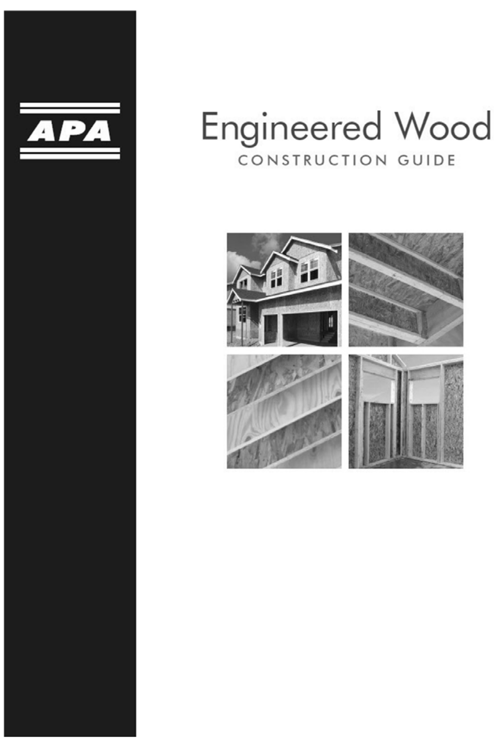
Architecture 544
Wood Structures

Engineered Wood Products:
I-Joists
LVL
PSL
LSL

- Properties
- NDS criteria
- Literature & Design Aids
- Applications

APA – E30




A GUIDE TO ENGINEERED WOOD PRODUCTS

The evolution of engineered wood products has greatly expanded building options and methods in all forms of residential and commercial construction. The product section of this APA guide provides product information and specification recommendations for several of the most common engineered wood products—plywood, oriented strand board, glulam, structural composite lumber (SCL) and I-joists. Other engineered wood products that are often used in the construction systems described in this guide include cross-laminated timber (CLT) and Rim Board®.

"Engineered wood" describes wood products that are engineered for structural applications. Plywood has been used since the 1940s and is considered by many to be the original engineered wood product. Engineered wood products are made by combining wood strands, veneers, lumber or other wood fiber with moisture-resistant adhesives to form a larger composite structural unit. They are designed and manufactured to maximize the natural strength and stiffness characteristics of wood by optimally orienting the wood veneers, strands or laminations and by combining wood with durable structural adhesives.

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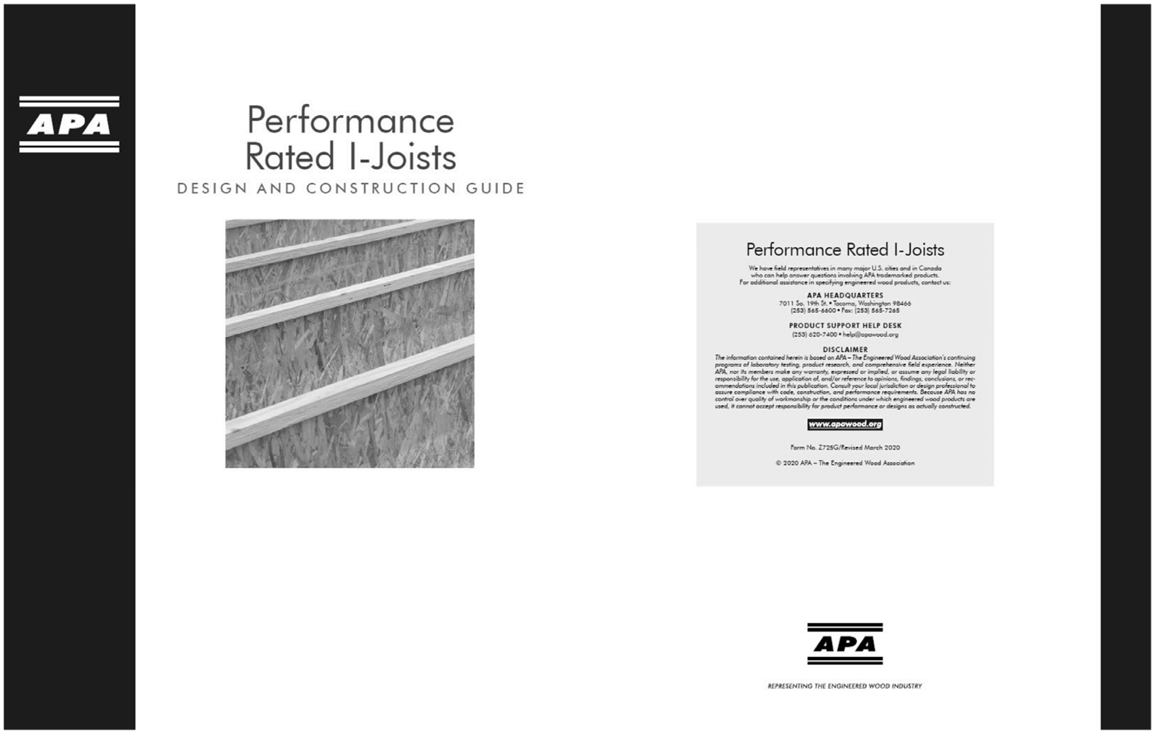

APA

Performance
Rated I-Joists
DESIGN AND CONSTRUCTION GUIDE

Performance Rated I-Joists

We have field representatives in many major U.S. cities and in Canada who can help answer questions involving APA trademarked products. For additional assistance in specifying engineered wood products, contact us:

APA HEADQUARTERS
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APA

REPRESENTING THE ENGINEERED WOOD INDUSTRY

APA – manufacture of I Joists

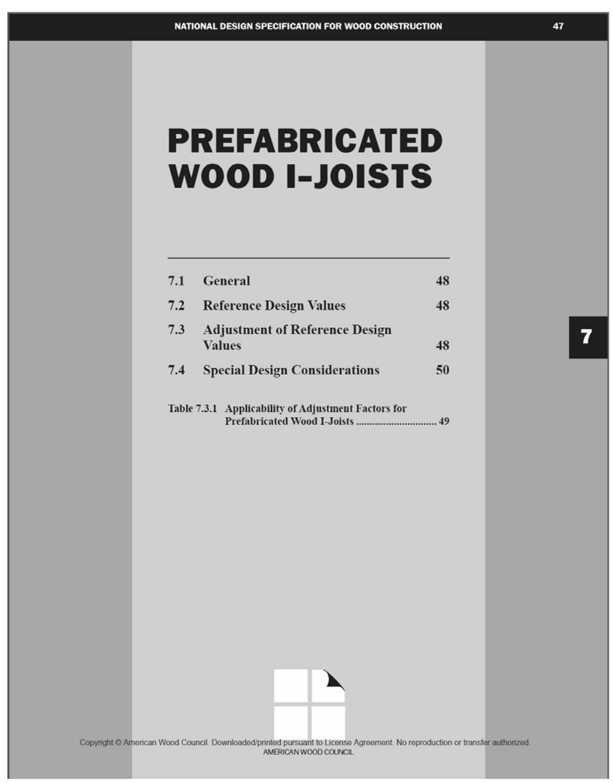
Manufactures – e.g. Weyerhaeuser

NDS – Chap. 7

- General
- Adjustment Factors

7.1.2 Definition

The term "prefabricated wood I-joist" refers to a structural member manufactured using sawn or structural composite lumber flanges and wood structural panel webs bonded together with exterior exposure adhesives, forming an "I" cross-sectional shape.



PREFABRICATED WOOD I-JOISTS

7

NDS – Chap. 7

7.2 Reference Design Values

Reference design values for prefabricated wood I-joists shall be obtained from the prefabricated wood I-joist manufacturer's literature or code evaluation reports.

7.3 Adjustment of Reference Design Values

7.3.2 Load Duration Factor, C_D (ASD Only)

All reference design values except stiffness, EI, $(EI)_{min}$, and K, shall be multiplied by load duration factors, C_D, as specified in 2.3.2.

7.3.3 Wet Service Factor, C_M

Reference design values for prefabricated wood I-joists are applicable to dry service conditions as specified in 7.1.4 where $C_M = 1.0$. When the service conditions differ from the specified conditions, adjustments for high moisture shall be in accordance with information provided by the prefabricated wood I-joist manufacturer.

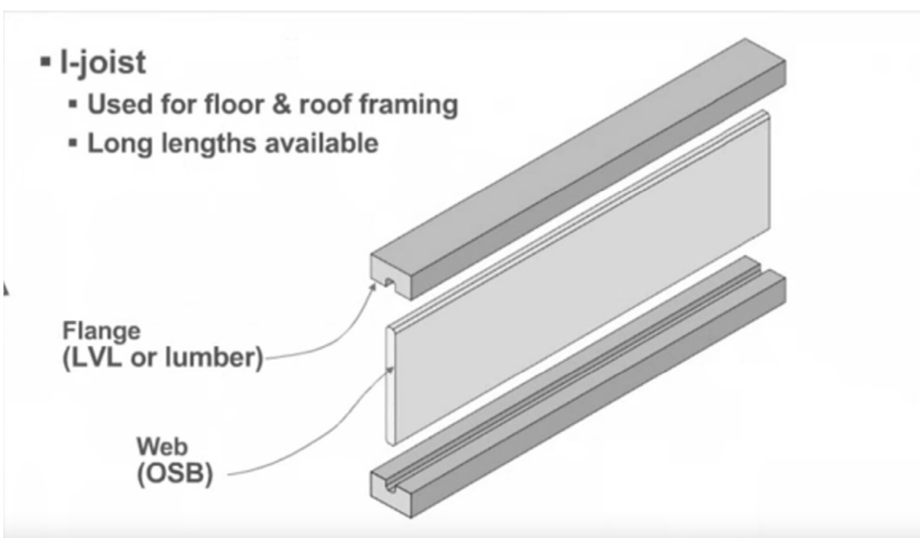
7.3.4 Temperature Factor, C_t

When structural members will experience sustained exposure to elevated temperatures up to 150°F (see Appendix C), reference design values shall be multiplied by the temperature factors, C_t, specified in 2.3.3. For M_r, V_r, R_r, EI, $(EI)_{min}$, and K use C_t for F_b, F_v, F_v, E, E_{min}, and F_v, respectively.

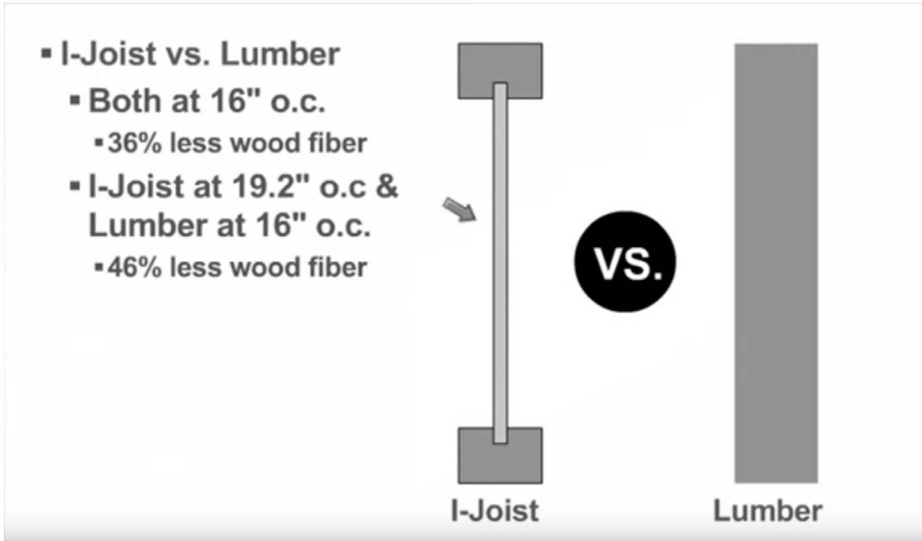
Table 7.3.1 Applicability of Adjustment Factors for Prefabricated Wood I-Joists

		ASD only	ASD and LRFD				LRFD only		
		Load Duration Factor	Wet Service Factor	Temperature Factor	Beam Stability Factor	Repetitive Member Factor	Format Conversion Factor K_F	Resistance Factor ϕ	Time Effect Factor
$M_r' = M_r$	x	C_D	C_M	C_t	C_L	C_r	K_F	0.85	λ
$V_r' = V_r$	x	C_D	C_M	C_t	-	-	K_F	0.75	λ
$R_r' = R_r$	x	C_D	C_M	C_t	-	-	K_F	0.75	λ
$EI' = EI$	x	-	C_M	C_t	-	-	-	-	-
$(EI)_{min}' = (EI)_{min}$	x	-	C_M	C_t	-	-	K_F	0.85	-
$K' = K$	x	-	C_M	C_t	-	-	-	-	-

I-Joists



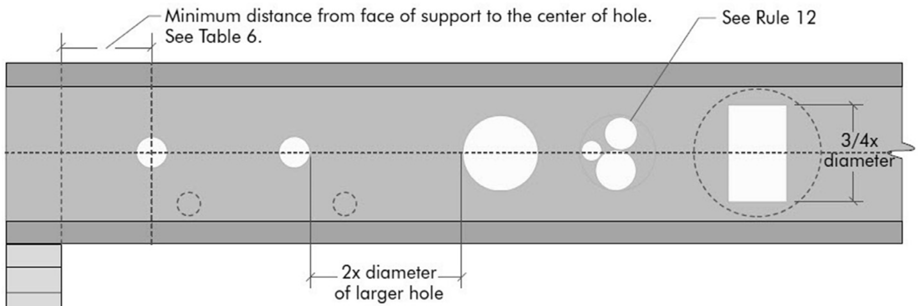
I-Joists



I-Joists – APA - construction methods

I-Joists

PRI JOIST TYPICAL HOLES



Knockouts are prescored holes often provided by I-joist manufacturers for the contractor's convenience to install electrical or small plumbing lines. They are typically 1-3/8 to 1-3/4 inches in diameter, and are spaced 12 to 24 inches on center along the length of the I-joist. Where possible, it is preferable to use knockouts instead of field-cutting holes.

I-Joists

Cutting the Hole

- Never drill, cut or notch the flange, or over-cut the web.
- Holes in webs should be cut with a sharp saw.
- For rectangular holes, avoid over-cutting the corners, as this can cause unnecessary stress concentrations. Slightly rounding the corners is recommended. Starting the rectangular hole by drilling a 1-inch-diameter hole in each of the four corners and then making the cuts between the holes is another good method to minimize damage to the I-joist.

Weyerhaeuser – Trus Joist - TJI

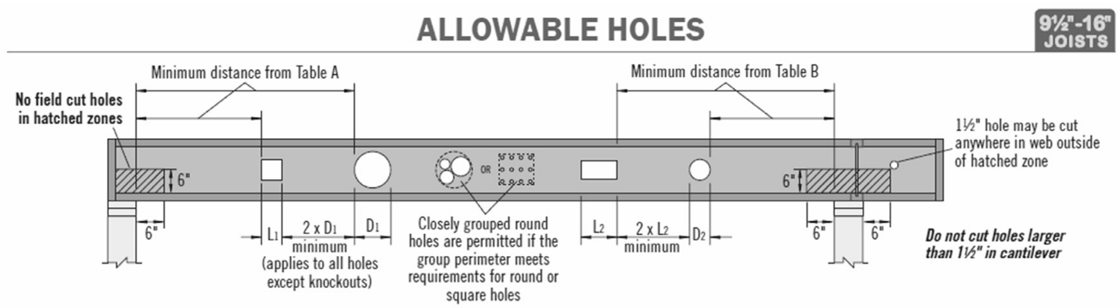
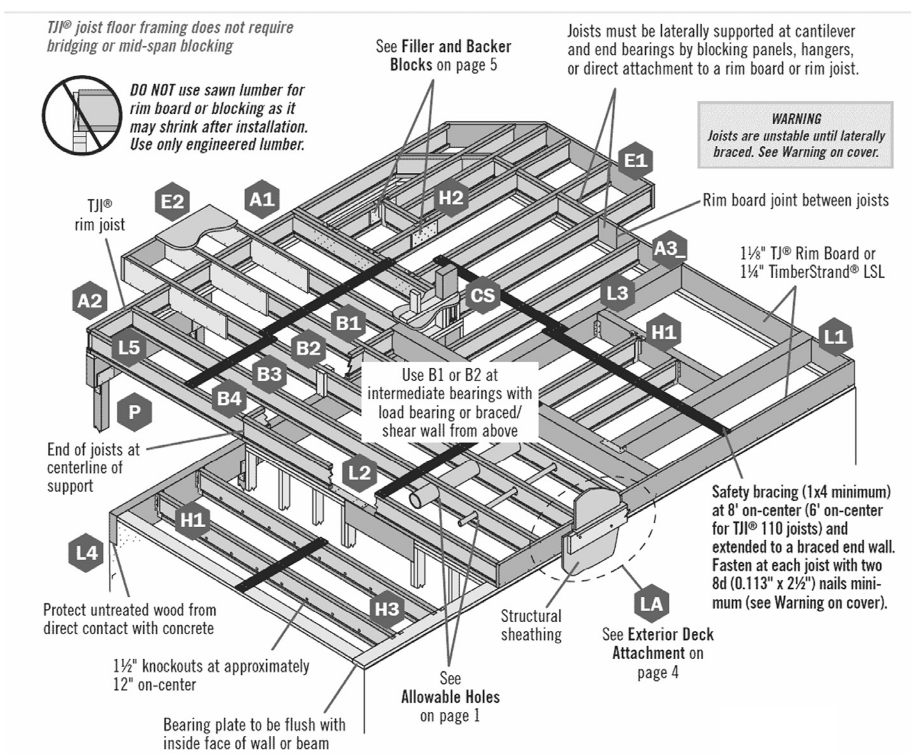


Table A, End Support: Minimum distance from edge of hole to inside face of nearest end support

Depth	TJI®	● Round Hole Size									■ Square or Rectangular Hole Size								
		2"	3"	4"	5"	6½"	7"	8⅞"	11"	13"	2"	3"	4"	5"	6½"	7"	8⅞"	11"	13"
9½"	110	1'-0"	1'-6"	2'-0"	3'-0"	5'-0"					1'-0"	1'-6"	2'-6"	3'-6"	4'-6"				
	210	1'-0"	1'-6"	2'-6"	3'-0"	5'-6"					1'-0"	2'-0"	2'-6"	4'-0"	5'-0"				
	230	1'-6"	2'-0"	2'-6"	3'-6"	5'-6"					1'-0"	2'-0"	3'-0"	4'-6"	5'-0"				
11⅞"	110	1'-0"	1'-0"	1'-6"	2'-0"	2'-6"	3'-0"	5'-6"			1'-0"	1'-6"	2'-0"	2'-6"	4'-6"	5'-0"	6'-0"		
	210	1'-0"	1'-6"	2'-0"	2'-0"	3'-0"	3'-6"	6'-0"			1'-0"	1'-6"	2'-6"	3'-0"	5'-0"	5'-6"	6'-6"		
	230	1'-0"	1'-6"	2'-0"	2'-6"	3'-0"	3'-6"	6'-6"			1'-0"	2'-0"	2'-6"	3'-6"	5'-6"	5'-6"	7'-0"		
	360	1'-6"	2'-0"	3'-0"	3'-6"	4'-6"	5'-0"	7'-0"			1'-6"	2'-6"	3'-6"	4'-6"	6'-6"	6'-6"	7'-6"		
	560	1'-6"	2'-6"	3'-0"	4'-0"	5'-6"	6'-0"	8'-0"			2'-6"	3'-6"	4'-6"	5'-6"	7'-0"	7'-6"	8'-0"		
14"	110	1'-0"	1'-0"	1'-0"	1'-0"	1'-6"	2'-0"	3'-0"	5'-6"		1'-0"	1'-0"	1'-6"	2'-0"	3'-6"	4'-0"	6'-0"	8'-0"	
	210	1'-0"	1'-0"	1'-0"	1'-6"	2'-0"	2'-6"	3'-6"	6'-0"		1'-0"	1'-0"	2'-0"	2'-6"	4'-0"	4'-6"	6'-6"	8'-6"	
	230	1'-0"	1'-0"	1'-0"	1'-6"	2'-6"	2'-6"	4'-0"	7'-0"		1'-0"	1'-0"	2'-0"	3'-0"	4'-0"	5'-0"	7'-0"	9'-0"	
	360	1'-0"	1'-0"	1'-6"	2'-6"	3'-6"	4'-0"	5'-6"	8'-0"		1'-0"	1'-6"	2'-6"	4'-0"	6'-0"	6'-6"	8'-0"	9'-6"	
	560	1'-0"	1'-0"	2'-0"	3'-0"	4'-6"	5'-0"	6'-6"	9'-0"		1'-6"	3'-0"	4'-0"	5'-0"	7'-0"	7'-6"	9'-0"	10'-0"	
16"	110	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	2'-0"	3'-0"	5'-0"	1'-0"	1'-0"	1'-0"	1'-6"	3'-0"	3'-0"	5'-6"	7'-6"	10'-0"
	210	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-6"	2'-6"	3'-6"	6'-0"	1'-0"	1'-0"	1'-0"	2'-0"	3'-0"	3'-6"	6'-6"	8'-0"	11'-0"
	230	1'-0"	1'-0"	1'-0"	1'-0"	1'-6"	1'-6"	3'-0"	4'-0"	7'-0"	1'-0"	1'-0"	1'-0"	2'-0"	3'-6"	4'-0"	7'-0"	9'-0"	11'-0"
	360	1'-0"	1'-0"	1'-0"	1'-0"	2'-6"	2'-6"	4'-6"	6'-6"	9'-0"	1'-0"	1'-0"	1'-6"	3'-0"	5'-0"	5'-6"	9'-0"	10'-0"	11'-6"
	560	1'-0"	1'-0"	1'-0"	1'-0"	2'-6"	3'-0"	5'-0"	7'-6"	10'-0"	1'-0"	2'-0"	3'-0"	4'-6"	6'-6"	7'-0"	10'-0"	11'-0"	12'-0"

Weyerhaeuser – Trus Joist - TJI



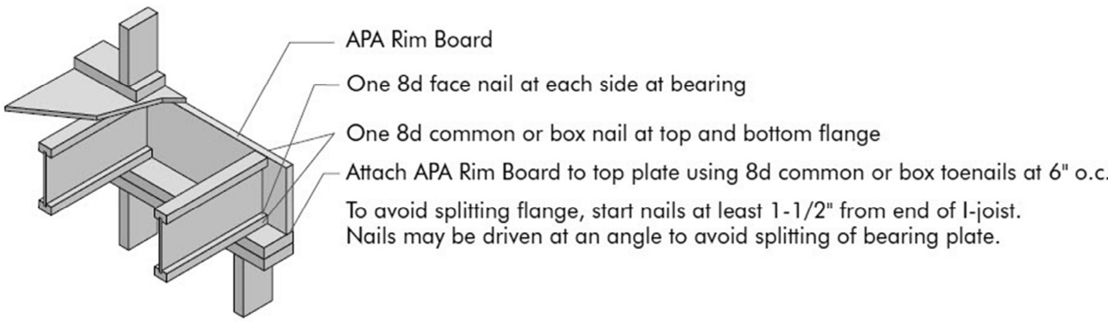
APA – Z725 I-Joist – rim board

1b

Blocking Panel or Rim Joist	Uniform Vertical Load Transfer Capacity[a] (plf)
1-1/8" APA Rim Board Plus, B2 or better[b]	4850
1-1/8" APA Rim Board, C1 or better[b]	4400
1" APA Rim Board, C2 or better[b]	3300

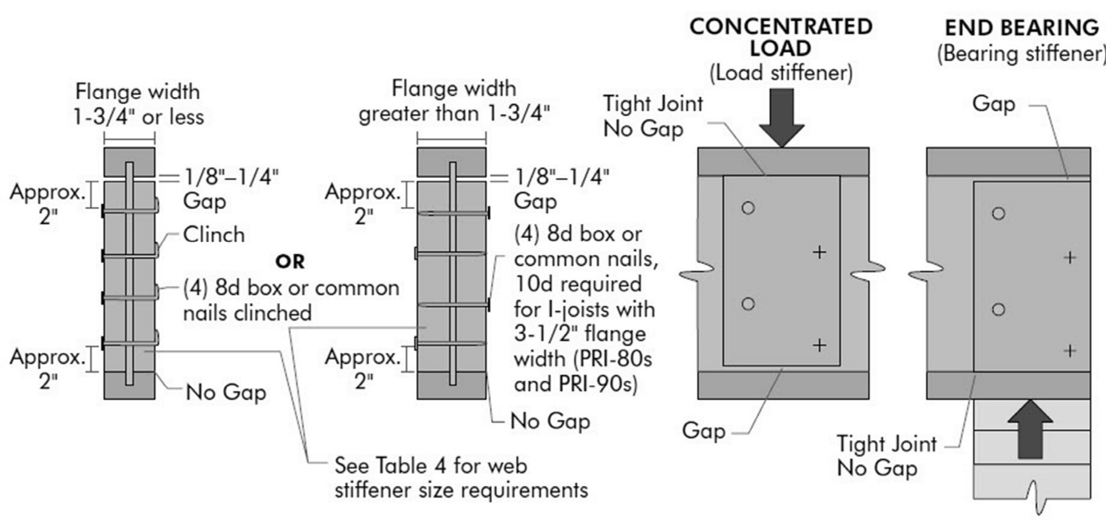
a. The uniform vertical load capacity is limited to a Rim Board depth of 16 inches or less and shall not be increased for any load duration shorter than the normal (10-yr) load duration. It shall not be used in the design of a bending member, such as joist, header, or rafter. For concentrated vertical load transfer capacity, see 1d.

b. See ANSI/APA PRR 410, *Standard for Performance-Rated Engineered Wood Rim Boards,* Form PRR-410.



APA – Z725 I-Joist – web stiffeners

WEB STIFFENER INSTALLATION DETAILS



Weyerhaeuser – Trus Joist – TJI - properties

Design Properties (100% Load Duration)

Depth	TJI®	Basic Properties				Reaction Properties					
		Joist Weight (lbs/ft)	Maximum Resistive Moment(1) (ft-lbs)	Joist Only EI x 10^6 (in.²-lbs)	Maximum Vertical Shear (lbs)	1¾" End Reaction (lbs)	3½" End Reaction (lbs)	3½" Intermediate Reaction (lbs)		5¼" Intermediate Reaction (lbs)	
								No Web Stiffeners	With Web Stiffeners(2)	No Web Stiffeners	With Web Stiffeners(2)
9½"	110	2.3	2,500	157	1,220	910	1,220	1,935	N.A.	2,350	N.A.
	210	2.6	3,000	186	1,330	1,005	1,330	2,145	N.A.	2,565	N.A.
	230	2.7	3,330	206	1,330	1,060	1,330	2,410	N.A.	2,790	N.A.
11⅞"	110	2.5	3,160	267	1,560	910	1,375	1,935	2,295	2,350	2,705
	210	2.8	3,795	315	1,655	1,005	1,460	2,145	2,505	2,565	2,925
	230	3.0	4,215	347	1,655	1,060	1,485	2,410	2,765	2,790	3,150
	360	3.0	6,180	419	1,705	1,080	1,505	2,460	2,815	3,000	3,360
	560	4.0	9,500	636	2,050	1,265	1,725	3,000	3,475	3,455	3,930
14"	110	2.8	3,740	392	1,860	910	1,375	1,935	2,295	2,350	2,705
	210	3.1	4,490	462	1,945	1,005	1,460	2,145	2,505	2,565	2,925
	230	3.3	4,990	509	1,945	1,060	1,485	2,410	2,765	2,790	3,150
	360	3.3	7,335	612	1,955	1,080	1,505	2,460	2,815	3,000	3,360
	560	4.2	11,275	926	2,390	1,265	1,725	3,000	3,475	3,455	3,930
16"	110	3.0	4,280	535	2,145	910	1,375	1,935	2,295	2,350	2,705
	210	3.3	5,140	629	2,190	1,005	1,460	2,145	2,505	2,565	2,925
	230	3.5	5,710	691	2,190	1,060	1,485	2,410	2,765	2,790	3,150
	360	3.5	8,405	830	2,190	1,080	1,505	2,460	2,815	3,000	3,360
	560	4.5	12,925	1,252	2,710	1,265	1,725	3,000	3,475	3,455	3,930

(1) **Caution: Do not** increase joist moment design properties by a repetitive member use factor.
(2) See detail W on page 27 for web stiffener requirements and nailing information.

- Tables are based on:
  - Uniform loads.
  - More restrictive of simple or continuous span.
  - Clear distance between supports
  - Minimum bearing length of 1¾" end (no web stiffeners) and 3½" intermediate.
- Assumed composite action with a single layer of 24" on-center span-rated, glue-nailed floor panels for deflection only. **When subfloor adhesive is not applied, spans shall be reduced 6" for nails and 12" for proprietary fasteners.**
- For continuous spans, ratio of short span to long span should be 0.4 or greater to prevent uplift.
- Spans generated from Weyerhaeuser software may exceed the spans shown in these tables because software reflects actual design conditions.
- For multi-family applications and other loading conditions not shown, refer to Weyerhaeuser software or to the load table on page 8.

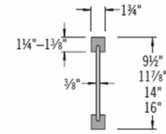
For TJI® 110, 210, 230, and 360 Joists

$$\Delta = \frac{22.5\ wL^4}{EI} + \frac{2.67\ wL^2}{d \times 10^5}$$

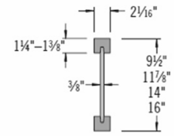
For TJI® 560 Joists

$$\Delta = \frac{22.5\ wL^4}{EI} + \frac{2.29\ wL^2}{d \times 10^5}$$

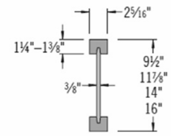
w = uniform load in pounds per linear foot
L = span in feet
d = out-to-out depth of the joist in inches
EI = value from table above



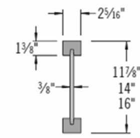
TJI® 110 joists



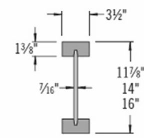
TJI® 210 joists



TJI® 230 joists



TJI® 360 joists



TJI® 560 joists

Weyerhaeuser – Trus Joist – TJI – span table

L/360 Live Load Deflection (Minimum Criteria per Code)

Depth	TJI®	40 PSF Live Load / 10 PSF Dead Load				40 PSF Live Load / 20 PSF Dead Load			
		12" o.c.	16" o.c.	19.2" o.c.	24" o.c.	12" o.c.	16" o.c.	19.2" o.c.	24" o.c.
9½"	110	18'-9"	17'-2"	15'-8"	14'-0"	18'-1"	15'-8"	14'-3"	12'-9"
	210	19'-8"	18'-0"	17'-0"	15'-4"	19'-8"	17'-2"	15'-8"	14'-0"
	230	20'-3"	18'-6"	17'-5"	16'-2"	***20'-3"***	18'-1"	16'-6"	14'-9"
11⅞"	110	22'-3"	19'-4"	17'-8"	15'-9"(1)	20'-5"	17'-8"	16'-1"(1)	14'-4"(1)
	210	23'-4"	21'-2"	19'-4"	17'-3"(1)	***22'-4"***	19'-4"	17'-8"	15'-9"(1)
	230	24'-0"	21'-11"	20'-5"	18'-3"	***23'-7"***	20'-5"	18'-7"	16'-7"(1)
	360	25'-4"	23'-2"	21'-10"	20'-4"(1)	***25'-4"***	***23'-2"***	***21'-10"(1)***	17'-10"(1)
	560	28'-10"	26'-3"	24'-9"	23'-0"	***28'-10"***	***26'-3"***	***24'-9"***	20'-11"(1)
14"	110	24'-4"	21'-0"	19'-2"	17'-2"(1)	22'-2"	19'-2"	17'-6"(1)	15'-0"(1)
	210	26'-6"	23'-1"	21'-1"	18'-10"(1)	24'-4"	21'-1"	19'-2"(1)	16'-7"(1)
	230	27'-3"	24'-4"	22'-2"	19'-10"(1)	***25'-8"***	22'-2"	20'-3"(1)	17'-6"(1)
	360	28'-9"	26'-3"	24'-9"(1)	21'-5"(1)	***28'-9"***	***26'-3"(1)***	22'-4"(1)	17'-10"(1)
	560	32'-8"	29'-9"	28'-0"	25'-2"(1)	***32'-8"***	***29'-9"***	***26'-3"(1)***	20'-11"(1)
16"	110	26'-0"	22'-6"	20'-7"(1)	18'-1"(1)	23'-9"	20'-7"(1)	18'-9"(1)	15'-0"(1)
	210	28'-6"	24'-8"	22'-6"(1)	19'-11"(1)	26'-0"	22'-6"(1)	20'-7"(1)	16'-7"(1)
	230	30'-1"	26'-0"	23'-9"	21'-1"(1)	***27'-5"***	23'-9"	21'-8"(1)	17'-6"(1)
	360	31'-10"	29'-0"	26'-10"(1)	21'-5"(1)	***31'-10"***	***26'-10"(1)***	22'-4"(1)	17'-10"(1)
	560	36'-1"	32'-11"	31'-0"(1)	25'-2"(1)	***36'-1"***	***31'-6"(1)***	26'-3"(1)	20'-11"(1)

(1) Web stiffeners are required at intermediate supports of continuous-span joists when the intermediate bearing length is ***less*** than 5¼" and the span on either side of the intermediate bearing is greater than the following spans:

Weyerhaeuser – Trus Joist – TJI – span table L/480

9½"-16" JOISTS

FLOOR LOAD TABLE

Floor—100% (PLF)

Depth	TJI®	8' Live Load L/480	8' Total Load	10' Live Load L/480	10' Total Load	12' Live Load L/480	12' Total Load	14' Live Load L/480	14' Total Load	16' Live Load L/480	16' Total Load	18' Live Load L/480	18' Total Load	20' Live Load L/480	20' Total Load	22' Live Load L/480	22' Total Load	24' Live Load L/480	24' Total Load
9½"	110	*	190	140	152	85	127	56	99	38	76								
	210	*	210	161	169	99	141	65	119	45	90								
	230	*	236	175	190	108	158	71	133	49	99								
11⅞"	110	*	190	*	152	*	127	92	109	63	95	45	76						
	210	*	210	*	169	*	141	106	121	74	106	53	92						
	230	*	236	*	190	*	158	116	136	80	119	58	102	43	83				
	360	*	241	*	193	*	162	136	139	95	121	69	108	51	97	39	78		
	560	*	294	*	236	*	197	*	169	138	148	101	132	76	119	58	108	45	91
14"	110	*	190	*	152	*	127	*	109	91	95	66	85						
	210	*	210	*	169	*	141	*	121	*	106	76	94	57	85				
	230	*	236	*	190	*	158	*	136	115	119	83	106	62	95	47	81		
	360	*	241	*	193	*	162	*	139	*	121	98	108	73	97	56	88	44	81
	560	*	294	*	236	*	197	*	169	*	148	*	132	107	119	83	108	65	99
16"	110	*	190	*	152	*	127	*	109	*	95	*	85	66	76				
	210	*	210	*	169	*	141	*	121	*	106	*	94	76	85	58	77		
	230	*	236	*	190	*	158	*	136	*	119	*	106	83	95	64	87	50	78
	360	*	241	*	193	*	162	*	139	*	121	*	108	*	97	75	88	59	81
	560	*	294	*	236	*	197	*	169	*	148	*	132	*	119	*	108	86	99

* Indicates that **Total Load** value controls.

How to Use This Table

1. Calculate actual total and live load in pounds per linear foot (plf).
2. Select appropriate **Joist Clear Span**.
3. Scan down the column to find a TJI® joist that meets or exceeds actual total and live loads.

Refer to PSF to PLF Conversion table on page 31

General Notes

- Table is based on:
  - Minimum bearing length of 1¾" end and 3½" intermediate, without web stiffeners
  - Uniform loads.
  - More restrictive of simple or continuous span
  - No composite action provided by sheathing.
- **Total Load** values are limited to deflection of L/240.
- **Live Load** is based on joist deflection of L/480.
- If a live load deflection limit of L/360 is desired, multiply value in **Live Load** column by 1.33. The resulting live load must not exceed the **Total Load** shown.
- Table does not account for concentrated loads. Use Weyerhaeuser software when this condition applies.

I-Joist Selection

procedure

1. Calculate actual load in PLF
2. Pick deflection limit (e.g. L/480)
3. Pick o.c. spacing

4. From load table find a section to carry load with span

or

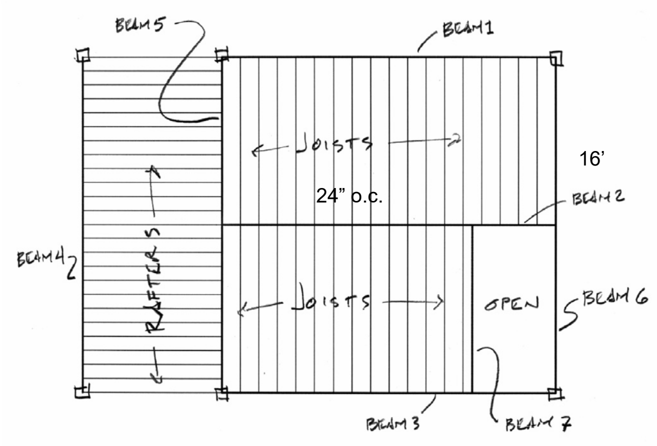
4. Calculate shear and moment
5. Pick section from properties table

6. Check deflection

I-Joist Selection

Example – floor joists

Given: span = 16 ft.
o.c. = 24 in.
DL 10 psf LL 40 psf



1. Find floor load in PSF
2. Pick deflection limit (e.g. L/480)
3. Pick o.c. spacing – calculate PLF
4. From load table find a section to carry load with span

CONVERT LOAD TO PLF

$$PSF \times \frac{O.C.}{12}$$

$$10\ PSF \times \frac{24}{12} = 20\ PLF\ DL$$

$$40\ PSF \times \frac{24}{12} = 80\ PLF\ LL$$

100 PLF TOTAL

Weyerhaeuser – Trus Joist - TJI

9½"-16" JOISTS

FLOOR LOAD TABLE

Floor—100% (PLF)

Depth	TJI®	Joist Clear Span																	
		8'		10'		12'		14'		16'		18'		20'		22'		24'	
		Live Load L/480	Total Load	Live Load L/480	Total Load	Live Load L/480	Total Load	Live Load L/480	Total Load	Live Load L/480	Total Load	Live Load L/480	Total Load	Live Load L/480	Total Load	Live Load L/480	Total Load	Live Load L/480	Total Load
9½"	110	*	190	140	152	85	127	56	99	38	76								
	210	*	210	161	169	99	141	65	119	45	90								
	230	*	236	175	190	108	158	71	133	49	99								
11⅞"	110	*	190	*	152	*	127	92	109	63	95	45	76						
	210	*	210	*	169	*	141	106	121	74	106	53	92						
	230	*	236	*	190	*	158	116	136	80	119	58	102	43	83				
	360	*	241	*	193	*	162	136	139	95	121	69	108	51	97	39	78		
	560	*	294	*	236	*	197	*	169	138	148	101	132	76	119	58	108	45	91
14"	110	*	190	*	152	*	127	*	109	91	95	66	85						
	210	*	210	*	169	*	141	*	121	*	106	76	94	57	85				
	230	*	236	*	190	*	158	*	136	115	119	83	106	62	95	47	81		
	360	*	241	*	193	*	162	*	139	*	121	98	108	73	97	56	88	44	81
	560	*	294	*	236	*	197	*	169	*	148	*	132	107	119	83	108	65	99
16"	110	*	190	*	152	*	127	*	109	*	95	*	85	66	76				
	210	*	210	*	169	*	141	*	121	*	106	*	94	76	85	58	77		
	230	*	236	*	190	*	158	*	136	*	119	*	106	83	95	64	87	50	78
	360	*	241	*	193	*	162	*	139	*	121	*	108	*	97	75	88	59	81
	560	*	294	*	236	*	197	*	169	*	148	*	132	*	119	*	108	86	99

* Indicates that **Total Load** value controls.

How to Use This Table

1. Calculate actual total and live load in pounds per linear foot (plf).
2. Select appropriate **Joist Clear Span**.
3. Scan down the column to find a TJI® joist that meets or exceeds actual total and live loads.

Refer to PSF to PLF Conversion table on page 31

General Notes

- Table is based on:
  - Minimum bearing length of 1¾" end and 3½" intermediate, without web stiffeners
  - Uniform loads.
  - More restrictive of simple or continuous span
  - No composite action provided by sheathing.
- **Total Load** values are limited to deflection of L/240.
- **Live Load** is based on joist deflection of L/480.
- If a live load deflection limit of L/360 is desired, multiply value in **Live Load** column by 1.33. The resulting live load must not exceed the **Total Load** shown.
- Table does not account for concentrated loads. Use Weyerhaeuser software when this condition applies.

Weyerhaeuser – Trus Joist - TJI

L/360 Live Load Deflection (Minimum Criteria per Code)

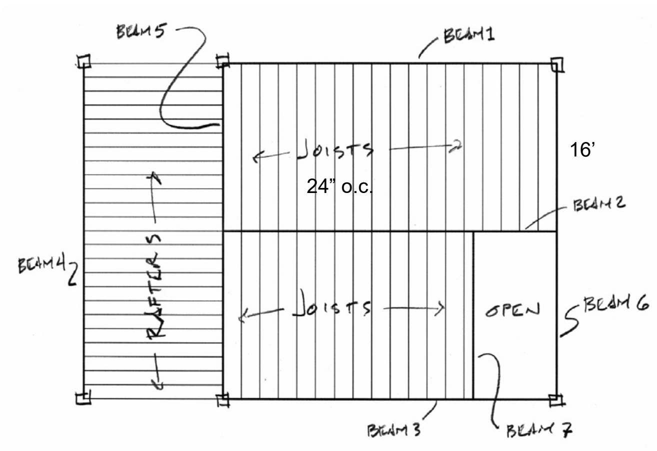
Depth	TJI®	40 PSF Live Load / 10 PSF Dead Load				40 PSF Live Load / 20 PSF Dead Load			
		12" o.c.	16" o.c.	19.2" o.c.	24" o.c.	12" o.c.	16" o.c.	19.2" o.c.	24" o.c.
9½"	110	18'-9"	17'-2"	15'-8"	14'-0"	18'-1"	15'-8"	14'-3"	12'-9"
	210	19'-8"	18'-0"	17'-0"	15'-4"	19'-8"	17'-2"	15'-8"	14'-0"
	230	20'-3"	18'-6"	17'-5"	16'-2"	***20'-3"***	18'-1"	16'-6"	14'-9"
11⅞"	110	22'-3"	19'-4"	17'-8"	15'-9"(1)	20'-5"	17'-8"	16'-1"(1)	14'-4"(1)
	210	23'-4"	21'-2"	19'-4"	17'-3"(1)	***22'-4"***	19'-4"	17'-8"	15'-9"(1)
	230	24'-0"	21'-11"	20'-5"	18'-3"	***23'-7"***	20'-5"	18'-7"	16'-7"(1)
	360	25'-4"	23'-2"	21'-10"	20'-4"(1)	***25'-4"***	***23'-2"***	***21'-10"(1)***	17'-10"(1)
	560	28'-10"	26'-3"	24'-9"	23'-0"	***28'-10"***	***26'-3"***	***24'-9"***	20'-11"(1)
14"	110	24'-4"	21'-0"	19'-2"	17'-2"(1)	22'-2"	19'-2"	17'-6"(1)	15'-0"(1)
	210	26'-6"	23'-1"	21'-1"	18'-10"(1)	24'-4"	21'-1"	19'-2"(1)	16'-7"(1)
	230	27'-3"	24'-4"	22'-2"	19'-10"(1)	***25'-8"***	22'-2"	20'-3"(1)	17'-6"(1)
	360	28'-9"	26'-3"	24'-9"(1)	21'-5"(1)	***28'-9"***	***26'-3"(1)***	22'-4"(1)	17'-10"(1)
	560	32'-8"	29'-9"	28'-0"	25'-2"(1)	***32'-8"***	***29'-9"***	***26'-3"(1)***	20'-11"(1)
16"	110	26'-0"	22'-6"	20'-7"(1)	18'-1"(1)	23'-9"	20'-7"(1)	18'-9"(1)	15'-0"(1)
	210	28'-6"	24'-8"	22'-6"(1)	19'-11"(1)	26'-0"	22'-6"(1)	20'-7"(1)	16'-7"(1)
	230	30'-1"	26'-0"	23'-9"	21'-1"(1)	***27'-5"***	23'-9"	21'-8"(1)	17'-6"(1)
	360	31'-10"	29'-0"	26'-10"(1)	21'-5"(1)	***31'-10"***	***26'-10"(1)***	22'-4"(1)	17'-10"(1)
	560	36'-1"	32'-11"	31'-0"(1)	25'-2"(1)	***36'-1"***	***31'-6"(1)***	26'-3"(1)	20'-11"(1)

(1) Web stiffeners are required at intermediate supports of continuous-span joists when the intermediate bearing length is ***less*** than 5¼" and the span on either side of the intermediate bearing is greater than the following spans:

I-Joist Selection

Example – floor joists

Given: span = 16 ft.
o.c. = 24 in.
DL 10 psf LL 40 psf



1. Calculate actual load in PLF
2. Pick deflection limit (e.g. L/360)
3. Pick o.c. spacing
4. Calculate shear and moment
5. Pick section from properties table
6. Calculate deflection

$$M_{\mathbb{C}} = \frac{w l^2}{8} = \frac{100\ \text{PLF}\ (16')^2}{8} = 3200\ '\text{-}\#$$

$$V_{max} = \frac{w l}{2} = \frac{100\ (16)}{2} = 800\ \#$$

Weyerhaeuser – Trus Joist - TJI

Design Properties (100% Load Duration)

Depth	TJI®	Basic Properties: Joist Weight (lbs/ft)	Maximum Resistive Moment(1) (ft-lbs)	Joist Only EI x 10^6 (in.²-lbs)	Maximum Vertical Shear (lbs)	Reaction Properties: 1¾" End Reaction (lbs)	3½" End Reaction (lbs)	3½" Intermediate Reaction (lbs): No Web Stiffeners	3½" Intermediate Reaction (lbs): With Web Stiffeners(2)	5¼" Intermediate Reaction (lbs): No Web Stiffeners	5¼" Intermediate Reaction (lbs): With Web Stiffeners(2)
9½"	110	2.3	2,500	157	1,220	910	1,220	1,935	N.A.	2,350	N.A.
	210	2.6	3,000	186	1,330	1,005	1,330	2,145	N.A.	2,565	N.A.
	230	2.7	3,330	206	1,330	1,060	1,330	2,410	N.A.	2,790	N.A.
11⅞"	110	2.5	3,160	267	1,560	910	1,375	1,935	2,295	2,350	2,705
	210	2.8	3,795	315	1,655	1,005	1,460	2,145	2,505	2,565	2,925
	230	3.0	4,215	347	1,655	1,060	1,485	2,410	2,765	2,790	3,150
	360	3.0	6,180	419	1,705	1,080	1,505	2,460	2,815	3,000	3,360
	560	4.0	9,500	636	2,050	1,265	1,725	3,000	3,475	3,455	3,930
14"	110	2.8	3,740	392	1,860	910	1,375	1,935	2,295	2,350	2,705
	210	3.1	4,490	462	1,945	1,005	1,460	2,145	2,505	2,565	2,925
	230	3.3	4,990	509	1,945	1,060	1,485	2,410	2,765	2,790	3,150
	360	3.3	7,335	612	1,955	1,080	1,505	2,460	2,815	3,000	3,360
	560	4.2	11,275	926	2,390	1,265	1,725	3,000	3,475	3,455	3,930
16"	110	3.0	4,280	535	2,145	910	1,375	1,935	2,295	2,350	2,705
	210	3.3	5,140	629	2,190	1,005	1,460	2,145	2,505	2,565	2,925
	230	3.5	5,710	691	2,190	1,060	1,485	2,410	2,765	2,790	3,150
	360	3.5	8,405	830	2,190	1,080	1,505	2,460	2,815	3,000	3,360
	560	4.5	12,925	1,252	2,710	1,265	1,725	3,000	3,475	3,455	3,930

(1) **Caution: Do not** increase joist moment design properties by a repetitive member use factor.
(2) See detail W on page 27 for web stiffener requirements and nailing information.

- Tables are based on:
  - Uniform loads.
  - More restrictive of simple or continuous span.
  - Clear distance between supports
  - Minimum bearing length of 1¾" end (no web stiffeners) and 3½" intermediate.
- Assumed composite action with a single layer of 24" on-center span-rated, glue-nailed floor panels for deflection only. **When subfloor adhesive is not applied, spans shall be reduced 6" for nails and 12" for proprietary fasteners.**
- For continuous spans, ratio of short span to long span should be 0.4 or greater to prevent uplift.
- Spans generated from Weyerhaeuser software may exceed the spans shown in these tables because software reflects actual design conditions.
- For multi-family applications and other loading conditions not shown, refer to Weyerhaeuser software or to the load table on page 8.

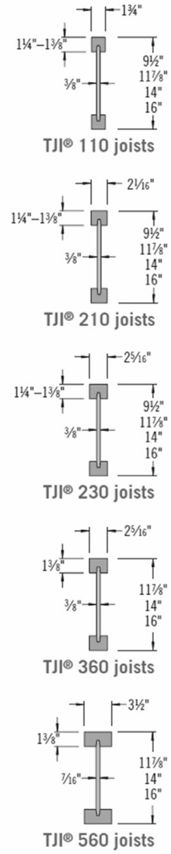
For TJI® 110, 210, 230, and 360 Joists

$$\Delta = \frac{22.5\,wL^4}{EI} + \frac{2.67\,wL^2}{d \times 10^5}$$

For TJI® 560 Joists

$$\Delta = \frac{22.5\,wL^4}{EI} + \frac{2.29\,wL^2}{d \times 10^5}$$

w = uniform load in pounds per linear foot
L = span in feet
d = out-to-out depth of the joist in inches
EI = value from table above



Weyerhaeuser – Trus Joist - TJI

- Tables are based on:
  - Uniform loads.
  - More restrictive of simple or continuous span.
  - Clear distance between supports
  - Minimum bearing length of 1¾" end (no web stiffeners) and 3½" intermediate.
- Assumed composite action with a single layer of 24" on-center span-rated, glue-nailed floor panels for deflection only. **When subfloor adhesive is not applied, spans shall be reduced 6" for nails and 12" for proprietary fasteners.**
- For continuous spans, ratio of short span to long span should be 0.4 or greater to prevent uplift.
- Spans generated from Weyerhaeuser software may exceed the spans shown in these tables because software reflects actual design conditions.
- For multi-family applications and other loading conditions not shown, refer to Weyerhaeuser software or to the load table on page 8.

For TJI® 110, 210, 230, and 360 Joists

$$\Delta = \frac{22.5\,wL^4}{EI} + \frac{2.67\,wL^2}{d \times 10^5}$$

For TJI® 560 Joists

$$\Delta = \frac{22.5\,wL^4}{EI} + \frac{2.29\,wL^2}{d \times 10^5}$$

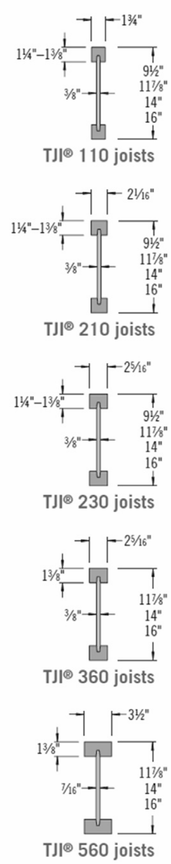
w = uniform load in pounds per linear foot
L = span in feet
d = out-to-out depth of the joist in inches
EI = value from table above

9.5" TJI 230 (without composite flooring)

$$\Delta_{LL} = \frac{22.5(80\text{PLF})(16)^4}{206\,000\,000} + \frac{2.67(80\text{PLF})16^2}{9.5''\ 1000000} =$$

$$0.5726'' + 0.0058'' = 0.578''$$

$$\frac{\ell}{360} = \frac{16'(12)}{360} = 0.53''$$



NDS – Chap. 8

8.1.2 Definitions

LVL 8.1.2.1 The term "laminated veneer lumber" refers to a composite of wood veneer sheet elements with wood fiber primarily oriented along the length of the member. Veneer thickness shall not exceed 0.25".

PSL 8.1.2.2 The term "parallel strand lumber" refers to a composite of wood strand elements with wood fibers primarily oriented along the length of the member. The least dimension of the strands shall not exceed 0.25" and the average length shall be a minimum of 150 times the least dimension.

LSL 8.1.2.3 The term "laminated strand lumber", refers to a composite of wood strand elements with wood fibers primarily oriented along the length of the member. The least dimension of the strands shall not exceed 0.10" and the average length shall be a minimum of 150 times the least dimension.

OSL 8.1.2.4 The term "oriented strand lumber", refers to a composite of wood strand elements with wood fibers primarily oriented along the length of the member. The least dimension of the strands shall not exceed 0.10" and the average length shall be a minimum of 75 times the least dimension.

8.1.2.5 The term "structural composite lumber" refers to either laminated veneer lumber, parallel strand lumber, laminated strand lumber, or oriented strand lumber. These materials are structural members bonded with an exterior adhesive.

STRUCTURAL COMPOSITE LUMBER

8

NDS – Chap. 8

Table 8.3.1 Applicability of Adjustment Factors for Structural Composite Lumber

		ASD only	ASD and LRFD							LRFD only		
		Load Duration Factor	Wet Service Factor	Temperature Factor	Beam Stability Factor	Volume Factor	Repetitive Member Factor	Column Stability Factor	Bearing Area Factor	Format Conversion Factor	Resistance Factor	Time Effect Factor
										K_F	ϕ	
$F_b' = F_b$	x	C_D	C_M	C_t	C_L[1]	C_V[1]	C_r	-	-	2.54	0.85	λ
$F_t' = F_t$	x	C_D	C_M	C_t	-	C_V	-	-	-	2.70	0.80	λ
$F_v' = F_v$	x	C_D	C_M	C_t	-	-	-	-	-	2.88	0.75	λ
$F_c' = F_c$	x	C_D	C_M	C_t	-	-	-	C_P	-	2.40	0.90	λ
$F_{c\perp}' = F_{c\perp}$	x	-	C_M	C_t	-	-	-	-	C_b	1.67	0.90	-
$E' = E$	x	-	C_M	C_t	-	-	-	-	-	-	-	-
$E_{min}' = E_{min}$	x	-	C_M	C_t	-	-	-	-	-	1.76	0.85	-

1. See 8.3.6.1 for information on simultaneous application of the volume factor, C_V, and the beam stability factor, C_L, to the reference bending design value, F_b

8.3.2 Load Duration Factor, C_D (ASD Only)

All reference design values except modulus of elasticity, E, modulus of elasticity for beam and column stability, E_{min}, and compression perpendicular to grain, $F_{c\perp}$, shall be multiplied by load duration factors, C_D, as specified in 2.3.2.

8.3.3 Wet Service Factor, C_M

Reference design values for structural composite lumber are applicable to dry service conditions as specified in 8.1.4 where $C_M = 1.0$. When the service conditions differ from the specified conditions, adjustments for high moisture shall be in accordance with information provided by the structural composite lumber manufacturer.

8.3.4 Temperature Factor, C_t

When structural members will experience sustained exposure to elevated temperatures up to 150°F (see Appendix C), reference design values shall be multiplied by the temperature factors, C_t, specified in 2.3.3.

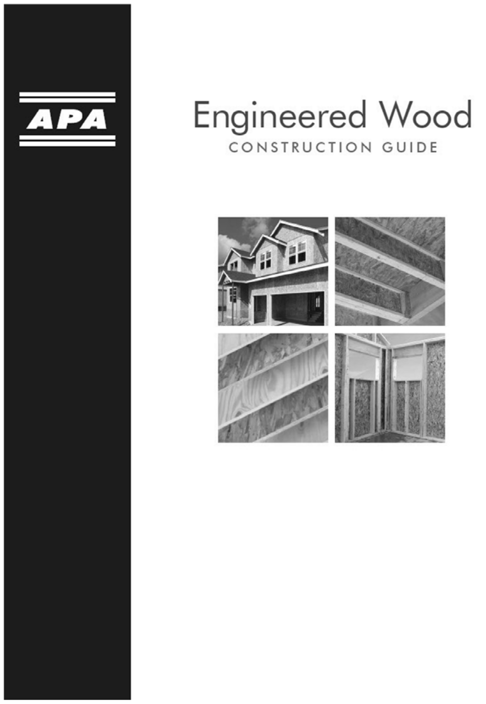
8.3.5 Beam Stability Factor, C_L

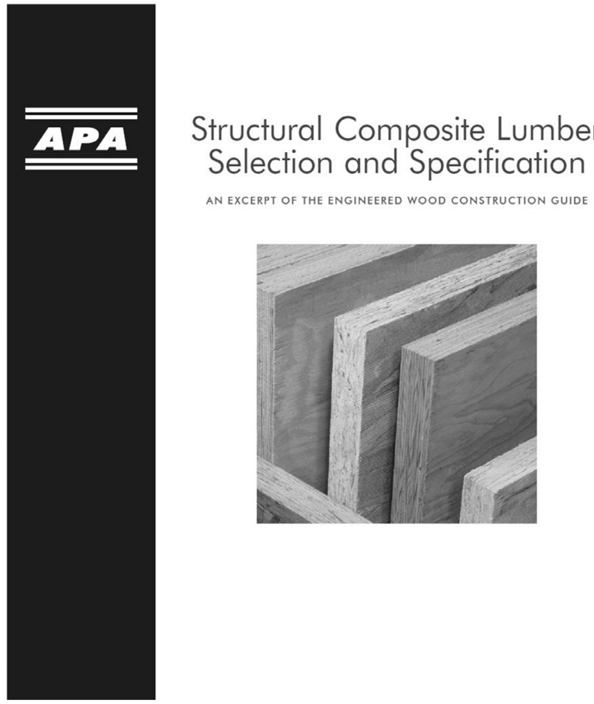
Structural composite lumber bending members shall be laterally supported in accordance with 3.3.3.

8.3.6 Volume Factor, C_V

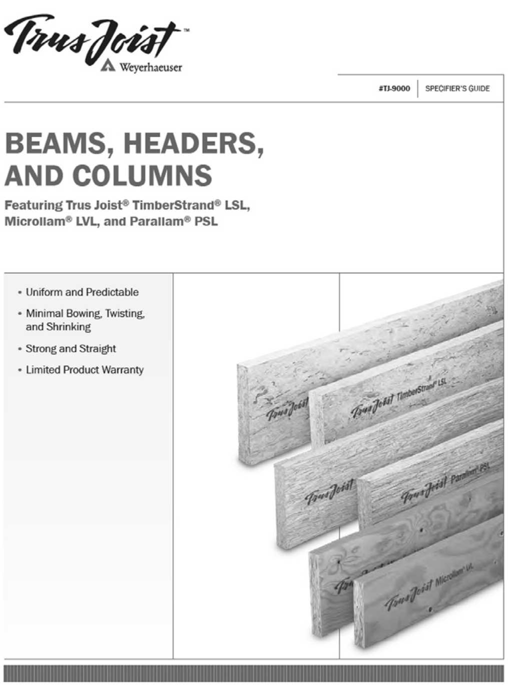
8.3.6.1 Reference bending design values, F_b, for structural composite lumber shall be multiplied by the volume factor, C_V, which shall be obtained from the structural composite lumber manufacturer's literature

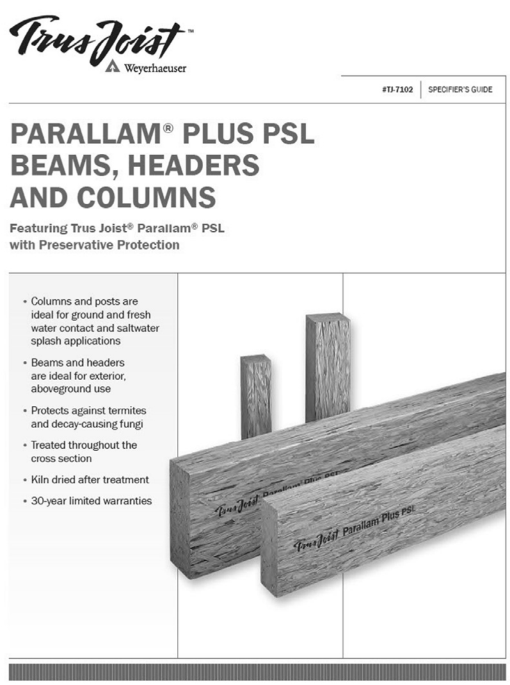
APA – from E30





Manufactures – e.g. Weyerhaeuser





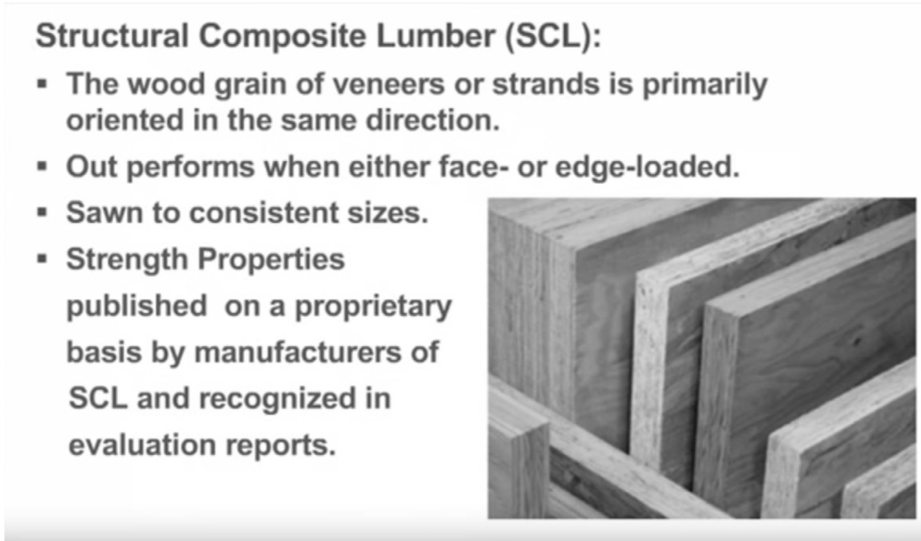
Structural Composite Lumber

LVL

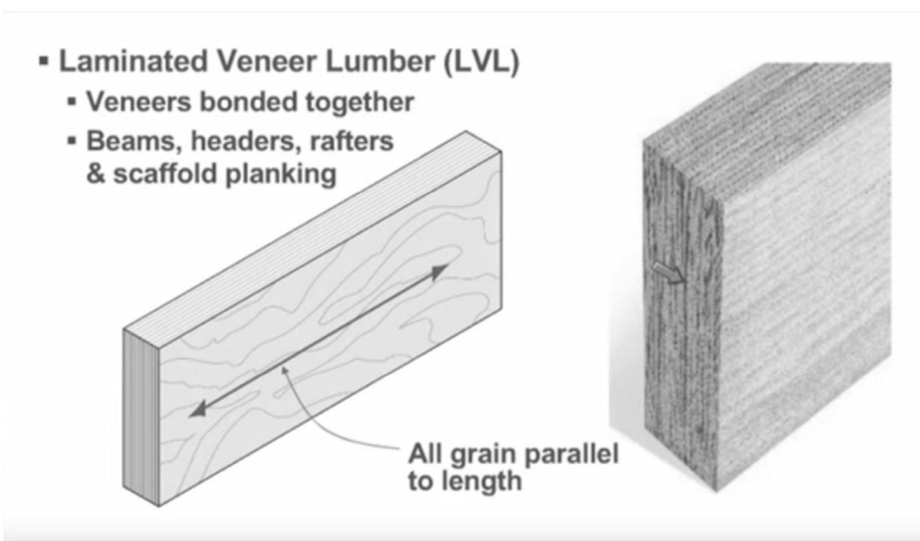
PSL

LSL

OSL

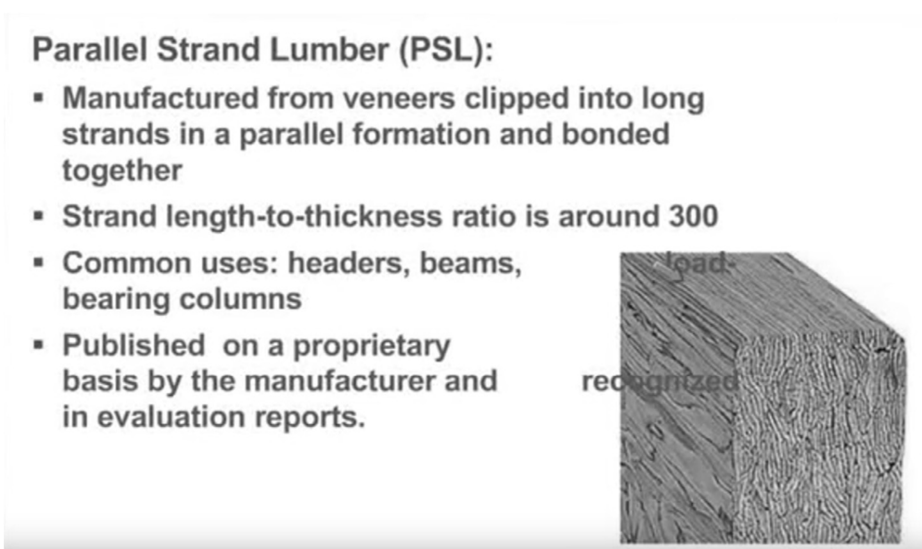


Laminated Veneer Lumber - LVL



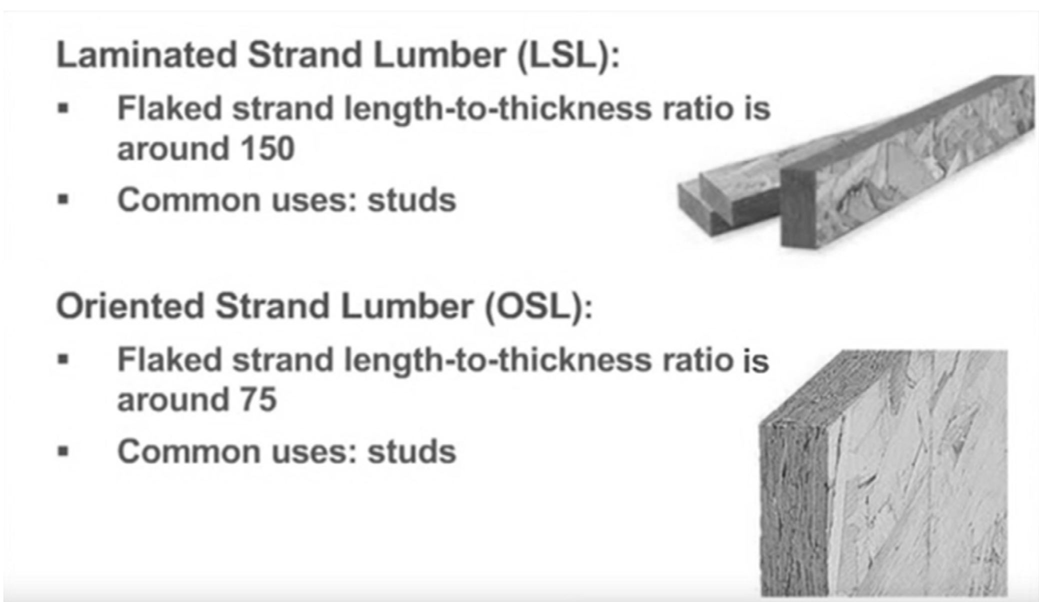
LVL construction

Parallel Strand Lumber - PSL

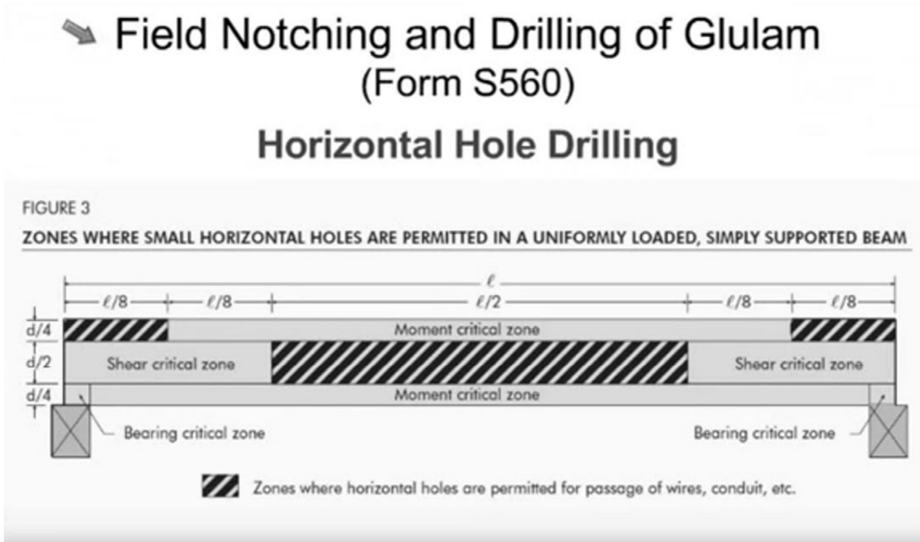


Parallel Strand Lumber - PSL

Laminated Strand Lumber – LSL
Oriented Strand Lumber - OSL



Structural Composite Lumber



Weyerhaeuser – Trus Joist
LSL – LVL – PSL

TJ_9000

This guide features Trus Joist® engineered lumber in the following widths and depths:

TimberStrand® LSL

1.55E TimberStrand® LSL sizes:
Widths: 1¾" and 3½"
Depths: 9½", 11⅞", 14", and 16"

1.3E TimberStrand® LSL header sizes:
Width: 3½"
Depths: 4⅜", 5½", and 7¼"

1.3E TimberStrand® LSL column and post sizes:
3½" x 3½"   3½" x 4⅜"   3½" x 5½"   3½" x 7¼"

Microllam® LVL

2.0E Microllam® LVL header and beam sizes:
Width: 1¾"
Depths: 5½", 7¼", 9¼", 9½", 11¼", 11⅞", 14", 16", 18", and 20"

Parallam® PSL

2.0E Parallam® PSL header and beam sizes:
Widths: 3½", 5¼", and 7"
Depths: 9¼", 9½", 11¼", 11⅞", 14", 16", and 18"

1.8E Parallam® PSL column and post sizes:
3½" x 3½"   3½" x 5¼"   3½" x 7"   5¼" x 5¼"   5¼" x 7"   7" x 7"

For deeper depth Parallam® PSL beams, see the Trus Joist® 2.2E Parallam® PSL Deep Beam guide, TJ-7001, or contact your Weyerhaeuser representative.

Weyerhaeuser – Trus Joist – LSL – LVL – PSL

TJ_9000.pdf

DESIGN PROPERTIES

Allowable Design Properties[1] (100% Load Duration)

Grade	Width	Design Property	Depth 4⅜"	5½"	5½" Plank Orientation	7¼"	9¼"	9½"	11¼"	11⅞"	14"	16"	18"	20"
TimberStrand® LSL														
1.3E	3½"	Moment (ft-lbs)	1,735	2,685	1,780	4,550								
		Shear (lbs)	4,340	5,455	1,925	7,190								
		Moment of Inertia (in.⁴)	24	49	20	111								
		Weight (plf)	4.5	5.6	5.6	7.4								
1.55E	1¾"	Moment (ft-lbs)						5,210		7,975	10,920	14,090		
		Shear (lbs)						3,435		4,295	5,065	5,785		
		Moment of Inertia (in.⁴)						125		244	400	597		
		Weight (plf)						5.2		6.5	7.7	8.8		
	3½"	Moment (ft-lbs)						10,420		15,955	21,840	28,180		
		Shear (lbs)						6,870		8,590	10,125	11,575		
		Moment of Inertia (in.⁴)						250		488	800	1,195		
		Weight (plf)						10.4		13	15.3	17.5		
Microllam® LVL														
2.0E	1¾"	Moment (ft-lbs)		2,125		3,555	5,600	5,885	8,070	8,925	12,130	15,555	19,375	23,580
		Shear (lbs)		1,830		2,410	3,075	3,160	3,740	3,950	4,655	5,320	5,985	6,650
		Moment of Inertia (in.⁴)		24		56	115	125	208	244	400	597	851	1,167
		Weight (plf)		2.8		3.7	4.7	4.8	5.7	6.1	7.1	8.2	9.2	10.2
Parallam® PSL														
2.0E	3½"	Moment (ft-lbs)					12,415	13,055	17,970	19,900	27,160	34,955	43,665	
		Shear (lbs)					6,260	6,430	7,615	8,035	9,475	10,825	12,180	
		Moment of Inertia (in.⁴)					231	250	415	488	800	1,195	1,701	
		Weight (plf)					10.1	10.4	12.3	13.0	15.3	17.5	19.7	
	5¼"	Moment (ft-lbs)					18,625	19,585	26,955	29,855	40,740	52,430	65,495	
		Shear (lbs)					9,390	9,645	11,420	12,055	14,210	16,240	18,270	
		Moment of Inertia (in.⁴)					346	375	623	733	1,201	1,792	2,552	
		Weight (plf)					15.2	15.6	18.5	19.5	23.0	26.3	29.5	
	7"	Moment (ft-lbs)					24,830	26,115	35,940	39,805	54,325	69,905	87,325	
		Shear (lbs)					12,520	12,855	15,225	16,070	18,945	21,655	24,360	
		Moment of Inertia (in.⁴)					462	500	831	977	1,601	2,389	3,402	
		Weight (plf)					20.2	20.8	24.6	26.0	30.6	35.0	39.4	

(1) For product in beam orientation, unless otherwise noted.

Weyerhaeuser – Trus Joist – LSL – LVL – PSL

DESIGN PROPERTIES

Design Stresses[1] (100% Load Duration)

Grade	Orientation	G Shear Modulus of Elasticity (psi)	E Modulus of Elasticity (psi)	E_{min} Adjusted Modulus of Elasticity[2] (psi)	F_b Flexural Stress[3] (psi)	F_t Tension Stress[4] (psi)	$F_{c\perp}$ Compression Perpendicular to Grain[5] (psi)	$F_{c\parallel}$ Compression Parallel to Grain (psi)	F_v Horizontal Shear Parallel to Grain (psi)	SG Equivalent Specific Gravity[6]
TimberStrand® LSL										
1.3E	Beam/Column	81,250	1.3×10^6	660,750	1,700	1,075	710	1,835	425	0.50[7]
	Plank	81,250	1.3×10^6	660,750	1,900[8]	1,075	635[9]	1,835	150	0.50[7]
1.55E	Beam	96,875	1.55×10^6	787,815	2,325	1,070[10]	900	2,170	310[10]	0.50[7]
Microllam® LVL										
2.0E	Beam	125,000	2.0×10^6	1,016,535	2,600	1,555	750	2,510	285	0.50
Parallam® PSL										
1.8E	Column	112,500	1.8×10^6	914,880	2,400[11]	1,755	545[11]	2,500	190[11]	0.50
2.0E	Beam	125,000	2.0×10^6	1,016,535	2,900	2,025	625[12]	2,900[13]	290	0.50

(1) Unless otherwise noted, adjustment to the design stresses for duration of load are permitted in accordance with the applicable code.
(2) Reference modulus of elasticity for beam and column stability calculations, per NDS®.
(3) For 12" depth. For other depths, multiply F_b by the appropriate factor as follows:
– For TimberStrand® LSL, multiply by $\left[\frac{12}{d}\right]^{0.092}$
– For Microllam® LVL, multiply by $\left[\frac{12}{d}\right]^{0.136}$
– For Parallam® PSL, multiply by $\left[\frac{12}{d}\right]^{0.111}$
(4) F_t has been adjusted to reflect the volume effects for most standard applications.
(5) $F_{c\perp}$ may not be increased for duration of load.
(6) For lateral connection design only.
(7) Specific gravity of 0.58 may be used for bolts installed perpendicular to face and loaded perpendicular to grain.
(8) Values are for thickness up to 3½".
(9) For members less than 1¾" thick and in plank orientation, use $F_{c\perp}$ of 670 psi.
(10) Value accounts for large hole capabilities. See **Allowable Holes** on page 26.
(11) Value shown is for plank orientation.
(12) Use 750 psi for Parallam® PSL identified with plant number 0579.
(13) For column applications, use $F_{c\parallel}$ of 500 psi. Alternatively, refer to ESR-1387, Table 1, footnote 15.

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Weyerhaeuser – Trus Joist – LSL – LVL – PSL

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General Assumptions for Trus Joist® Beams

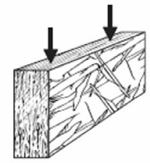
- Lateral support is required at bearing and along the span at 24" on-center, maximum.
- Bearing lengths are based on each product's bearing stress for applicable grade and orientation.
- All members 7¼" and less in depth are restricted to a maximum deflection of 5⁄16".
- Beams that are 1¾" x 16" and deeper require multiple plies. Some exceptions allowed when using Weyerhaeuser software.
- No camber.
- Beams and columns must remain straight to within $L^2/4608$ (in.) of true alignment. L is the unrestrained length of the member in feet.

For applications not covered in this brochure, contact your Weyerhaeuser representative.

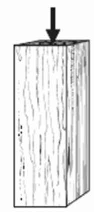
See pages 28 and 29 for multiple-member beam connections.

TimberStrand® LSL, Microllam® LVL, and untreated Parallam® PSL are intended for dry-use applications

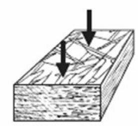
Beam Orientation



Column Orientation



Plank Orientation



Weyerhaeuser – Trus Joist – LVL – Load Capacity Table

2.0E Microllam® LVL: Roof—Non-Snow Load Area 125% (PLF)

Span	Condition	1¾" Width							3½" Width (2 ply)					
		5½"	7¼"	9¼"	9½"	11¼"	11⅞"	14"	5½"	7¼"	9¼"	9½"	11¼"	11⅞"
6'	Total Load	474	954	1,285	1,329	1,656	1,781	1,961	948	1,908	2,571	2,659	3,313	3,563
	Deflection L/240	458	*	*	*	*	*	*	916	*	*	*	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	2.2/5.5	2.9/7.4	3.1/7.6	3.8/9.5	4.1/10.2	4.5/11.3	1.5/3.5	2.2/5.5	2.9/7.4	3.1/7.6	3.8/9.5	4.1/10.2
8'	Total Load	153	342	870	915	1,145	1,224	1,469	307	685	1,741	1,830	2,290	2,449
	Deflection L/240	*	*	*	*	*	*	*	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.7/6.7	2.8/7	3.5/8.8	3.8/9.4	4.5/11.3	1.5/3.5	1.5/3.5	2.7/6.7	2.8/7	3.5/8.8	3.8/9.4
9'-6"	Total Load	77	174	615	647	888	982	1,212	154	349	1,231	1,294	1,776	1,965
	Deflection L/240	*	*	543	585	*	*	*	*	*	1,086	1,171	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.2/5.6	2.4/5.9	3.2/8.1	3.6/8.9	4.4/11	1.5/3.5	1.5/3.5	2.2/5.6	2.4/5.9	3.2/8.1	3.6/8.9
10'	Total Load	62	142	555	583	801	886	1,137	124	284	1,110	1,167	1,602	1,772
	Deflection L/240	*	*	470	506	*	*	*	*	*	940	1,013	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.1/5.3	2.2/5.6	3.1/7.7	3.4/8.5	4.4/10.9	1.5/3.5	1.5/3.5	2.1/5.3	2.2/5.6	3.1/7.7	3.4/8.5
12'	Total Load		67	367	397	554	613	835	57	135	735	794	1,109	1,227
	Deflection L/240		*	279	301	488	568	*	*	*	558	602	976	1,137
	Min. End/Int. Bearing (in.)		1.5/3.5	1.7/4.3	1.8/4.6	2.6/6.4	2.8/7.1	3.9/9.6	1.5/3.5	1.5/3.5	1.7/4.3	1.8/4.6	2.6/6.4	2.8/7.1
14'	Total Load			233	252	405	449	611		70	466	505	811	898
	Deflection L/240			178	193	314	367	585		*	357	386	629	734
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	2.2/5.5	2.4/6.1	3.3/8.3		1.5/3.5	1.5/3.5	1.5/3.5	2.2/5.5	2.4/6.1
16'-6"	Total Load			142	154	255	299	438			285	308	510	598
	Deflection L/240			110	119	195	228	367			220	238	391	457
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.6/4.1	1.9/4.8	2.8/7			1.5/3.5	1.5/3.5	1.6/4.1	1.9/4.8
18'-6"	Total Load			100	108	181	212	345			200	217	362	425
	Deflection L/240			78	85	140	164	264			157	170	280	328
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.9	2.5/6.2			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.9
20'	Total Load			78	85	143	168	274			157	171	286	336
	Deflection L/240			62	67	111	130	211			125	135	223	261
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.1/5.4			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
22'	Total Load			58	63	106	125	206			116	126	213	251
	Deflection L/240			47	51	84	98	160			94	102	168	197
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.5			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
24'	Total Load					81	95	158			87	95	162	191
	Deflection L/240					65	76	124			73	79	130	153
	Min. End/Int. Bearing (in.)					1.5/3.5	1.5/3.5	1.5/3.8			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
26'	Total Load					62	74	123			67	73	125	148
	Deflection L/240					51	60	98			57	62	102	120
	Min. End/Int. Bearing (in.)					1.5/3.5	1.5/3.5	1.5/3.5			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
28'	Total Load						58	98			52	56	98	117
	Deflection L/240						48	78			46	50	82	97
	Min. End/Int. Bearing (in.)						1.5/3.5	1.5/3.5			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
30'	Total Load							78					78	93
	Deflection L/240							64					67	79
	Min. End/Int. Bearing (in.)							1.5/3.5					1.5/3.5	1.5/3.5

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* Indicates **Total Load** value controls.

LVL – PSL – LSL
Selection

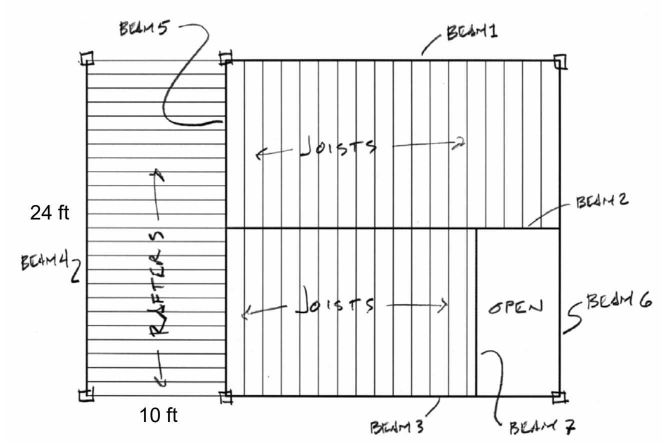
1. Calculate total beam load
2. Choose beam span in chart
3. Find section to carry load

or

2. Calculate shear and moment
3. Use properties chart to find section
4. Include adjustment factors: C_D, C_V

LVL
Example – Beam 4

Given: span = 24 ft.
D 6 psf Lr 20 psf



1. Calculate total beam load
2. Choose beam span in chart
3. Find section to carry load

LOAD IN PLF

$D + L_r = 6 + 20 = 26$ PSF

$26 (5') = 130$ PLF

LVL

Example

Beam 4

Span = 24 ft

Load = 130 plf

Lr = 100 plf

Pick 1 ¾" x 14"

2.0E Microllam® LVL: Roof—Non-Snow Load Area 125% (PLF)

Span	Condition	1¾" Width							3½" Width (2 ply)					
		5½"	7¼"	9¼"	9½"	11¼"	11⅞"	14"	5½"	7¼"	9¼"	9½"	11¼"	11⅞"
6'	Total Load	474	954	1,285	1,329	1,656	1,781	1,961	948	1,908	2,571	2,659	3,313	3,563
	Deflection L/240	458	*	*	*	*	*	*	916	*	*	*	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	2.2/5.5	2.9/7.4	3.1/7.6	3.8/9.5	4.1/10.2	4.5/11.3	1.5/3.5	2.2/5.5	2.9/7.4	3.1/7.6	3.8/9.5	4.1/10.2
8'	Total Load	153	342	870	915	1,145	1,224	1,469	307	685	1,741	1,830	2,290	2,449
	Deflection L/240	*	*	*	*	*	*	*	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.7/6.7	2.8/7	3.5/8.8	3.8/9.4	4.5/11.3	1.5/3.5	1.5/3.5	2.7/6.7	2.8/7	3.5/8.8	3.8/9.4
9'-6"	Total Load	77	174	615	647	888	982	1,212	154	349	1,231	1,294	1,776	1,965
	Deflection L/240	*	*	543	585	*	*	*	*	*	1,086	1,171	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.2/5.6	2.4/5.9	3.2/8.1	3.6/8.9	4.4/11	1.5/3.5	1.5/3.5	2.2/5.6	2.4/5.9	3.2/8.1	3.6/8.9
10'	Total Load	62	142	555	583	801	886	1,137	124	284	1,110	1,167	1,602	1,772
	Deflection L/240	*	*	470	506	*	*	*	*	*	940	1,013	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.1/5.3	2.2/5.6	3.1/7.7	3.4/8.5	4.4/10.9	1.5/3.5	1.5/3.5	2.1/5.3	2.2/5.6	3.1/7.7	3.4/8.5
12'	Total Load		67	367	397	554	613	835	57	135	735	794	1,109	1,227
	Deflection L/240		*	279	301	488	568	*	*	*	558	602	976	1,137
	Min. End/Int. Bearing (in.)		1.5/3.5	1.7/4.3	1.8/4.6	2.6/6.4	2.8/7.1	3.9/9.6	1.5/3.5	1.5/3.5	1.7/4.3	1.8/4.6	2.6/6.4	2.8/7.1
14'	Total Load			233	252	405	449	611		70	466	505	811	898
	Deflection L/240			178	193	314	367	585		*	357	386	629	734
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	2.2/5.5	2.4/6.1	3.3/8.3		1.5/3.5	1.5/3.5	1.5/3.5	2.2/5.5	2.4/6.1
16'-6"	Total Load			142	154	255	299	438			285	308	510	598
	Deflection L/240			110	119	195	228	367			220	238	391	457
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.6/4.1	1.9/4.8	2.8/7			1.5/3.5	1.5/3.5	1.6/4.1	1.9/4.8
18'-6"	Total Load			100	108	181	212	345			200	217	362	425
	Deflection L/240			78	85	140	164	264			157	170	280	328
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.9	2.5/6.2			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.9
20'	Total Load			78	85	143	168	274			157	171	286	336
	Deflection L/240			62	67	111	130	211			125	135	223	261
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.1/5.4			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
22'	Total Load			58	63	106	125	206			116	126	213	251
	Deflection L/240			47	51	84	98	160			94	102	168	197
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.5			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
24'	Total Load					81	95	158			87	95	162	191
	Deflection L/240					65	76	124			73	79	130	153
	Min. End/Int. Bearing (in.)					1.5/3.5	1.5/3.5	1.5/3.8			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
26'	Total Load					62	74	123			67	73	125	148
	Deflection L/240					51	60	98			57	62	102	120
	Min. End/Int. Bearing (in.)					1.5/3.5	1.5/3.5	1.5/3.5			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
28'	Total Load						58	98			52	56	98	117
	Deflection L/240						48	78			46	50	82	97
	Min. End/Int. Bearing (in.)						1.5/3.5	1.5/3.5			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
30'	Total Load							78					78	93
	Deflection L/240							64					67	79
	Min. End/Int. Bearing (in.)							1.5/3.5					1.5/3.5	1.5/3.5

* Indicates **Total Load** value controls.

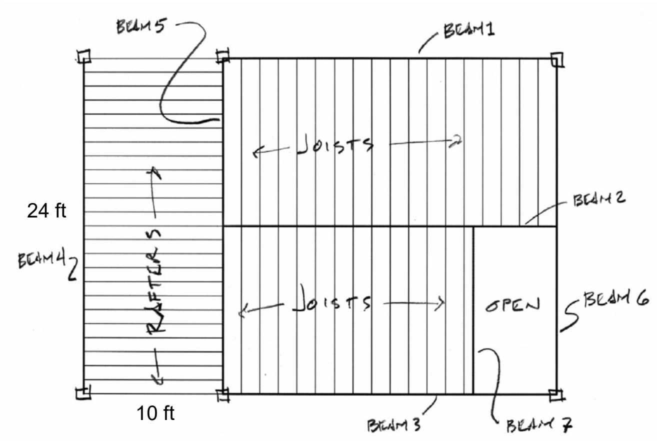
LVL – PSL – LSL

Example – Beam 4

Given: span = 24 ft.

D 6 psf Lr 20 psf

130 plf



1. Calculate total beam load
2. Calculate shear and moment
3. Use properties chart to find section
4. Check stresses
5. Check deflection

$$M_{MAX} = \frac{w l^2}{8} = \frac{130(24)^2}{8} = 9360 \text{ '-\#}$$

$$V_{max} = \frac{w l}{2} = \frac{130(24)}{2} = 1560 \text{ \#}$$

Weyerhaeuser – Trus Joist – LSL – LVL – PSL

Moment:
9360 ft-lb

Shear:
1560 lbs

DESIGN PROPERTIES

Allowable Design Properties(1) (100% Load Duration)

Grade	Width	Design Property	Depth 4⅜"	5½"	5½" Plank Orientation	7¼"	9¼"	9½"	11¼"	11⅞"	14"	16"	18"	20"
TimberStrand® LSL														
1.3E	3½"	Moment (ft-lbs)	1,735	2,685	1,780	4,550								
		Shear (lbs)	4,340	5,455	1,925	7,190								
		Moment of Inertia (in.⁴)	24	49	20	111								
		Weight (plf)	4.5	5.6	5.6	7.4								
1.55E	1¾"	Moment (ft-lbs)						5,210		7,975	10,920	14,090		
		Shear (lbs)						3,435		4,295	5,065	5,785		
		Moment of Inertia (in.⁴)						125		244	400	597		
		Weight (plf)						5.2		6.5	7.7	8.8		
	3½"	Moment (ft-lbs)						10,420		15,955	21,840	28,180		
		Shear (lbs)						6,870		8,590	10,125	11,575		
		Moment of Inertia (in.⁴)						250		488	800	1,195		
		Weight (plf)						10.4		13	15.3	17.5		
Microllam® LVL														
2.0E	1¾"	Moment (ft-lbs)		2,125		3,555	5,600	5,885	8,070	8,925	12,130	15,555	19,375	23,580
		Shear (lbs)		1,830		2,410	3,075	3,160	3,740	3,950	4,655	5,320	5,985	6,650
		Moment of Inertia (in.⁴)		24		56	115	125	208	244	400	597	851	1,167
		Weight (plf)		2.8		3.7	4.7	4.8	5.7	6.1	7.1	8.2	9.2	10.2
Parallam® PSL														
2.0E	3½"	Moment (ft-lbs)					12,415	13,055	17,970	19,900	27,160	34,955	43,665	
		Shear (lbs)					6,260	6,430	7,615	8,035	9,475	10,825	12,180	
		Moment of Inertia (in.⁴)					231	250	415	488	800	1,195	1,701	
		Weight (plf)					10.1	10.4	12.3	13.0	15.3	17.5	19.7	
	5¼"	Moment (ft-lbs)					18,625	19,585	26,955	29,855	40,740	52,430	65,495	
		Shear (lbs)					9,390	9,645	11,420	12,055	14,210	16,240	18,270	
		Moment of Inertia (in.⁴)					346	375	623	733	1,201	1,792	2,552	
		Weight (plf)					15.2	15.6	18.5	19.5	23.0	26.3	29.5	
	7"	Moment (ft-lbs)					24,830	26,115	35,940	39,805	54,325	69,905	87,325	
		Shear (lbs)					12,520	12,855	15,225	16,070	18,945	21,655	24,360	
		Moment of Inertia (in.⁴)					462	500	831	977	1,601	2,389	3,402	
		Weight (plf)					20.2	20.8	24.6	26.0	30.6	35.0	39.4	

(1) For product in beam orientation, unless otherwise noted.

LVL

Example – Beam 4

Given: span = 24 ft.
D 6 psf Lr 20 psf
130 plf (total load)

3. Use properties chart to find section

TRY LVL 2.0E 1¾" × 14"

$$S_x = \frac{bd^2}{6} = \frac{1.75(14)^2}{6} = 57.16 \text{ in}^3$$

$$f_b = \frac{M}{S_x} = \frac{9360(12)}{57.16} = 1965 \text{ PSI}$$

$$A = 1.75(14) = 24.5 \text{ in}^2$$

$$f_v = \frac{3}{2}\frac{V}{A} = 1.5\ \frac{1560}{24.5} = 63.7 \text{ PSI}$$

Weyerhaeuser – Trus Joist – LSL – LVL – PSL

DESIGN PROPERTIES

Design Stresses[1] (100% Load Duration)

Grade	Orientation	G Shear Modulus of Elasticity (psi)	E Modulus of Elasticity (psi)	E_{min} Adjusted Modulus of Elasticity[2] (psi)	F_b Flexural Stress[3] (psi)	F_t Tension Stress[4] (psi)	$F_{c\perp}$ Compression Perpendicular to Grain[5] (psi)	$F_{c\parallel}$ Compression Parallel to Grain (psi)	F_v Horizontal Shear Parallel to Grain (psi)	SG Equivalent Specific Gravity[6]
TimberStrand® LSL										
1.3E	Beam/Column	81,250	1.3×10^6	660,750	1,700	1,075	710	1,835	425	0.50[7]
	Plank	81,250	1.3×10^6	660,750	1,900[8]	1,075	635[9]	1,835	150	0.50[7]
1.55E	Beam	96,875	1.55×10^6	787,815	2,325	1,070[10]	900	2,170	310[10]	0.50[7]
Microllam® LVL										
→ 2.0E	Beam	125,000	2.0×10^6	1,016,535	2,600	1,555	750	2,510	285	0.50
Parallam® PSL										
1.8E	Column	112,500	1.8×10^6	914,880	2,400[11]	1,755	545[11]	2,500	190[11]	0.50
2.0E	Beam	125,000	2.0×10^6	1,016,535	2,900	2,025	625[12]	2,900[13]	290	0.50

(1) Unless otherwise noted, adjustment to the design stresses for duration of load are permitted in accordance with the applicable code.
(2) Reference modulus of elasticity for beam and column stability calculations, per NDS®.
(3) For 12" depth. For other depths, multiply F_b by the appropriate factor as follows:
– For TimberStrand® LSL, multiply by $\left[\frac{12}{d}\right]^{0.092}$
→ – For Microllam® LVL, multiply by $\left[\frac{12}{d}\right]^{0.136}$
– For Parallam® PSL, multiply by $\left[\frac{12}{d}\right]^{0.111}$
(4) F_t has been adjusted to reflect the volume effects for most standard applications.
(5) $F_{c\perp}$ may not be increased for duration of load.
(6) For lateral connection design only.
(7) Specific gravity of 0.58 may be used for bolts installed perpendicular to face and loaded perpendicular to grain.
(8) Values are for thickness up to 3½".
(9) For members less than 1¾" thick and in plank orientation, use $F_{c\perp}$ of 670 psi.
(10) Value accounts for large hole capabilities. See **Allowable Holes** on page 26.
(11) Value shown is for plank orientation.
(12) Use 750 psi for Parallam® PSL identified with plant number 0579.
(13) For column applications, use $F_{c\parallel}$ of 500 psi. Alternatively, refer to ESR-1387, Table 1, footnote 15.

LVL

Example – Beam 4

Given: span = 24 ft.
D 6 psf Lr 20 psf
130 plf
1 ¾" x 14"

4. Check stresses

F_b ADJUSTMENT

$C_D = 1.25$

$C_V = \left[\frac{12}{d}\right]^{0.136} = \left(\frac{12}{14}\right)^{0.136} = 0.979$

C_L (PER NDS 3.3.3)
BRACED BY RAFTERS ∴ $C_L = 1.0$

$C_M,\ C_t,\ C_r = 1.0$

LVL 2.0E

$F_b = 2600$ PSI
$F_v = 285$ PSI

$F'_b = 2600(1.25)(0.979) = 3182$ PSI
$F'_b = 3182 > 1965 = f_b$ ∴ ✓OK

$F'_v = 285(1.25) = 356$ PSI
$F'_v = 356 > 63.7 = f_v$ ✓OK

LVL

Example – Beam 4

Given: span = 24 ft.
D 6 psf Lr 20 psf
130 plf
1 ¾" x 14"

$$I = \frac{bd^3}{12} = \frac{1.75(14)^3}{12} = 400 \text{ in}^4$$

5. Check deflection

$$\Delta = \frac{5 w l^4}{384 EI} = \frac{5(130)(24)^4(1728)}{384(2000000)(400)} = 1.21 \text{ in}$$

$$\frac{L}{240} = \frac{24(12)}{240} = 1.20 \approx 1.21 \text{ in} \quad \text{OK} \checkmark$$