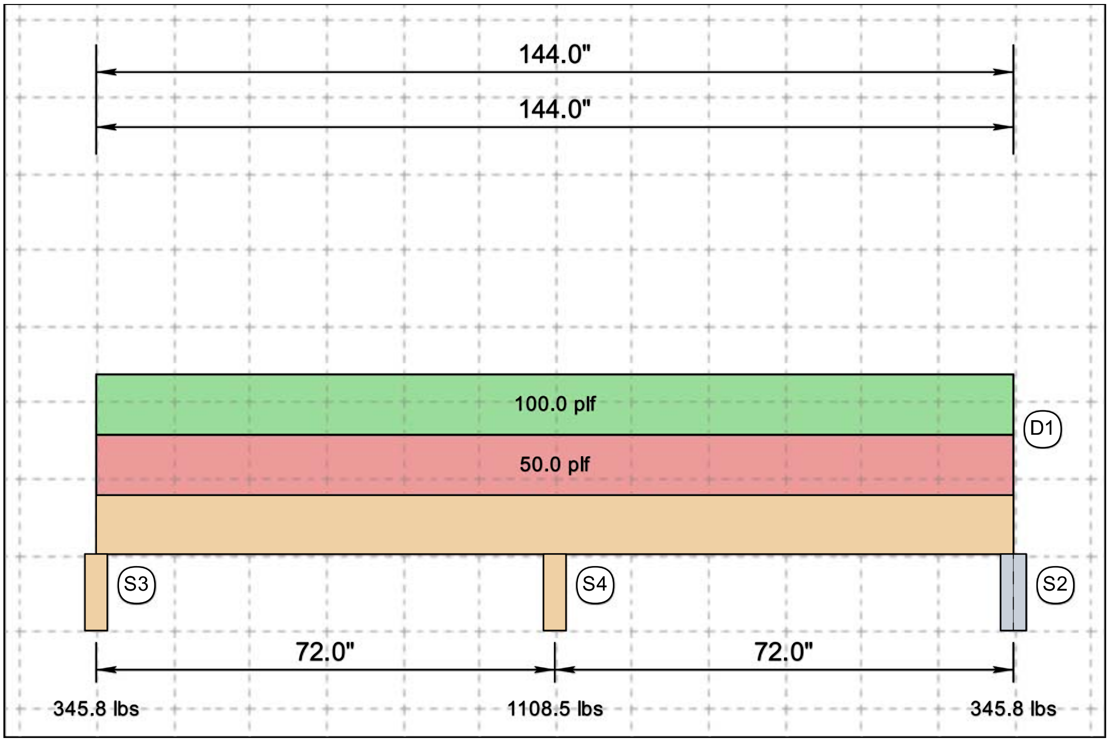
Beam Design



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1. Beam Data

Beam Type:	Glulam
Species:	Western Species
Grade:	24F-V4 1.8E DF/DF
Size:	3.5 x 9
Beam Length:	9.45 ft.
Beam Ply (N):	1
Code Standard:	ASCE7-22, NDS 2024
Notes:	

2. Design Options

Lateral Support (B):	braced
Lateral Support (T):	braced
Defl. Limits:	360|240
Load Duration:	1.15
Exposure:	dry
Temperature:	T <= 100°F
Orientation:	Vertical
Incised:	Yes
Rep. Members:	No

3. Adjustment Factors

Factor	Description	F_b	F_t	F_v	F_c	$F_{c\perp}$	E/E_{min}
C_D	Load Duration Factor	1.15	1.15	1.15	1.15	-	-
C_M	Wet Service Factor	1.0[b]	1.0	1.0	1.0[c]	1.0	1.0
C_t	Temperature Factor	1.0	1.0	1.0	1.0	1.0	1.0
C_L	Beam Stability Factor		-	-	-	-	-
C_F	Size Factor	1.1	1.1	-	1.0	-	-
C_{fu}	Flat Use Factor	1.2[d]	-	-	-	-	-
C_i	Incising Factor	1.0	1.0	1.0	1.0	1.0	1.0
C_r	Rep. Member Factor	1.0	-	-	-	-	-

a) Adjustment factors per AWC NDS 2024 and NDS 2024 Supplement.

b) When $(F_b)(C_F) \leq 1{,}150$ psi, $C_M = 1.0$.

c) When $(F_c)(C_F) \leq 750$ psi, $C_M = 1.0$.

d) Only applies when sawn lumber or glulam beams are loaded in bending about the y-y axis.

6. Beam Calculations

Determine reference design values, sectional properties and self weight of beam:

$A = b \times d = 1.5 \times 9.25 = 13.875$ in.^{2}

$S_x = \frac{bd^2}{6} = (1.5)(9.25)^2/6 = 21.391$ in.^{3} , $S_y = \frac{b^2 d}{6} = (1.5)^2(9.25)/6 = 3.469$ in.^{3}

$I_x = \frac{bd^3}{12} = (1.5)(9.25)^3/12 = 98.932$ in.^{4} , $I_y = \frac{b^3 d}{12} = (1.5)^3(9.25)/12 = 2.602$ in.^{4}

Reference Design Values from Table 4A NDS Supplement (Reference Design Values for Visually Graded Dimension Lumber, 2" - 4" thick).

Species & Grade	F_b	F_t	F_v	$F_{c\perp}$	F_c	E	E_{min}	SG
DF No.1	1000	675	180	625	1500	1700000	620000	0.5

The following formula shall be used to determine the density of wood (lbs/ft^3. *(NDS Supplement Sec. 3.1.3)*

$$\rho_w = 62.4\left[\frac{SG}{1+SG(0.009)(m.c)}\right]\left[1+\frac{m.c.}{100}\right] = 62.4\left[\frac{0.5}{1+0.5(0.009)(19)}\right]\left[1+\frac{19}{100}\right] = 34.2 \text{ lbs/ft}^3$$

where:

ρ_w = Density of wood (lbs/ft^3
SG = 0.5 Specific gravity of wood (dimensionless)
m.c. = 19 % (Max. moisture content at dry service conditions)

$\text{Volume}_{beam} = N[A \times L] = 1 \times [13.875 \times 144.0] \div (12 \text{ in./ft.})^3 = 1.16 \text{ ft}^3$

Self Weight (W_S) = $\rho_w \times \text{Volume}_{beam} = 34.2 \times 1.16 = 39.55$ lbs

Distributed Self Weight (w_s) = $\frac{W_S}{L} = \frac{39.55}{12.0} = 3.296$ plf

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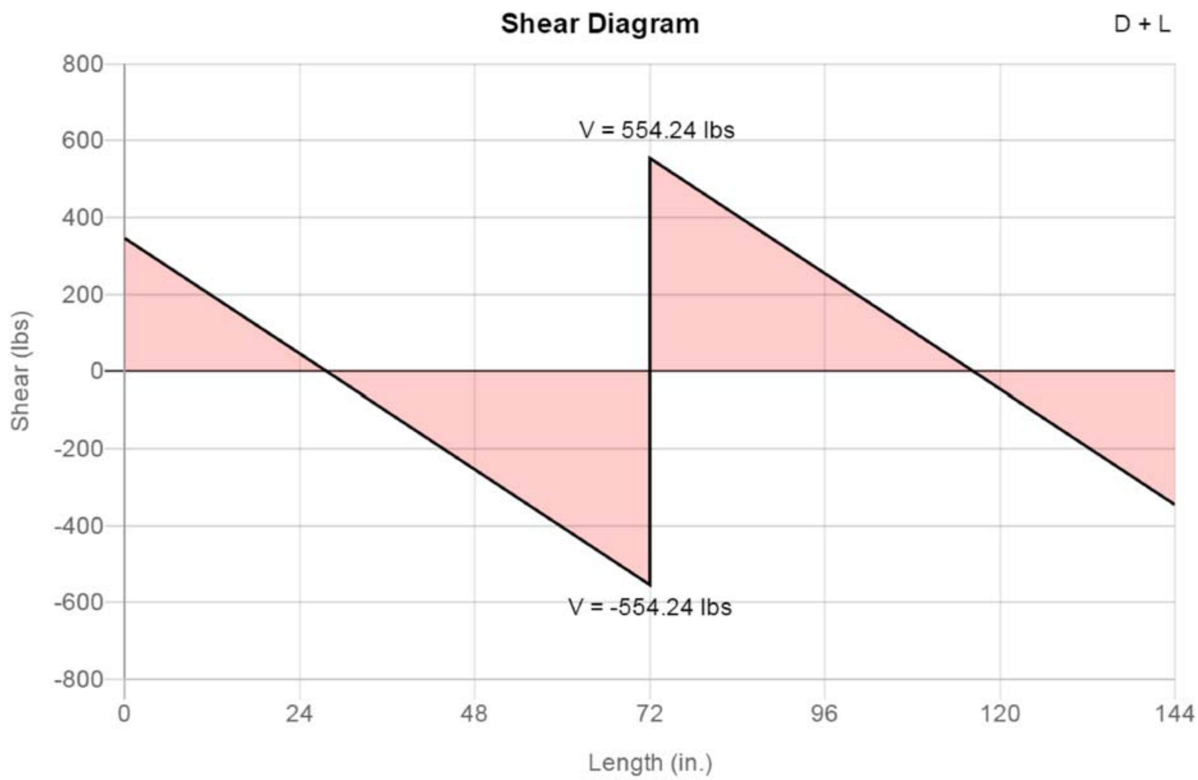
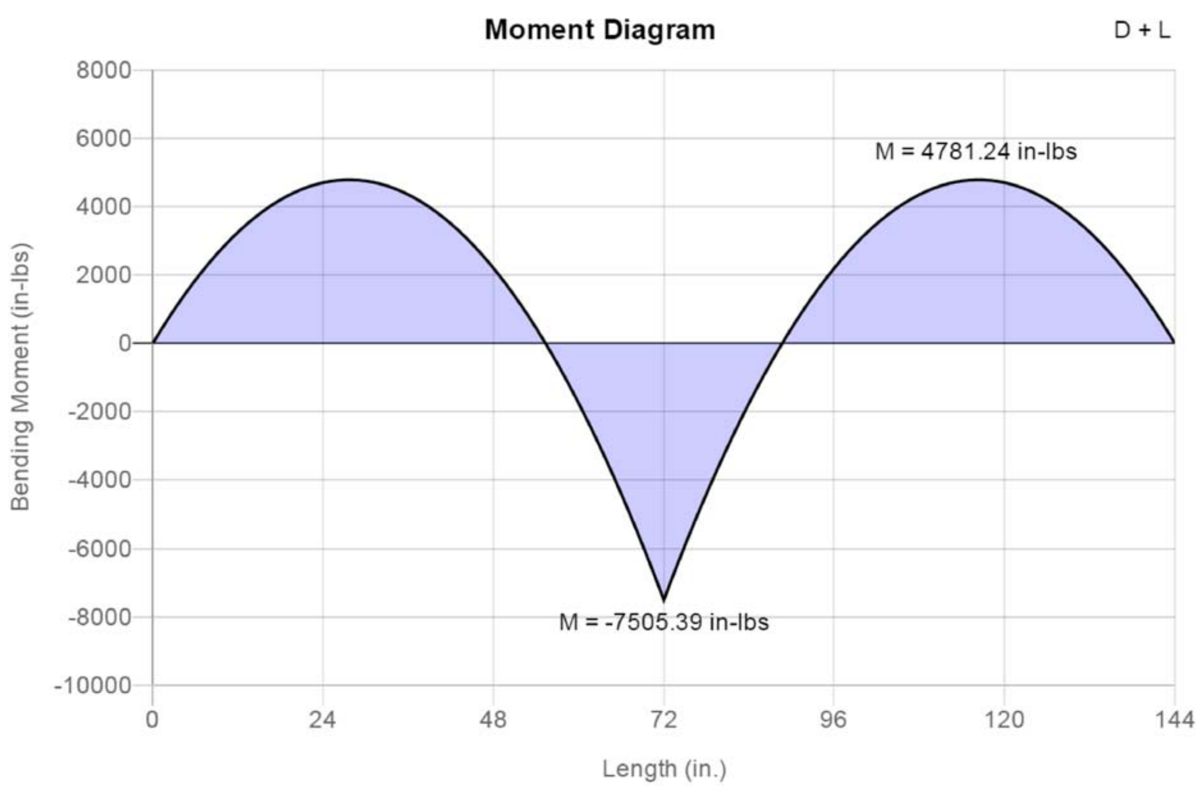


Shear Load Case: D + L ▼



Moment Load Case: D + L ▼

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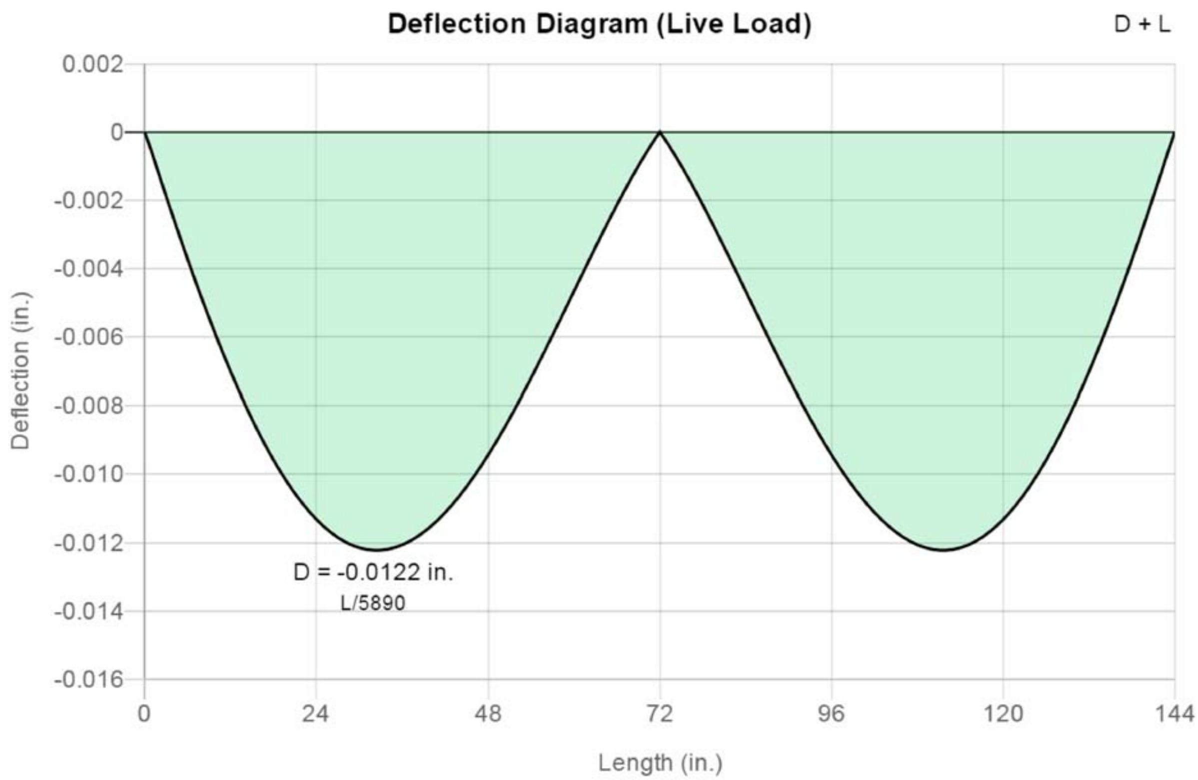
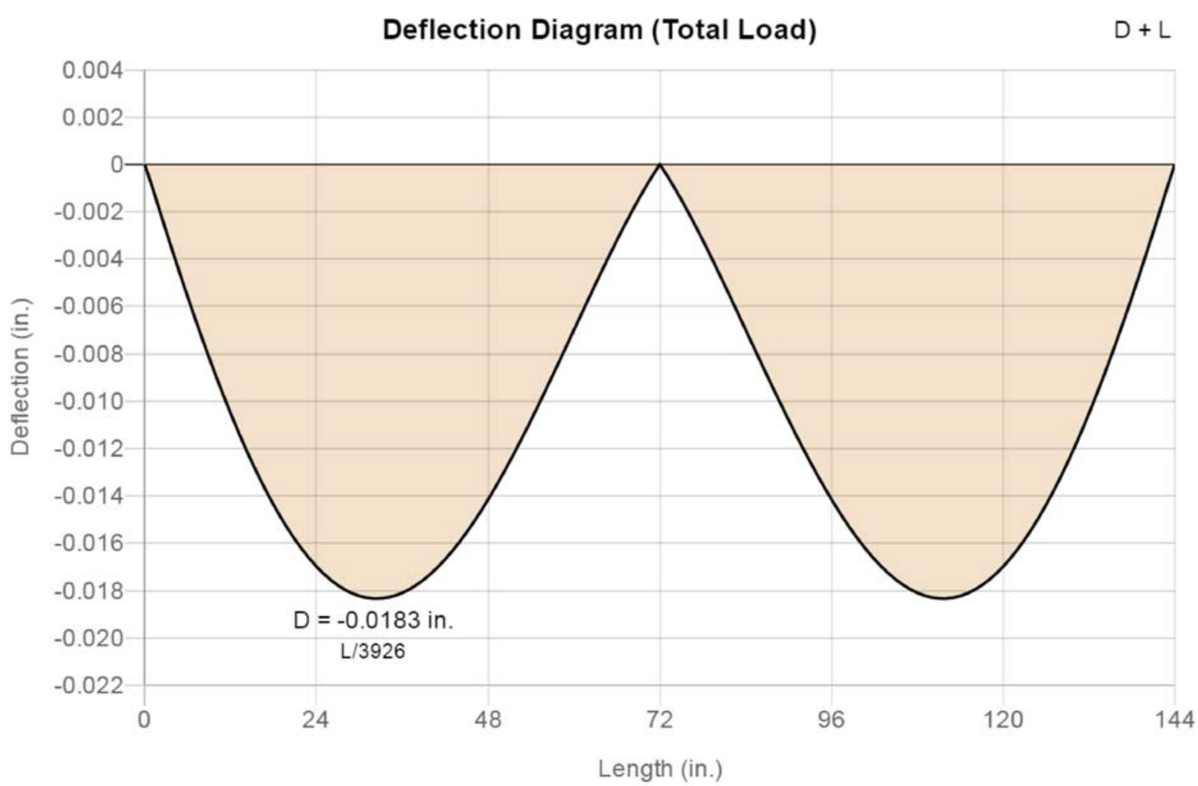


Deflection Load Case: D + L ▼



Deflection Load Case: D + L ▼

Subject	Customer	Location	Job. No.
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Engr. Nathaniel Wilkerson	MEDEEK ENGINEERING LLC 1927 S 1030 W Orem, Utah 84058 ph. 425-652-4188 design.medeek.com	This report may not be copied, reproduced or distributed without the written consent of Medeek Engineering LLC. Copyright © 2025	Rev. -
Date 08/05/2025			Page 5

2.) <u>Shear</u>:

Members subject to shear stresses shall be proportioned so that the actual shear stress parallel to grain or shear force at any cross section of the bending member shall not exceed the adjusted shear design value:

$f_v \leq F_v'$ *(NDS Sec. 3.4.1)*

where:

$f_v = \frac{3V}{2A}$

$F_v' = F_v(C_D)(C_M)(C_t)$

$F_{vx}' = (180)(1.0)(1.0)(1.0) = 180.00$ psi

$f_v = \frac{3V}{2(N \times A)} = \frac{3(554.24)}{2(1 \times 13.875)} = 59.92$ psi

$f_v = 59.92$ psi $< F_{vx}' = 180.00$ psi (CSI = 0.33) ➜ **OK**

3.) <u>Deflection</u>:

Bending deflections calculated per standard method of engineering mechanics for live load and total load:

LL Allowable: L/360
TL Allowable: L/240

$E_x' = E_x(C_M)(C_t)(C_i) = 1700000(1.0)(1.0)(1.0) = 1700000$ psi

$\Delta_{LL} = -0.0122$ in.

$(L/d)_{LL} = 72.0 / -0.0122 = 5890$

$\Delta_{LL} = -0.0122$ in = L/5890 < L/360 ➜ **OK**

Calculations shown for load combination "D + L" at location x = 32 in.

$\Delta_{TL} = -0.0183$ in.

$(L/d)_{TL} = 72.0 / -0.0183 = 3926$

$\Delta_{TL} = -0.0183$ in = L/3926 < L/240 ➜ **OK**

Calculations shown for load combination "D + L" at location x = 32 in.

4.) Bearing:

Members subject to bearing stresses perpendicular to the grain shall be proportioned so that the actual compressive stress perpendicular to grain shall be based on the net bearing area and shall not exceed the adjusted compression design value perpendicular to grain:

$f_{c\perp} \leq F_{c\perp}'$ *(NDS Sec. 3.10.2)*

where:

$F_{c\perp}' = F_{c\perp}(C_M)(C_t)(C_i)$

$F_{c\perp x}' = (625)(1.0)(1.0)(1.0) = 625.00$ psi

$f_{c\perp} = \frac{R}{A_b}$

$A_b = b \times l_b = 1.5 \times 3.5 = 5.25 \text{ in}^2$

$f_{c\perp} = \frac{R}{N \times A_b} = \frac{1108.48}{1 \times 5.25} = 211.1$ psi

$f_{c\perp} = 211.1$ psi $< F_{c\perp x}' = 625.00$ psi (CSI = 0.34) ➜ **OK**

Calculations shown for load combination "D + L" at support S4.

*Disclaimer: The calculations produced herein are for initial design and estimating purposes only. The calculations and drawings presented do not constitute a fully engineered design. All of the potential load cases required to fully design an actual structure may not be provided by this calculator. For the design of an actual structure, a registered and licensed professional should be consulted as per IRC 2021 Sec. R106.1 and R802.10.2 and designed according to the minimum requirements of ASCE 7-22. The beam calculations provided by this online tool are for educational and illustrative purposes only. Medeek Design assumes no liability or loss for any designs presented and does not guarantee fitness for use.