
   D. Shop paint fabricated steel with one coat of rust inhibitive primer. Bolts are not shop painted with primer.

7. Appearance Grade:
   Provide Grade timbers complying with AITC 110. Choose one of the following Appearance Grades.

   A. AITC Premium provides a smooth surface of free knot holes or voids, should be specified when members are to be stained or varnished. AITC Architectural is suitable for applications where appearance is a factor; knot holes and loose knots over 3/4 inch in diameter are not allowed.
   B. AITC Industrial can be specified when appearance is not a factor, for applications including floor beams, concealed construction or industrial installations.
   C. Rustique features a weathered, roughened surface that can be factory stained to provide a rustic motif; dark stains develop more uniform color.

8. Finish:
   Choose one of the following finishes.
   Factory applied penetrating sealer.

   Factory finished with (1) coat of stain, Arkansas Laminating, LLC will submit samples of finish for approval.

9. Factory Applied Protection:
   Immediately after end-cutting each member to final length, apply a saturation coat of end sealer to ends and other cross cut surfaces. Before shipping or exposing to outdoor conditions, individually wrap each member with manufacturer’s standard, opaque, durable, water-resistant, plastic coated paper covering with water resistant seams.

10. Product Handling:
   Schedule delivery and installation of glued-laminated wood members to avoid extended on-site storage. Comply with AITC III-Recommended Practice for Protection of Structural Glued-Laminated Timber During Transit, Storage, and Erection.
   Keep laminated wood members as dry as possible during all phases of construction. If jibsete storage is necessary, place members on blocking away from ponding water and cover with a waterproof covering which will not allow ultraviolet ray penetration.
   Time of removal of factory wrapping is optional, but it must be emphasized that factory applied wrapping provides additional protection from damage in handling and in-transit only. If further utilization of the wrap is desired for protection after shipment, the members should be inspected and provided with additional protection as necessary. If it is impractical to replace wrapping, ALL of it should be removed. Do not allow moisture to accumulate inside wrapping.
   Do not remove wrapping on individually wrapped members until it will serve no useful purpose, including protection from the weather, soiling, and damage from work of other trades.
   It is imperative that the field handling instructions sheet (white envelope) that comes with the material shipment be thoroughly reviewed before unloading.

11. Installation:
   General:
   The anchor bolt settings and/or bearing elevations (not Arkansas Laminating, LLC’s responsibility) must be held within 1/8” of the dimensions shown on the shop drawings.
   All members must be adequately braced until the complete structural system (all pertinent construction materials) has been installed. Correction of minor misfits and a reasonable amount of curving, reaming, redrilling or alignment with drift pins will be considered a legitimate expense of erection.