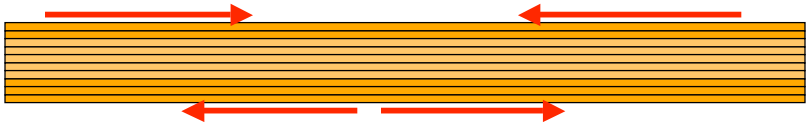
What is Glue Laminated wood?

Glue laminated wood (glulam) is kiln dried dimension lumber glued together under controlled conditions (AITC standards) to make the many pieces of wood behave like one beam..or column or bent.

Efficiency

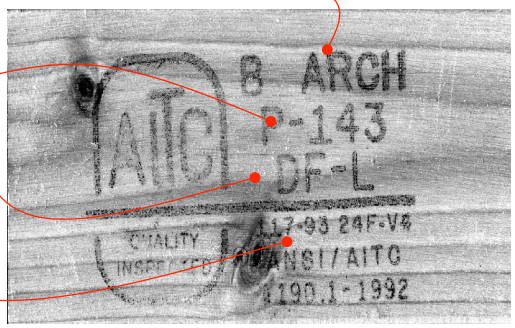


Because the glulam is made up of many pieces of wood, engineers can use high performing wood species (douglas fir) in areas of compression and tension, while selecting lower performing species (spruce) for neutral areas of the beam

Making the Grade

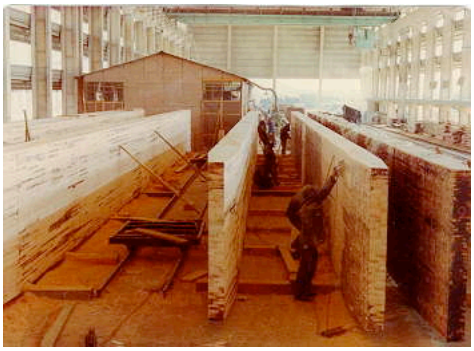
Like dimension lumber, each piece of laminated wood is graded according to standards established by the American Institute of Timber Construction (AITC).

The grade stamp tells us
the appearance quality
The product standard met
The species (doug fir-larch)
And the plant



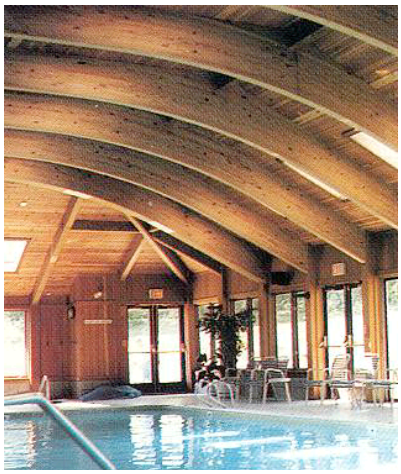
Sizes

- Stock widths 6-1/2” to 6-7/8”
- Custom widths up to 14-1/2” in 2” increments, made by side-joining
- Stock depths from 4-1/2” to 7’(feet!) in increments of 1-1/2” or 3/4”
- Lengths to 130’, 170’



…other glulam related words

‘**Stock**’ - usually straight beams, columns up to 7” wide, 28” deep and 60’ long.
‘**Custom**’ - curved, tapered, bents, circular, lengths to 170’ (typically under 60’)
Architectural - appearance graded, sanded, no defects on surface, shipped wrapped to protect during placing.
Industrial - appearance graded, may have knots, defects, sawmarks, shipped wrapped, but not for damage protection.



Cheaper than wood!

Type of Beam	Size (in.)	Weight (lb.)	$/lineal ft.	Total $
Flitch beam	3½ × 11¼	320	17.40	200.00
Solid timber	6½ × 14	228	10.50	126.00
Steel I-beam	4 × 8⅛	173	9.07	105.00
Parallel strand lumber (PSL)	3½ × 12	151	8.50	98.00
Glue-laminated timber (glulam)	3⅛ × 13½	120	7.00	81.00
Laminated veneer lumber (LVL)	3½ × 11⅞	122	6.40	74.00
Nail-laminated beam	7½ × 11¼	250	5.95	72.00

Performance under fire

Laminated wood behaves like timber in a fire.

The outside develops a layer of charcoal at a rate of about 1/40 of an inch per minute to protect the structural core material.

Because of this, the code considers laminated wood to be equal to heavy timber construction. Type IV

Timber, Lams and the Code

		Non-combustible						Combustible		
Height (feet)		Type I A	Type I B	Type II A	Type II B	Type III A	Type III B	Type IV HT	Type V A	Type V B
Group	H / A	UL	160’	65’	55’	65’	55’	65’	50’	40’
A1	H	UL	5	3	2	3	2	3	2	1
	A	UL	UL	15,500	8,500	14,000	8,500	15,000	11,500	5,500
B	H	UL	11	5	4	5	4	5	3	2
	A	UL	UL	37,500	23,000	28,500	19,000	36,000	18,000	9,000

•Even as combustible construction, the code recognizes that timber and laminated wood framed buildings afford occupants more time to evacuate, and firefighters more time to fight a fire because the massive members don’t burn through and fail nearly as quickly as lightwood (stud) framing members.

•Due to this slow burn through (a function of the charring acting as insulation) the code gives type IV HT construction an additional two floors in height and twice the square footage than a type V-a construction type for a ‘B’ occupancy.

Rules of Thumb

Glulam beam: depth = 1/20th of span (so a beam spanning 20' is 12" deep)

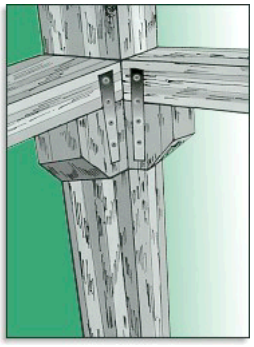
width= 1/3 to 1/4 of the depth

Glulam girder (any member framing into a column and carrying a beam) depth = 1/20th of span plus 6"
Width = 1/3 to 1/2 of the girder depth

Glulam column - 6x6 can carry approx. 600 square feet of roof and floor area

8x8 can carry approx 1,000 s.f. of roof and floor area
10x10 can carry approx 2,000 s.f. of roof and floor area
12x12 can carry approx 3,000 s.f.
14x14 can carry approx 4,000 s.f.
columns are usually square in cross section

Columns



Often fabricated to be multi-story

Usually have projections (haunches) where beams will attach to provide temporary placing support as well as additional shear resistance.

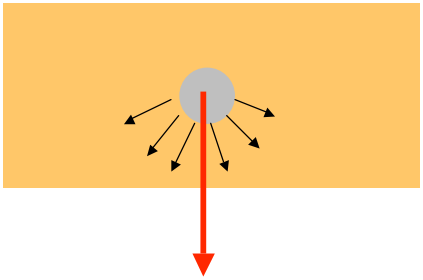
Usually square in cross section, can be turned on a lathe (a really big lathe) to be round.

Connections

Often surface mounted steel plates, angles, brackets.

Sized to carry enough bolts, to engage enough wood fibers, to resist the anticipated loading.

Joining



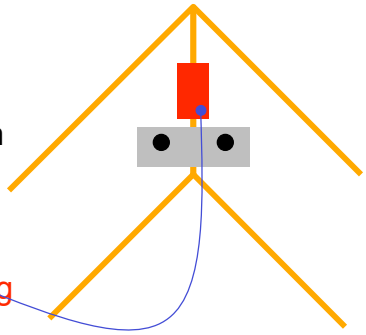
The joining of glulams is typically done with steel connectors. The mismatch between the ability of steel to concentrate loads and the relatively fragile wood fibers usually means big connections…to engage many fibers.

A 1 inch bolt has an overall circumference of 3.14 inches

- If we hang a 10,000 pound load from a 1 inch bolt, the bottom half of the bolt distributes the 10,000 pounds across a surface area of 3.14/2=1.57 inches
- If the bolt is 6” long, it distributes 1,061 pounds per square inch! Way over the 700psi tension ability of the wood.
- Two bolts would distribute 530 pounds per square inch, well within the ability of the wood.

Shear ring

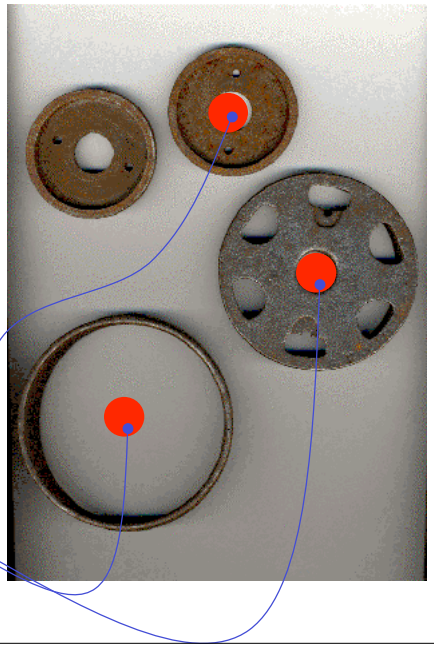
Joining glulams can often result in large loads concentrating at the joint. When many bolts are undesireable, a shear ring can often distribute the force across many fibers, and still leave just a few bolts connecting the members.



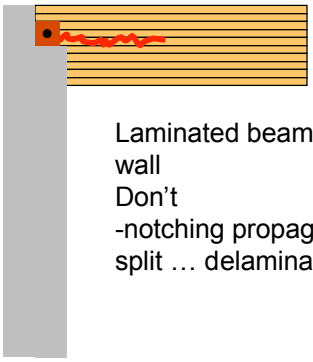
Shear ring 2

The shear ring is actually a cylinder which sits in a circular groove cut in each member.

Because the shear ring is much larger diameter than a bolt, it engages / transfers load over more wood fibers, preventing the shearing of the fibers.

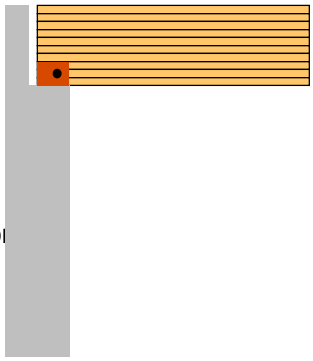


Glulam to wall

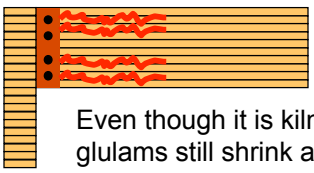


Laminated beam to wall
Don't
-notching propagates split … delamination

Do
Carry full beam depth in pocket or bracket



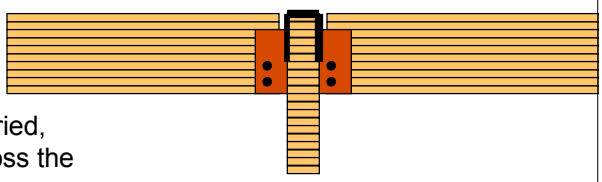
Glulam beam to girder



Even though it is kiln dried, glulams still shrink across the grain

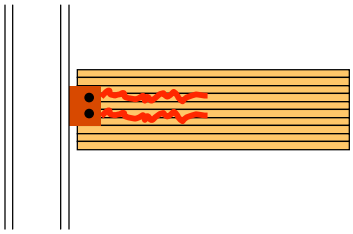
If a connector pins the top and bottom of the beam between steel plates that don't shrink, splitting and delamination can result.

Don't anchor a beam so it cannot shrink.

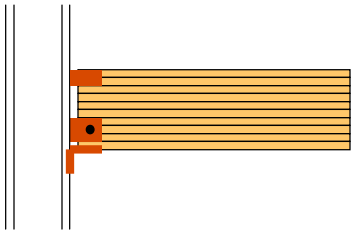


Make a saddle over the top of the girder, weld the beam angles to the saddle, bolt the beam to the saddle in the bottom 1/3 only.

Glulam beam to steel column



Don't place supporting bolts close to the beam center…splitting and delamination are likely

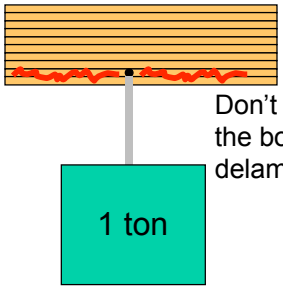


Carry the beam on a seat angle below,

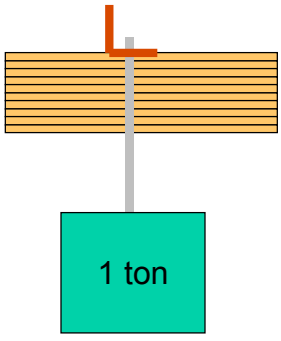
Connect the beam with a small angle and bolt near the bottom 1/3 of the beam,

Weld angles at the top of the beam to prevent twisting

Hanging Equipment

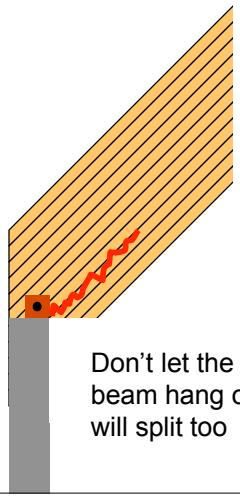


Don't carry heavy loads from the bottom of the glulam, delamination is likely

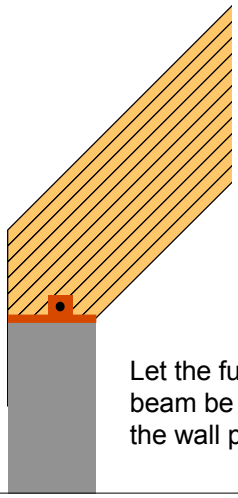


Carry the load from the top of the beam to engage the full depth of the beam.

Glulam roof beam at wall

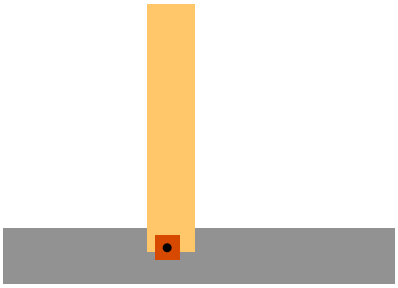


Don't let the inside of a beam hang off a wall…it will split too

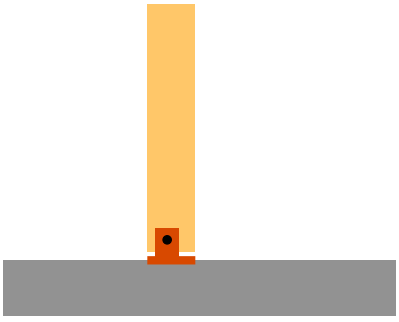


Let the full depth of the beam be carried over the wall plate

Wood column at slab



Don't cast the column base into the slab end grain will absorb lots of water and rot the end off quickly



Keep the column base isolated above the slab, carried on the base plate and bracket