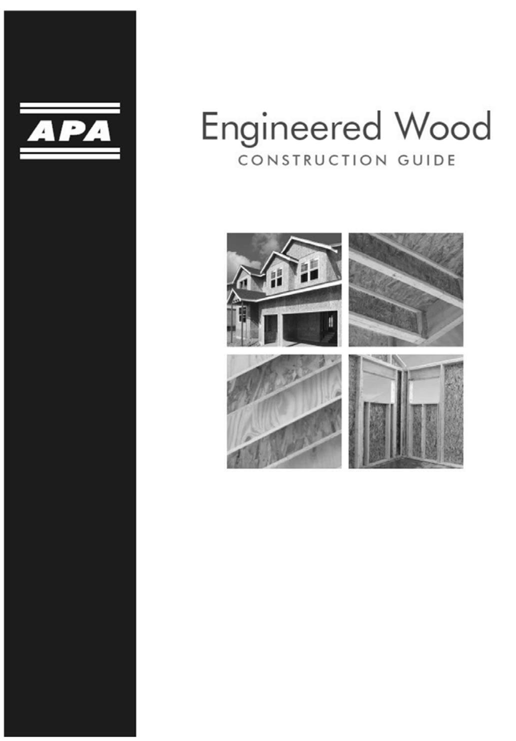
Architecture 544
Wood Structures

Engineered Wood Products:
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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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 K_F	Resistance Factor ϕ	Time Effect Factor
$F_b' = F_b$	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.

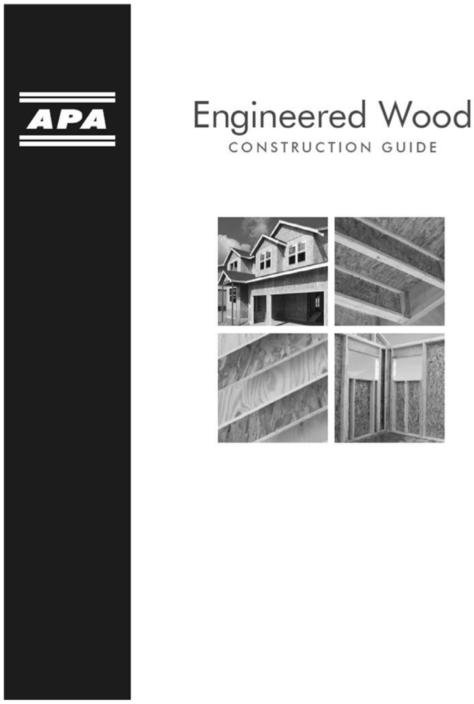
8.3.5 Beam Stability Factor, C_L

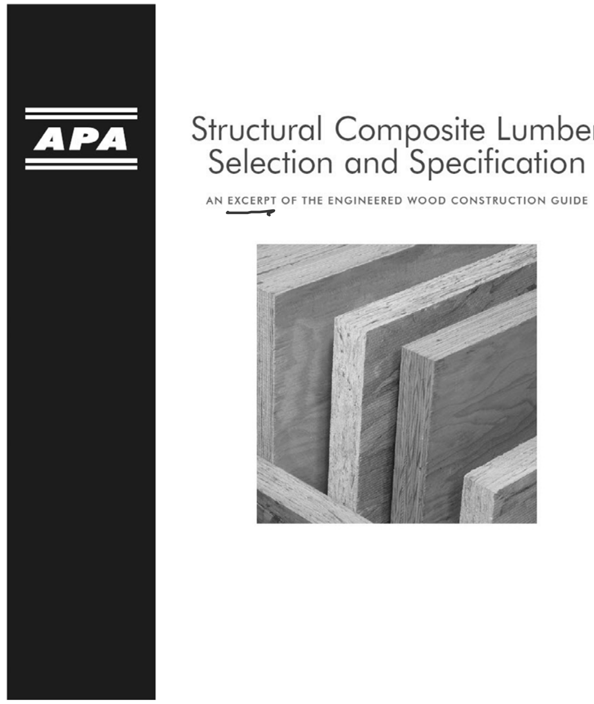
Structural composite lumber bending members shall be laterally supported in accordance with 3.3.3.

8.3.6 Volume Factor, C_V

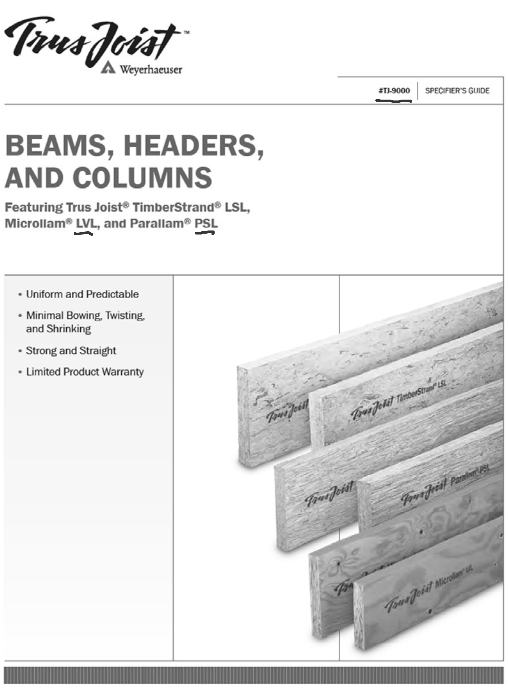
8.3.6.1 Reference bending design values, F_b, for structural composite lumber shall be multiplied by the volume factor, C_V, which shall be obtained from the structural composite lumber manufacturer's literature

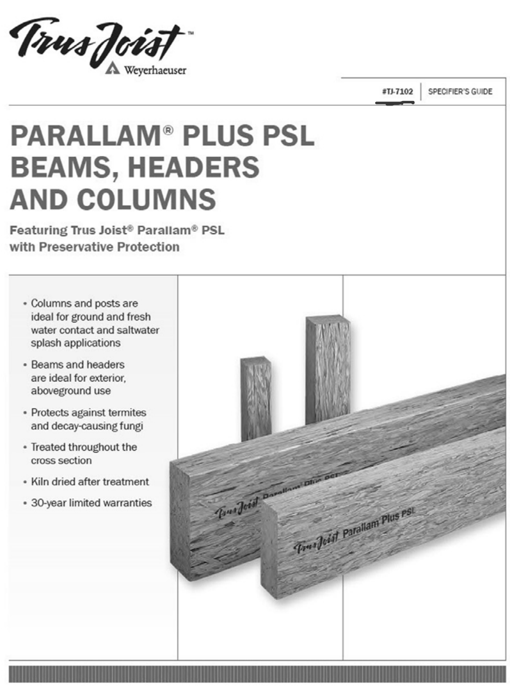
APA – from E30





Manufactures – e.g. Weyerhaeuser





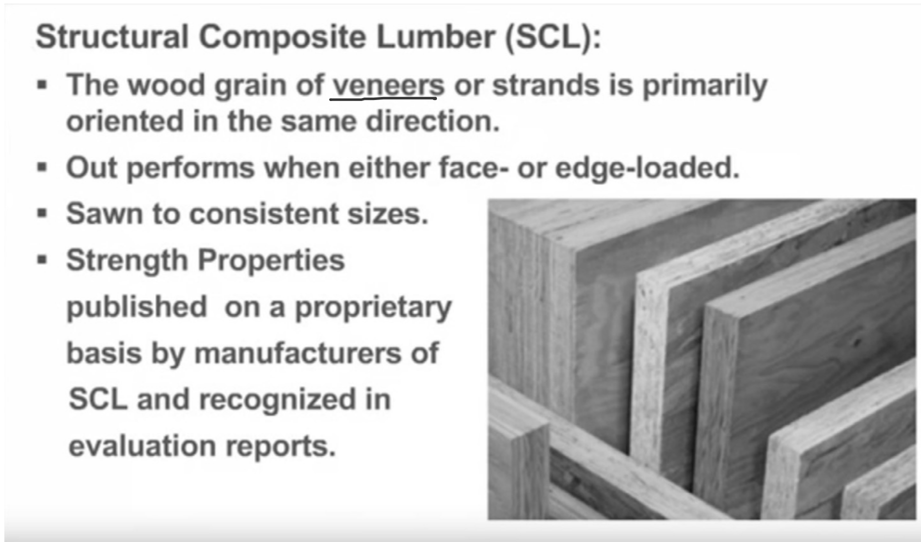
Structural Composite Lumber

LVL

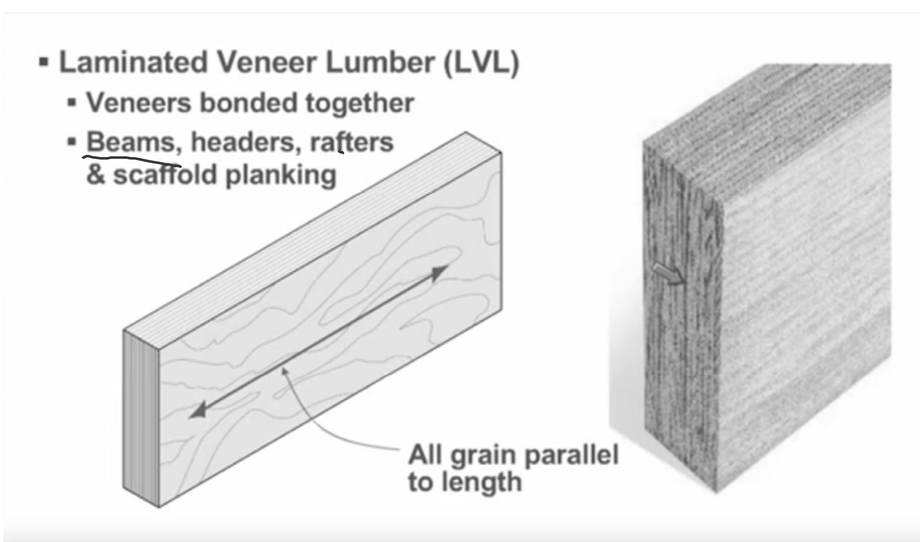
PSL

LSL

OSL



Laminated Veneer Lumber - LVL

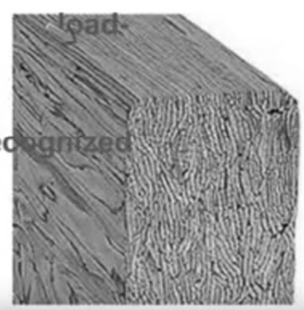


LVL construction

Parallel Strand Lumber - PSL

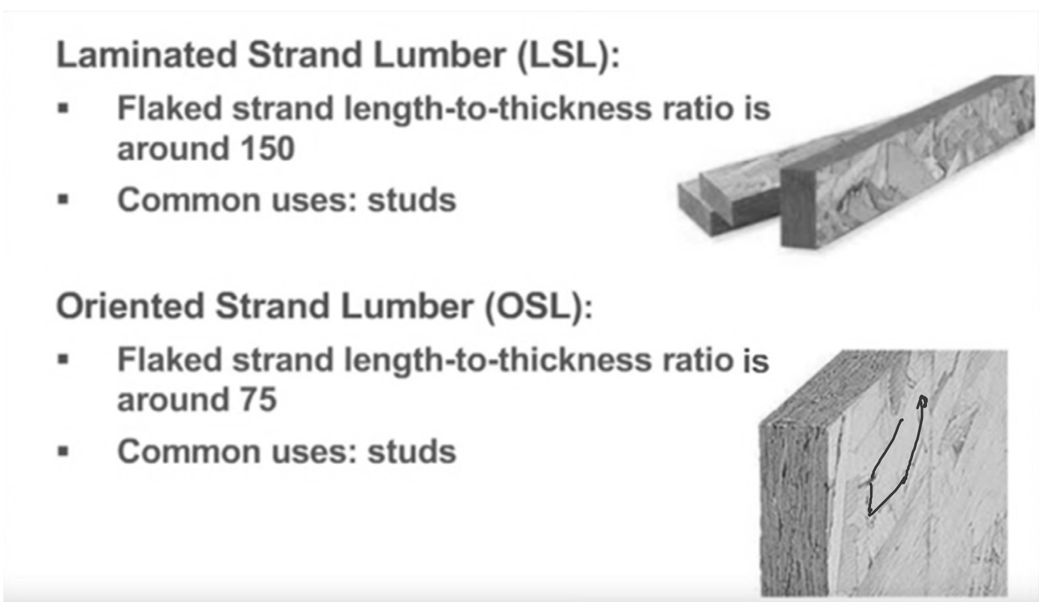
Parallel Strand Lumber (PSL):

- **Manufactured from veneers clipped into long strands in a parallel formation and bonded together**
- **Strand length-to-thickness ratio is around 300**
- **Common uses: headers, beams, load-bearing columns**
- **Published on a proprietary basis by the manufacturer and recognized in evaluation reports.**

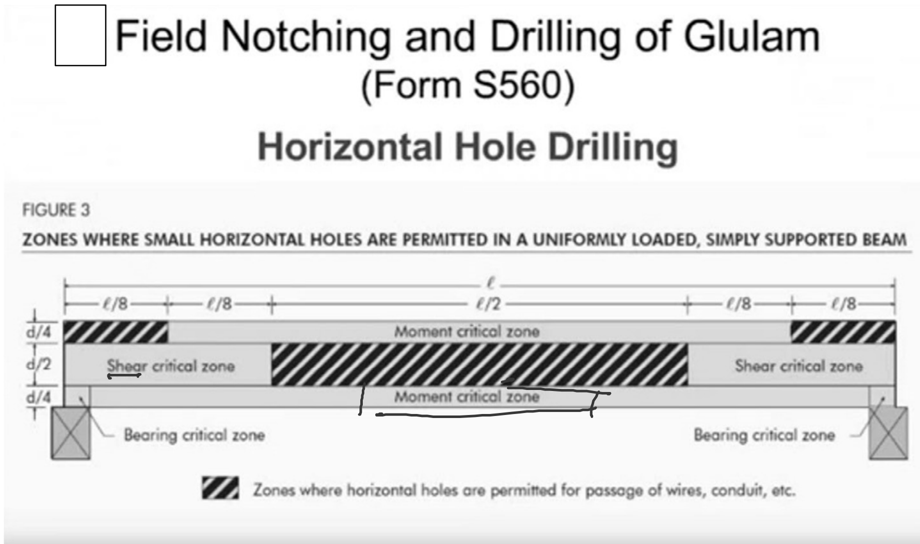


Parallel Strand Lumber - PSL

Laminated Strand Lumber – LSL
Oriented Strand Lumber - OSL



Structural Composite Lumber



Weyerhaeuser – Trus Joist
LSL – LVL – PSL

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.

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Weyerhaeuser – Trus Joist – LSL – LVL – PSL

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DESIGN PROPERTIES

$C_D = 1.0$

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

$C_D = 1.0$

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 $\left[\frac{12}{d}\right]^{0.136}$ C_F
– 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

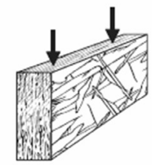
- Lateral support is required at bearing and along the span at 24" on-center, maximum.
- Bearing lengths are based on each product's bearing stress for applicable grade and orientation.
- All members 7¼" and less in depth are restricted to a maximum deflection of 5⁄16".
- Beams that are 1¾" x 16" and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

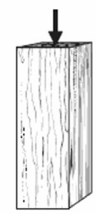
See pages 28 and 29 for multiple-member beam connections.

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

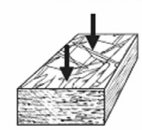
Beam Orientation



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

* Indicates **Total Load** value controls.

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LVL – PSL – LSL

Selection

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

or

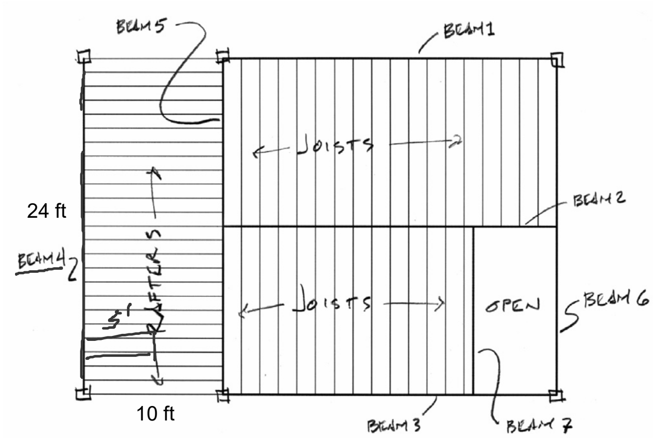
PROPERTIES

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	93	158			87	93	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.

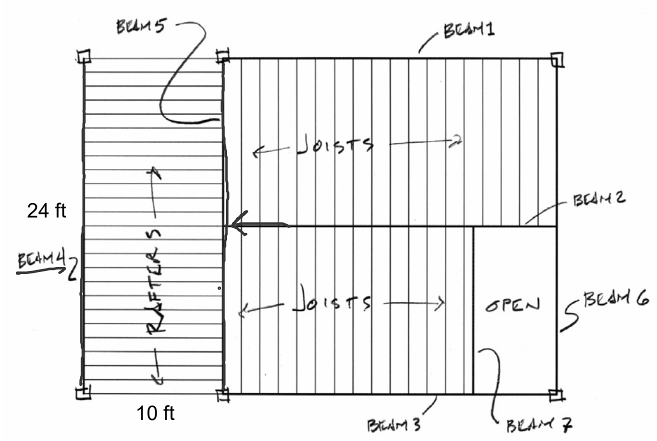
LVL – PSL – LSL

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

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

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

Weyerhaeuser – Trus Joist – LSL – LVL – PSL

Moment:
9360 ft-lb

CD=1.25

9360/1.25
=7488

Shear:
1560 lbs

1560/1.25
=1248

DESIGN PROPERTIES

Allowable Design Properties(1) (100% Load Duration) $C_D = 1.0$

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)
M = 9360 ft-lbs
V = 1560 lbs

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

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

3. Use properties chart to find section

TRY LVL 2.0E 1¾" × 11¼"

$$S_x = \frac{bd^2}{6} = \frac{1.75''(11.25)^2}{6} = 36.91 \text{ in}^3$$

$$f_b = \frac{M}{S_x} = \frac{9360(12)}{36.91} = 3042 \text{ psi (ACTUAL)}$$

$$A = 1.75(11.25) = 19.68 \text{ in}^2$$

$$f_v = \frac{3}{2}\frac{V}{A} = 1.5\frac{1560^{MAX}}{19.68} = 118.8 \text{ psi}$$

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)
1.3E	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 $\left[\frac{12}{d}\right]^{0.136}$ C_F
– 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.

multiply tabulated values by adjustment factors C_D ~~C_M~~ C_F ~~C_t~~ (~~C_L~~ or C_V) ~~C_r~~

BRACED

1.25 ?

LVL

Example – Beam 4

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

Try:
1 ¾" x 11.25"

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 $\therefore C_L = 1.0$

$C_M, C_t, C_r = 1.0$ ✓

LVL 2.0E 1¾" x 11¼"

$F_b = 2600$ psi

$F_v = 285$ psi

$F'_b = 2600(1.25)(0.979) = 3182$ psi   (C_D, C_F)

$F'_b = 3182 > 3042 = f_b$ OK ✓

$F'_v = 285(1.25) = 356$ psi   (C_D)

$F'_v = 356 > 118 = f_v$ OK ✓

LVL

Given: span = 24 ft.
Lr 20 psf
100 plf

5. Check deflection
   for Lr < L/240

IBC

Table 1604.3 DEFLECTION LIMITS [a, b, c, h, i]

CONSTRUCTION	L or L_r	S or W[f]	D + L[d, g]
Roof members:[e]			
Supporting plaster or stucco ceiling	l/360	l/360	l/240
Supporting nonplaster ceiling	l/240	l/240	l/180
Not supporting ceiling	l/180	l/180	l/120
Floor members	l/360	—	l/240
Exterior walls:			
With plaster or stucco finishes	—	l/360	—
With other brittle finishes	—	l/240	—
With flexible finishes	—	l/120	—
Interior partitions:[b]			
With plaster or stucco finishes	l/360	—	—
With other brittle finishes	l/240	—	—
With flexible finishes	l/120	—	—
Farm buildings	—	—	l/180
Greenhouses	—	—	l/120

1.75" x 11.25"

$$I = \frac{bd^3}{12} = 208 \text{ in}^4$$

$$\Delta = \frac{5wl^4}{384EI} = \frac{5(100)(24)^4(1728)}{384(2.0\times10^6)\,208\,[244]}$$

$$= 1.8'' \; [1.5''] \text{ — FAIL}$$

$$\frac{L}{240} = \frac{24(12)}{240} = 1.2'' < 1.8'' \quad \therefore \text{ FAILS}$$

1.75" x 14"

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

$$\Delta = \frac{5wl^4}{384EI} = \frac{5(100)(24)^4(1728)}{384(2000000)(400)} = 0.93 \text{ in}$$

$$\frac{L}{240} = \frac{24(12)}{240} = 1.20 > 0.93 \text{ in} \quad \text{OK}$$

Weyerhaeuser – Trus Joist – LSL – LVL – PSL

Moment:
9360 ft-lb

CD=1.25

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.