CONNECTIONS FOR BUILT-UP GLULAM BEAMS

When a pair of narrow glulam beams must be combined to carry a specific load, it is essential that the two glulam elements be attached together in a manner that will permit the load to be shared equally by both beams. The International Building Code provides guidance for lumber framing in Table 2304.9.1, item 24, "Built-up girder and beams." Developed for nominal 2x framing, the attachment recommendations listed are not appropriate for members wider than 1-1/2 inches. It is the purpose of this Technical Topic to provide similar guidance for glulam members 3-1/8-inches wide and wider.

For the purpose of this publication, both glulam beams are assumed to be full length, have adequate lateral bracing to avoid buckling, have the same width, stiffness, bending capacity and have adequate bearing at supports to carry the applied load.

Top-Loaded Applications: In a top-loaded application, load is applied perpendicular to the span of the built-up beam and parallel to the depth of the beams – e.g., a wall or post resting on the top of a built-up beam (Figure 1). Theoretically, if the load is bearing equally on both elements of the built-up beam and the elements are identical in strength and stiffness, the load should be equally distributed between both beams without any beam-to-beam connections. In reality, because the loads are seldom positioned and bearing exactly as planned, and due to the natural variability in any manufactured product, a minimum connection between the glulam beams is necessary. This minimum attachment is provided in Table 1. It is important to note that this also serves as the ***minimum*** attachment requirement between a pair of beams for any loading condition.

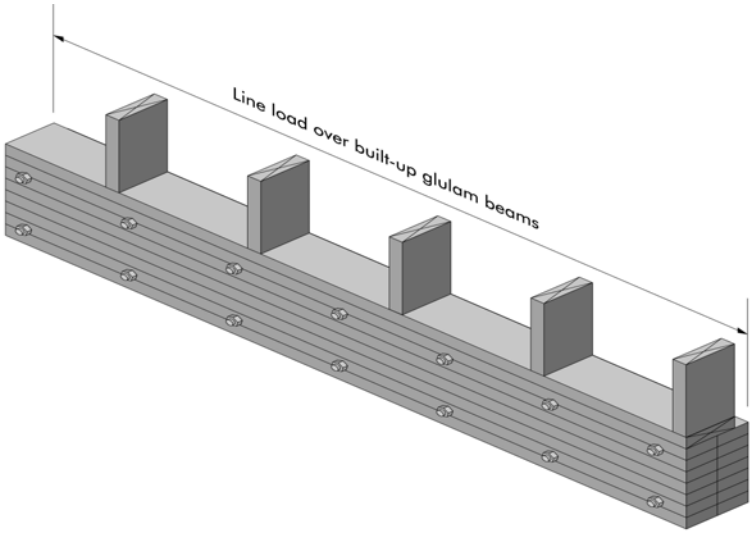

Figure 1

Table 1. Minimum connection requirements for top-loaded applications.

Fastener	Two rows spaced at:
1/2-inch-diameter lag screws[1]	24 inches on center
1/2-inch-diameter bolts[2]	

[1] Lag screws shall conform to ASTM A307 and have a minimum yield strength of 45,000 psi. Lag screws shall be of sufficient length to fully penetrate both glulam beams. For example, for 2 glulams 3-1/8-inches wide, the lag screw shall be at least 6-1/4-inches long. Lag screws shall be equipped with cut washers and placed with a wrench via a 3/8-inch lead hole. Lag screws **shall not** be driven into the beam with a hammer.

[2] Bolts shall conform to ASTM A307 and have a minimum yield strength of 45,000 psi. Bolt holes shall be the same diameter as the bolts and be located a minimum of 4 times the diameter of the bolt away from the glulam edge and end (2 inches for a 1/2-inch-diameter bolt). Standard cut washers shall be used between head and nut of the bolt and the glulam.

Side-Loaded Applications: When a load is applied to one side of a built-up glulam, or an unbalanced load is applied to both sides (Figure 2), the elements of the built-up beam shall be attached such that the applied load is distributed equally to all elements of the built-up glulam beam. Like the minimum attachment as shown in Table 1, this connection is most often made with lag screws or bolts. The capacities of various fastener types and diameters are given in Table 2 for a built-up beam composed of two beam elements only. Connections for more than two beam elements are beyond the scope of this publication.

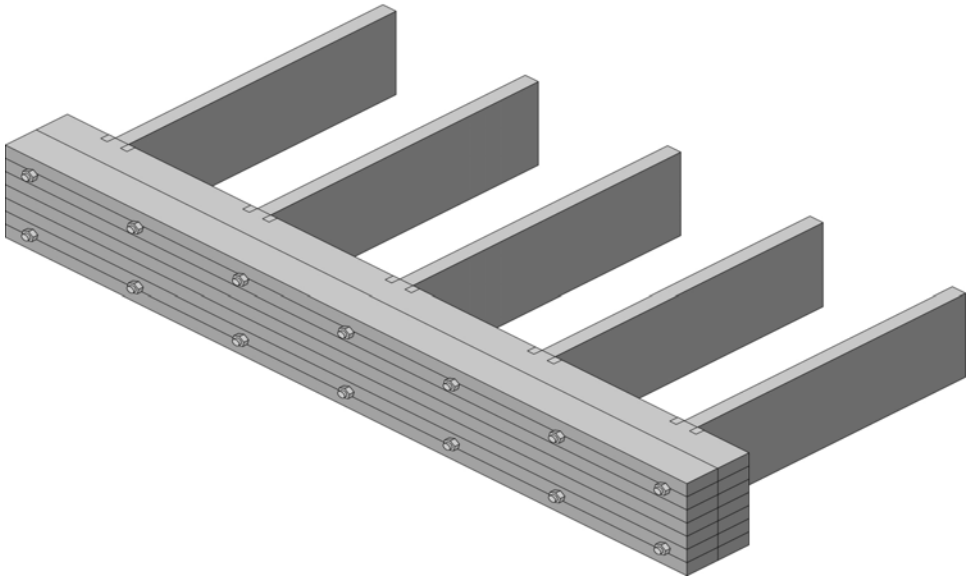

Figure 2

Table 2. Uniform load capacities of two-beam connections (plf) [1]

Fastener[2]	Two rows spaced at[5]					
	24 inches on center			12 inches on center		
	Glulam species					
	SP	DF	SPF	SP	DF	SPF
1/2-inch-diameter lag screws[3]	500	480	420	1000	960	840
1/2-inch-diameter bolts[4]	920	860	700	1840	1540	1400
5/8-inch-diameter lag screws[3]	780	720	640	1560	1440	1280
5/8-inch-diameter bolts[4]	1170	1000	790	2340	2000	1580

[1] Capacities given are for two-beam (single-shear) connections under normal (10-yr.) load duration. The minimum width for each glulam beam element is assumed to be 3-1/8 inches. Increases for other load durations are permitted. For connections with more than 2 beam elements (e.g. double-shear), consult with an engineer/architect competent in timber engineering.

[2] Use 5/8-inch-diameter bolts and lag screws when each glulam beam element is wider than 3-1/2 inches.

[3] Lag screws shall conform to ASTM A307 and have a minimum yield strength of 45,000 psi. Lag screws shall be of sufficient length to fully penetrate both glulam beams. For example, for 2 glulams 3-1/8-inches wide, the lag screw shall be at least 6-1/4-inches long. Lag screws shall be equipped with cut washers and placed with a wrench via a 3/8-inch lead hole for the 1/2-inch-diameter lag screws and a 15/32-inch lead hole for 5/8-inch-diameter lag screws. Lag screws **shall not** be driven into the beam with a hammer.

[4] Bolts shall conform to ASTM A307 and have a minimum yield strength of 45,000 psi. Boltholes shall be the same diameter as the bolts and be located 4 times the diameter of the bolt away from the glulam edge and end (2 inches for a 1/2-inch-diameter bolt). Standard cut washers shall be used between head and nut of the bolt and the glulam.

[5] Offset bolt or screw spacing so that protruding fasteners do not interfere with intersecting side members.

Design Procedure for Side-Loaded Applications:

- Determine maximum uniform load (lbf/ft) on built-up beam by summing up all uniform loads acting on the beam. Concentrated loads require special consideration. Consult with an engineer/architect competent in timber engineering.
- Select a glulam or glulams to carry this load based on manufacturer's recommendations.
- If 2 glulams are required for a built-up beam, select an attachment schedule from Table 2 with sufficient capacity to carry applied loads.
- Place bolts/lag screws in accordance with Figure 3. Maintain a minimum end and edge distance of 4 times the bolt diameter (2 inches for 1/2-inch-diameter and 2-1/2 inches for 5/8-inch-diameter bolts).

Technical Services Division