



<b>Project</b>	Maple Street Residence - Addition		
<b>Address</b>	1427 NW Maple St, Bend, OR		
<b>Engineer</b>	Demo Engineer	<b>License</b>	PE-00000

## Member Calculation Summary

Member	Size	Grade	Span	Governing	Status
FB-1 Floor Beam	4x12	Manual	12.000 ft	0.994 bending	PASS
RB-1 Ridge Beam	6x16	Manual	22.000 ft	0.846 deflection_total	PASS
B-3 Garage Header	W12X26	Fy 50.0 ksi	18.000 ft	0.853 deflection	PASS
MB-1 Hallway Beam	14.000 + 10.000 ft	Analysis	24.000 ft	0.517 span_1_bending	PASS

Project report profile: member pages follow the selected report depth.

<b>Project</b>	Maple Street Residence - Addition		
<b>Address</b>	1427 NW Maple St, Bend, OR		
<b>Member</b>	FB-1 Floor Beam		
<b>Engineer</b>	Demo Engineer	<b>License</b>	PE-00000

**PASS 4x12 Manual Governing DCR 0.994 bending**

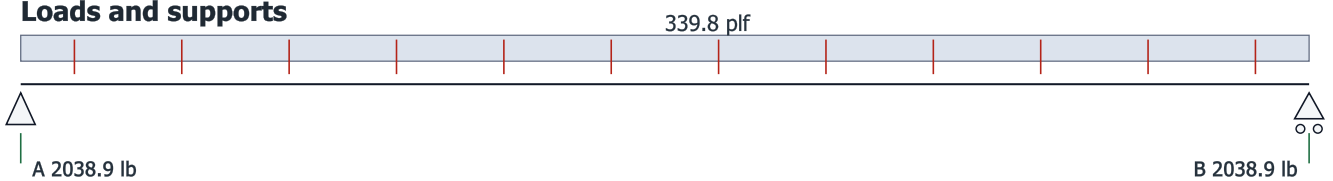
### Design checks

Check	Status	Demand	Capacity	DCR
Beam stability	PASS	15.702	50.000	0.314
Bending	PASS	994.2 psi	1000.0 psi	0.994
Shear Vmax	PASS	77.7 psi	180.0 psi	0.432
Shear Vdesign	PASS	65.5 psi	180.0 psi	0.364
Member bearing	PASS	166.4 psi	625.0 psi	0.266
Total deflection	PASS	0.225 in	0.600 in	0.374
Live deflection	PASS	0.159 in	0.400 in	0.397

### SBCP beam diagrams

Span 12.000 ft | Total load 4077.8 lb | Max M at x = 6.000 ft

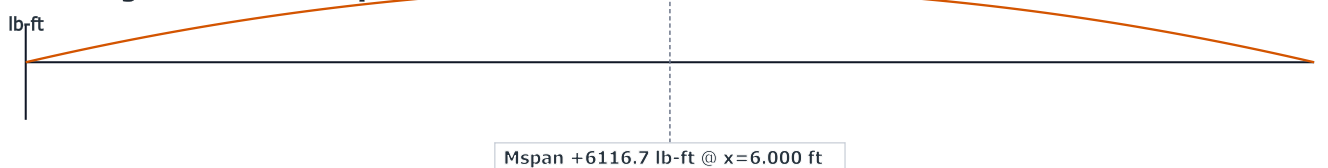
#### Loads and supports



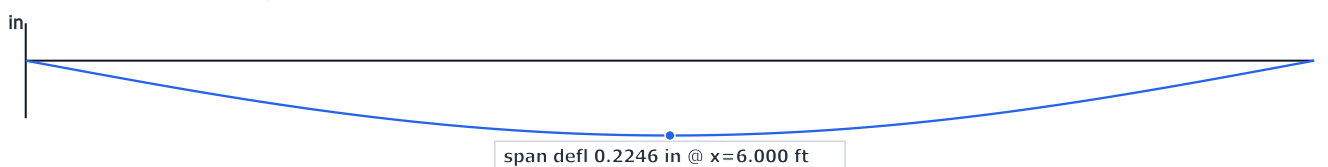
#### Shear force envelope



#### Bending moment envelope



#### Deflection envelope



SBCP Beam — Wood Single Span

Rectangular wood beam ASD

Code edition: NDS-2018-ASD

Span: 12.000 ft

Member size: 3.500 in x 11.250 in

Material: Manual entry

Self weight omitted: no

## Rectangular wood beam ASD

Status: PASS

Governing check: bending

Governing DCR: 0.994

Beam stability status: PASS [CL = 1.0 because compression edge fully braced is selected.]

Beam stability DCR: 0.314

Bending status: PASS

Bending DCR: 0.994

Shear Vmax status: PASS [Vmax is the absolute maximum shear at the support face for support, hanger, and bearing-force review.]

Shear Vmax DCR: 0.432

Shear Vdesign status: PASS [Shear demand evaluated at  $d = 0.937500$  ft from each support.]

Shear Vdesign DCR: 0.364

Member bearing status: PASS

Member bearing DCR: 0.266

Total deflection status: PASS [Dead plus live deflection limit.]

Total deflection DCR: 0.374

Live deflection status: PASS

Live deflection DCR: 0.397

## Top plate analysis

Status: PASS

Governing check: top\_plate\_bearing

Governing DCR: 0.266

Top plate bearing status: PASS [Beam is bearing on top plate with post below; top plate is checked for  $F_c$  perp crushing only.]

Top plate bearing DCR: 0.266

## Analysis summary

Envelope maximum moment: 6116.7 lb-ft [Eq. 16-9 D + L]

Envelope Vmax support shear: 2038.9 lb [Eq. 16-9 D + L]

Vdesign shear for member check: 1720.3 lb [at  $d = 0.938$  ft from supports]

Envelope total deflection: 0.2246 in [Eq. 16-9 D + L]

## Reactions

Left reaction: 2038.9 lb

Right reaction: 2038.9 lb

Total applied load: 4077.8 lb

## Calculation trace

Detailed calculation trace: SBCP Beam — Wood Single Span

Rectangular wood beam ASD

Code edition: NDS-2018-ASD

Span: 12.000 ft

Member size: 3.500 in x 11.250 in

Material: Manual entry

Self weight omitted: no

## Rectangular wood beam ASD

Status: PASS

Governing check: bending

Governing DCR: 0.994

Beam stability status: PASS [CL = 1.0 because compression edge fully braced is selected.]

Beam stability DCR: 0.314

Bending status: PASS

Bending DCR: 0.994

Shear Vmax status: PASS [Vmax is the absolute maximum shear at the support face for support, hanger, and bearing-force review.]

Shear Vmax DCR: 0.432

Shear Vdesign status: PASS [Shear demand evaluated at d = 0.937500 ft from each support.]

Shear Vdesign DCR: 0.364

Member bearing status: PASS

Member bearing DCR: 0.266

Total deflection status: PASS [Dead plus live deflection limit.]

Total deflection DCR: 0.374

Live deflection status: PASS

Live deflection DCR: 0.397

## Top plate analysis

Status: PASS

Governing check: top\_plate\_bearing

Governing DCR: 0.266

Top plate bearing status: PASS [Beam is bearing on top plate with post below; top plate is checked for Fc\_perp crushing only.]

Top plate bearing DCR: 0.266

## Analysis summary

Envelope maximum moment: 6116.7 lb-ft [Eq. 16-9 D + L]

Envelope Vmax support shear: 2038.9 lb [Eq. 16-9 D + L]

Vdesign shear for member check: 1720.3 lb [at d = 0.938 ft from supports]

Envelope total deflection: 0.2246 in [Eq. 16-9 D + L]

## Reactions

Left reaction: 2038.9 lb

Right reaction: 2038.9 lb

Total applied load: 4077.8 lb

## Calculation trace

Detailed calculation trace: Input summary

Code edition: NDS-2018-ASD    Load combinations: ASCE 7-16 / IBC 1605.3.1 ASD

Member size: 4x12    Grade: Manual entry  
 Span: 12.000 ft    Entered width x depth: 3.500 in x 11.250 in  
 Calculation width x depth: 3.500 in x 11.250 in  
 Bearing length: 3.500 in    Unbraced length: 12.000 ft    Compression edge fully braced: yes  
 Material source: Manual entry  
 Section values: Area 39.375 in<sup>2</sup>    S 73.828 in<sup>3</sup>    I 415.283 in<sup>4</sup>  
 Stiffness values: E 1700000 psi    Emin 620000 psi  
 Wood density: 35.9 pcf    Self-weight: 9.8 plf  
 Design method: ASD    Governing load combination: Eq. 16-9 D + L  
 Source dead UDL: 90.0 plf    Self-weight dead UDL: 9.8 plf  
 Applied dead UDL: 99.8 plf    Live UDL: 240.0 plf

Load inputs

Load 1: Uniform load

Source note: Generated from area load x tributary width over the horizontal beam projection: D 15.0 psf x 6.000 ft = 90.0 plf, L 40.0 psf x 6.000 ft = 240.0 plf.

Area source: D 15.0 psf, L 40.0 psf, tributary width 6.000 ft

Line loads: D 90.0 plf, L 240.0 plf

Unfactored load-case analysis

Each row is the beam solved with only that load case at factor 1.0.

Case	RA lb	RB lb	V  lb	M  lb-ft	defl  in
Dead	598.9	598.9	598.9	1796.7	0.0660
Live	1440.0	1440.0	1440.0	4320.0	0.1586

ASD load combinations applied

Source: ASCE 7-16 / IBC 1605.3.1 Table 2.3 excerpt. H, F, and R are zero in this MVP.

Load-case diagrams are superimposed with these factors; envelope governs are tracked separately for V, M, deflection, and reactions.

Eq. in	Combination	Gov	RA lb	RB lb	Load lb	V lb	M lb-ft	defl
16-8	D		598.9	598.9	1197.8	598.9	1796.7	
0.0660	0.314							
16-9	D + L	RVMD*	2038.9	2038.9	4077.8	2038.9	6116.7	
0.2246	0.994							

Envelope governs: R-left Eq. 16-9 D + L = 2038.9 lb; R-right Eq. 16-9 D + L = 2038.9 lb

Envelope governs: V Eq. 16-9 D + L = 2038.9 lb; M Eq. 16-9 D + L = 6116.7 lb-ft; deflection Eq. 16-9 D + L = 0.2246 in

Gov flags: R reaction, V shear, M moment, D deflection, \* governing DCR.

DCR checks

Check	Status	Demand	Units	Capacity	Units	DCR
Beam stability	PASS	15.7		50.0		0.314
Bending	PASS	994.2	psi	1000.0	psi	0.994
Shear Vmax	PASS	77.7	psi	180.0	psi	0.432
Shear Vdesign	PASS	65.5	psi	180.0	psi	0.364
Member bearing	PASS	166.4	psi	625.0	psi	0.266
Total deflection	PASS	0.225	in	0.600	in	0.374
Live deflection	PASS	0.159	in	0.400	in	0.397

Calculation detail

Section properties

$A = b d = 3.500 \text{ in} \times 11.250 \text{ in} = 39.375 \text{ in}^2$   
 $S = b d^2 / 6 = 3.500 \times 11.250^2 / 6 = 73.828 \text{ in}^3$   
 $I = b d^3 / 12 = 3.500 \times 11.250^3 / 12 = 415.283 \text{ in}^4$   
 Bearing area =  $b \times \text{bearing length} = 3.500 \times 3.500 = 12.250 \text{ in}^2$

#### Load and reaction calculations

Governing ASD combination = Eq. 16-9 D + L  
 Self-weight  $w_{\text{self}} = \text{density} \times A / 144 = 35.9 \text{ pcf} \times 39.375 / 144 = 9.82 \text{ plf}$   
 Dead UDL  $w_D = \text{source dead} + \text{self-weight} = 90.00 + 9.82 = 99.82 \text{ plf}$   
 Live UDL  $w_L = 240.00 \text{ plf}$   
 Service UDL  $w = w_D + w_L = 99.82 + 240.00 = 339.82 \text{ plf}$   
 $RA = RB = w \times L / 2 = 339.82 \times 12.000 / 2 = 2038.9 \text{ lb}$

#### Allowable stress and stiffness calculations

Beam stability factor CL per NDS 3.3.3  
 Compression edge fully braced: yes; CL forced to 1.000  
 Effective length case: Single span, uniformly distributed load  
 $l_u = 144.000 \text{ in}$ ;  $l_e = 1.63 l_u + 3d = 268.470 \text{ in}$   
 $RB = \sqrt{l_e d / b^2} = \sqrt{268.470 \times 11.250 / 3.500^2} = 15.702$   
 $F_b^* = F_b(1000.000) \times 1.000$ ; excludes  $C_{fu}$ ,  $C_v$  when  $C_v \leq 1.0$ , and  $CL = 1000.0 \text{ psi}$   
 $E_{min}' = E_{min}(620000.000) \times 1.000 = 620000.0 \text{ psi}$   
 $F_b E = 1.20 E_{min}' / RB^2 = 1.20 \times 620000.0 / 15.702^2 = 3017.6 \text{ psi}$   
 CL = 1.0 because compression edge fully braced is selected. CL = 1.000  
 $F_b' = F_b(1000.000) \times CL(1.000) = 1000.0 \text{ psi}$   
 $F_v' = F_v(180.000) \times 1.000 = 180.0 \text{ psi}$   
 $F_{c\_perp}' = F_{c\_perp}(625.000) \times 1.000 = 625.0 \text{ psi}$   
 $E' = E(1700000.000) \times 1.000 = 1700000.0 \text{ psi}$   
 E used by deflection analysis = 1700000.0 psi

#### Demand and DCR calculations

Moment equation at the governing station:  $M(x) = RA x - w x^2 / 2$   
 $M(6.000 \text{ ft}) = 2038.9 \times 6.000 - 339.82 \times 6.000^2 / 2 = 6116.7 \text{ lb-ft}$   
 $f_b = M_{\text{max}} \times 12 / S = 6116.7 \times 12 / 73.828 = 994.2 \text{ psi}$   
 Bending DCR =  $f_b / F_b' = 994.2 / 1000.0 = 0.994$   
 $V_{\text{max}} = \max(\text{abs}(V_{\text{max}+}), \text{abs}(V_{\text{max}-})) = \max(\text{abs}(2038.9), \text{abs}(-2038.9)) = 2038.9 \text{ lb}$   
 $f_{v,\text{max}} = 1.5 V_{\text{max}} / A = 1.5 \times 2038.9 / 39.375 = 77.7 \text{ psi}$   
 Shear  $V_{\text{max}}$  DCR =  $f_{v,\text{max}} / F_v' = 77.7 / 180.0 = 0.432$   
 $V_{\text{design}}$  is evaluated at distance  $d$  from each support, with  $d = 11.250 \text{ in} / 12 = 0.938 \text{ ft}$   
 $V_{\text{left}}(d) = RA - w d = 2038.9 - 339.82 \times 0.938 = 1720.3 \text{ lb}$   
 $V_{\text{right}}(L-d) = RA - w (L-d) = 2038.9 - 339.82 \times 11.062 = -1720.3 \text{ lb}$   
 $V_{\text{design}} = \max(\text{abs}(V_{\text{left}}), \text{abs}(V_{\text{right}})) = 1720.3 \text{ lb}$   
 $f_{v,d} = 1.5 V_{\text{design}} / A = 1.5 \times 1720.3 / 39.375 = 65.5 \text{ psi}$   
 Shear  $V_{\text{design}}$  DCR =  $f_{v,d} / F_v' = 65.5 / 180.0 = 0.364$   
 $f_{c\_perp} = R_{\text{max}} / A_{\text{bearing}} = \max(\text{abs}(2038.9), \text{abs}(-2038.9)) / 12.250 = 166.4 \text{ psi}$   
 Member bearing DCR =  $f_{c\_perp} / F_{c\_perp}' = 166.4 / 625.0 = 0.266$   
 Deflection method: curvature =  $M(x) \times 12 / (E I)$ , trapezoid integration over 4000 equal stations, then support chord correction so  $y(0)=y(L)=0$   
 $EI = 1700000.0 \times 415.283 = 705981445.3 \text{ lb-in}^2$

Total deflection DCR =  $\Delta_{total} / (L/240) = 0.2246 / 0.6000 = 0.374$

Live deflection DCR =  $\Delta_{live} / (L/360) = 0.1586 / 0.4000 = 0.397$

#### Top plate analysis

Top plate support: beam is bearing on top plate with post below; top plate check is  $F_{c,perp}$  crushing only.

Governing top plate ASD combination = Eq. 16-9 D + L

Top plate bearing material: Table 4A - DOUGLAS FIR-LARCH - Stud - 2" & wider

Top plate adjusted values

$F_{c,perp,plate}' = F_{c,perp} \times CM \times Ct = 625.0 \text{ psi}$

Top plate DCR checks

Check	Status	Demand	Units	Capacity	Units	DCR
Top plate bearing	PASS	166.4	psi	625.0	psi	0.266

Top plate demand calculations

RA = 2038.9 lb; RB = 2038.9 lb for the top plate governing combination

Top plate bearing DCR =  $f_{c,perp} / F_{c,perp,plate}' = 166.4 / 625.0 = 0.266$

#### Reactions by load type, unfactored (lb)

Case	Left	Right	Total
Dead	598.9	598.9	1197.8
Live	1440.0	1440.0	2880.0
DCR combo	2038.9	2038.9	4077.8
Envelope	2038.9	2038.9	-

#### Analysis results

Envelope maximum moment: 6116.7 lb-ft Governing Eq. 16-9 D + L

DCR-governing combination moment: 6116.7 lb-ft

Maximum moment station: 6.000 ft Shear left/right: 0.0 / 0.0 lb Zero check: OK

Envelope  $V_{max}$  support shear: 2038.9 lb Governing Eq. 16-9 D + L

DCR-governing  $V_{max}$  support shear: 2038.9 lb Stress  $f_{v,max}$ : 77.7 psi

$V_{design}$  shear for member check: 1720.3 lb at  $d = 0.938$  ft from supports Stress  $f_{v,d}$ : 65.5 psi ( $x = 0.938$  ft and 11.062 ft)

Envelope total deflection: 0.2246 in Governing Eq. 16-9 D + L

DCR-governing total deflection: 0.2246 in Allowable L/240: 0.6000 in

Live deflection: 0.1586 in Allowable L/360: 0.4000 in

#### ## Warnings

- Compression edge fully braced is checked; CL is set to 1.0 for the main member bending check.



SBCP Beam – Wood Single Span

Rectangular wood beam ASD

Code edition: NDS-2018-ASD

Span: 22.000 ft

Member size: 5.250 in x 16.000 in

Material: Manual entry

Self weight omitted: no

## Rectangular wood beam ASD

Status: PASS

Governing check: deflection\_total

Governing DCR: 0.846

Beam stability status: PASS [CL calculated from NDS 3.3.3 beam stability equations.]

Beam stability DCR: 0.152

Bending status: PASS

Bending DCR: 0.794

Shear Vmax status: PASS [Vmax is the absolute maximum shear at the support face for support, hanger, and bearing-force review.]

Shear Vmax DCR: 0.436

Shear Vdesign status: PASS [Shear demand evaluated at  $d = 1.333333$  ft from each support.]

Shear Vdesign DCR: 0.383

Member bearing status: PASS

Member bearing DCR: 0.337

Total deflection status: PASS [Dead plus live deflection limit.]

Total deflection DCR: 0.846

Live deflection status: PASS

Live deflection DCR: 0.000

## Top plate analysis

Status: PASS

Governing check: top\_plate\_bearing

Governing DCR: 0.337

Top plate bearing status: PASS [Beam is bearing on top plate with post below; top plate is checked for  $F_c$  perp crushing only.]

Top plate bearing DCR: 0.337

## Analysis summary

Envelope maximum moment: 38266.2 lb-ft [Eq. 16-10 D + Lr]

Envelope Vmax support shear: 6957.5 lb [Eq. 16-10 D + Lr]

Vdesign shear for member check: 6114.2 lb [at  $d = 1.333$  ft from supports]

Envelope total deflection: 0.9302 in [Eq. 16-10 D + Lr]

## Reactions

Left reaction: 6957.5 lb

Right reaction: 6957.5 lb

Total applied load: 13915.0 lb

## Calculation trace

Detailed calculation trace: SBCP Beam – Wood Single Span

Rectangular wood beam ASD

Code edition: NDS-2018-ASD

Span: 22.000 ft

Member size: 5.250 in x 16.000 in

Material: Manual entry

Self weight omitted: no

## Rectangular wood beam ASD

Status: PASS

Governing check: deflection\_total

Governing DCR: 0.846

Beam stability status: PASS [CL calculated from NDS 3.3.3 beam stability equations.]

Beam stability DCR: 0.152

Bending status: PASS

Bending DCR: 0.794

Shear Vmax status: PASS [Vmax is the absolute maximum shear at the support face for support, hanger, and bearing-force review.]

Shear Vmax DCR: 0.436

Shear Vdesign status: PASS [Shear demand evaluated at  $d = 1.333333$  ft from each support.]

Shear Vdesign DCR: 0.383

Member bearing status: PASS

Member bearing DCR: 0.337

Total deflection status: PASS [Dead plus live deflection limit.]

Total deflection DCR: 0.846

Live deflection status: PASS

Live deflection DCR: 0.000

## Top plate analysis

Status: PASS

Governing check: top\_plate\_bearing

Governing DCR: 0.337

Top plate bearing status: PASS [Beam is bearing on top plate with post below; top plate is checked for  $F_{c\perp}$  crushing only.]

Top plate bearing DCR: 0.337

## Analysis summary

Envelope maximum moment: 38266.2 lb-ft [Eq. 16-10 D + Lr]

Envelope Vmax support shear: 6957.5 lb [Eq. 16-10 D + Lr]

Vdesign shear for member check: 6114.2 lb [at  $d = 1.333$  ft from supports]

Envelope total deflection: 0.9302 in [Eq. 16-10 D + Lr]

## Reactions

Left reaction: 6957.5 lb

Right reaction: 6957.5 lb

Total applied load: 13915.0 lb

## Calculation trace

Detailed calculation trace: Input summary

Code edition: NDS-2018-ASD    Load combinations: ASCE 7-16 / IBC 1605.3.1 ASD

Member size: 6x16    Grade: Manual entry  
 Span: 22.000 ft    Entered width x depth: 5.250 in x 16.000 in  
 Calculation width x depth: 5.250 in x 16.000 in  
 Bearing length: 5.250 in    Unbraced length: 4.000 ft    Compression edge fully braced: no  
 Material source: Manual entry  
 Section values: Area 84.000 in<sup>2</sup>    S 224.000 in<sup>3</sup>    I 1792.000 in<sup>4</sup>  
 Stiffness values: E 2000000 psi    Emin 1016000 psi  
 Wood density: 42.0 pcf    Self-weight: 24.5 plf  
 Design method: ASD    Governing load combination: Eq. 16-10 D + Lr  
 Source dead UDL: 288.0 plf    Self-weight dead UDL: 24.5 plf  
 Applied dead UDL: 312.5 plf    Live UDL: 0.0 plf  
 Load inputs

Load 1: Uniform load

Source note: Generated from area load x tributary width over the horizontal beam projection: D 18.0 psf x 16.000 ft = 288.0 plf, L 0.0 psf x 16.000 ft = 0.0 plf.  
 Area source: D 18.0 psf, L 0.0 psf, tributary width 16.000 ft  
 Additional area loads: Lr 20.0 psf, S 0.0 psf, W 0.0 psf, E 0.0 psf  
 Line loads: D 288.0 plf, L 0.0 plf, Lr 320.0 plf, S 0.0 plf, W 0.0 plf, E 0.0 plf

Unfactored load-case analysis

Each row is the beam solved with only that load case at factor 1.0.

Case	RA lb	RB lb	V  lb	M  lb-ft	defl  in
Dead	3437.5	3437.5	3437.5	18906.2	0.4596
Roof live	3520.0	3520.0	3520.0	19360.0	0.4706

ASD load combinations applied

Source: ASCE 7-16 / IBC 1605.3.1 Table 2.3 excerpt. H, F, and R are zero in this MVP.

Load-case diagrams are superimposed with these factors; envelope governs are tracked separately for V, M, deflection, and reactions.

Eq.	Combination	Gov	RA lb	RB lb	Load lb	V lb	M lb-ft	defl
16-8	D		3437.5	3437.5	6875.0	3437.5	18906.2	0.4596
16-10	D + Lr	RVMD*	6957.5	6957.5	13915.0	6957.5	38266.2	0.9302

Envelope governs: R-left Eq. 16-10 D + Lr = 6957.5 lb; R-right Eq. 16-10 D + Lr = 6957.5 lb

Envelope governs: V Eq. 16-10 D + Lr = 6957.5 lb; M Eq. 16-10 D + Lr = 38266.2 lb-ft; deflection Eq. 16-10 D + Lr = 0.9302 in

Gov flags: R reaction, V shear, M moment, D deflection, \* governing DCR.

DCR checks

Check	Status	Demand	Units	Capacity	Units	DCR
Beam stability	PASS	7.6		50.0		0.152
Bending	PASS	2050.0	psi	2582.1	psi	0.794
Shear Vmax	PASS	124.2	psi	285.0	psi	0.436
Shear Vdesign	PASS	109.2	psi	285.0	psi	0.383
Member bearing	PASS	252.4	psi	750.0	psi	0.337
Total deflection	PASS	0.930	in	1.100	in	0.846
Live deflection	PASS	0.000	in	0.733	in	0.000

Calculation detail

**Section properties**

$A = b d = 5.250 \text{ in} \times 16.000 \text{ in} = 84.000 \text{ in}^2$   
 $S = b d^2 / 6 = 5.250 \times 16.000^2 / 6 = 224.000 \text{ in}^3$   
 $I = b d^3 / 12 = 5.250 \times 16.000^3 / 12 = 1792.000 \text{ in}^4$   
 Bearing area =  $b \times \text{bearing length} = 5.250 \times 5.250 = 27.562 \text{ in}^2$

**Load and reaction calculations**

Governing ASD combination = Eq. 16-10 D + Lr  
 Self-weight  $w_{\text{self}} = \text{density} \times A / 144 = 42.0 \text{ pcf} \times 84.000 / 144 = 24.50 \text{ plf}$   
 Dead UDL  $w_D = \text{source dead} + \text{self-weight} = 288.00 + 24.50 = 312.50 \text{ plf}$   
 Live UDL  $w_L = 0.00 \text{ plf}$   
 Dead plus floor-live UDL subtotal = 312.50 plf before any roof, snow, wind, or seismic load cases  
 Reactions are from the analysis kernel using the factored load cases in the governing ASD combination.  
 RA = 6957.5 lb; RB = 6957.5 lb

**Allowable stress and stiffness calculations**

Beam stability factor CL per NDS 3.3.3  
 Compression edge fully braced: no; CL calculated  
 Effective length case: Single span, uniformly distributed load  
 $l_u = 48.000 \text{ in}; l_e = 2.06 l_u = 98.880 \text{ in}$   
 $RB = \sqrt{l_e d / b^2} = \sqrt{98.880 \times 16.000 / 5.250^2} = 7.576$   
 $Fb^* = Fb(2600.000) \times 1.000$ ; excludes  $C_{fu}$ ,  $C_v$  when  $C_v \leq 1.0$ , and  $CL = 2600.0 \text{ psi}$   
 $E_{min}' = E_{min}(1016000.000) \times 1.000 = 1016000.0 \text{ psi}$   
 $FbE = 1.20 E_{min}' / RB^2 = 1.20 \times 1016000.0 / 7.576^2 = 21240.5 \text{ psi}$   
 $FbE/Fb^* = 8.169$   
 $CL = (1 + FbE/Fb^*)/1.9 - \sqrt{((1 + FbE/Fb^*)/1.9)^2 - (FbE/Fb^*)/0.95} = 0.993$   
 $Fb' = Fb(2600.000) \times CL(0.993) = 2582.1 \text{ psi}$   
 $Fv' = Fv(285.000) \times 1.000 = 285.0 \text{ psi}$   
 $Fc_{\text{perp}}' = Fc_{\text{perp}}(750.000) \times 1.000 = 750.0 \text{ psi}$   
 $E' = E(2000000.000) \times 1.000 = 2000000.0 \text{ psi}$   
 E used by deflection analysis = 2000000.0 psi

**Demand and DCR calculations**

$M_{\text{max}}$  is evaluated by the analysis kernel from the governing factored load diagram = 38266.2 lb-ft  
 $fb = M_{\text{max}} \times 12 / S = 38266.2 \times 12 / 224.000 = 2050.0 \text{ psi}$   
 Bending DCR =  $fb / Fb' = 2050.0 / 2582.1 = 0.794$   
 $V_{\text{max}} = \max(\text{abs}(V_{\text{max}+}), \text{abs}(V_{\text{max}-})) = \max(\text{abs}(6957.5), \text{abs}(-6957.5)) = 6957.5 \text{ lb}$   
 $f_{v,\text{max}} = 1.5 V_{\text{max}} / A = 1.5 \times 6957.5 / 84.000 = 124.2 \text{ psi}$   
 Shear  $V_{\text{max}}$  DCR =  $f_{v,\text{max}} / Fv' = 124.2 / 285.0 = 0.436$   
 $V_{\text{design}}$  is evaluated at distance  $d$  from each support, with  $d = 16.000 \text{ in} / 12 = 1.333 \text{ ft}$   
 $V_{\text{left}}(d)$  and  $V_{\text{right}}(L-d)$  are evaluated from the factored load diagram; selected 6114.2 lb / -6114.2 lb  
 $V_{\text{design}} = \max(\text{abs}(V_{\text{left}}), \text{abs}(V_{\text{right}})) = 6114.2 \text{ lb}$   
 $f_{v,d} = 1.5 V_{\text{design}} / A = 1.5 \times 6114.2 / 84.000 = 109.2 \text{ psi}$   
 Shear  $V_{\text{design}}$  DCR =  $f_{v,d} / Fv' = 109.2 / 285.0 = 0.383$   
 $fc_{\text{perp}} = R_{\text{max}} / A_{\text{bearing}} = \max(\text{abs}(6957.5), \text{abs}(6957.5)) / 27.562 = 252.4 \text{ psi}$   
 Member bearing DCR =  $fc_{\text{perp}} / Fc_{\text{perp}}' = 252.4 / 750.0 = 0.337$   
 Deflection method: curvature =  $M(x) \times 12 / (E I)$ , trapezoid integration over 4000 equal stations, then support chord correction so  $y(0)=y(L)=0$

$$EI = 2000000.0 \times 1792.000 = 3584000000.0 \text{ lb-in}^2$$

$$\text{Total deflection DCR} = \text{delta\_total} / (L/240) = 0.9302 / 1.1000 = 0.846$$

$$\text{Live deflection DCR} = \text{delta\_live} / (L/360) = 0.0000 / 0.7333 = 0.000$$

**Top plate analysis**

Top plate support: beam is bearing on top plate with post below; top plate check is Fc\_perp crushing only.

Governing top plate ASD combination = Eq. 16-10 D + Lr

Top plate bearing material: Table 4A - DOUGLAS FIR-LARCH - Stud - 2" & wider

Top plate adjusted values

$$F_{c\_perp,plate}' = F_{c\_perp} \times CM \times Ct = 750.0 \text{ psi}$$

Top plate DCR checks

Check	Status	Demand	Units	Capacity	Units	DCR
Top plate bearing	PASS	252.4	psi	750.0	psi	0.337

Top plate demand calculations

RA = 6957.5 lb; RB = 6957.5 lb for the top plate governing combination

$$\text{Top plate bearing DCR} = f_{c\_perp} / F_{c\_perp,plate}' = 252.4 / 750.0 = 0.337$$

**Reactions by load type, unfactored (lb)**

Case	Left	Right	Total
Dead	3437.5	3437.5	6875.0
Roof live	3520.0	3520.0	7040.0
DCR combo	6957.5	6957.5	13915.0
Envelope	6957.5	6957.5	-

**Analysis results**

Envelope maximum moment: 38266.2 lb-ft Governing Eq. 16-10 D + Lr

DCR-governing combination moment: 38266.2 lb-ft

Maximum moment station: 11.000 ft Shear left/right: 0.0 / 0.0 lb Zero check: OK

Envelope Vmax support shear: 6957.5 lb Governing Eq. 16-10 D + Lr

DCR-governing Vmax support shear: 6957.5 lb Stress fv,max: 124.2 psi

Vdesign shear for member check: 6114.2 lb at d = 1.333 ft from supports Stress fv,d: 109.2 psi (x = 1.333 ft and 20.667 ft)

Envelope total deflection: 0.9302 in Governing Eq. 16-10 D + Lr

DCR-governing total deflection: 0.9302 in Allowable L/240: 1.1000 in

Live deflection: 0.0000 in Allowable L/360: 0.7333 in



<b>Project</b>	Maple Street Residence - Addition		
<b>Address</b>	1427 NW Maple St, Bend, OR		
<b>Member</b>	B-3 Garage Header		
<b>Engineer</b>	Demo Engineer	<b>License</b>	PE-00000

**PASS    W12X26 Fy 50.0 ksi    Governing DCR 0.853    deflection**

**Design checks**

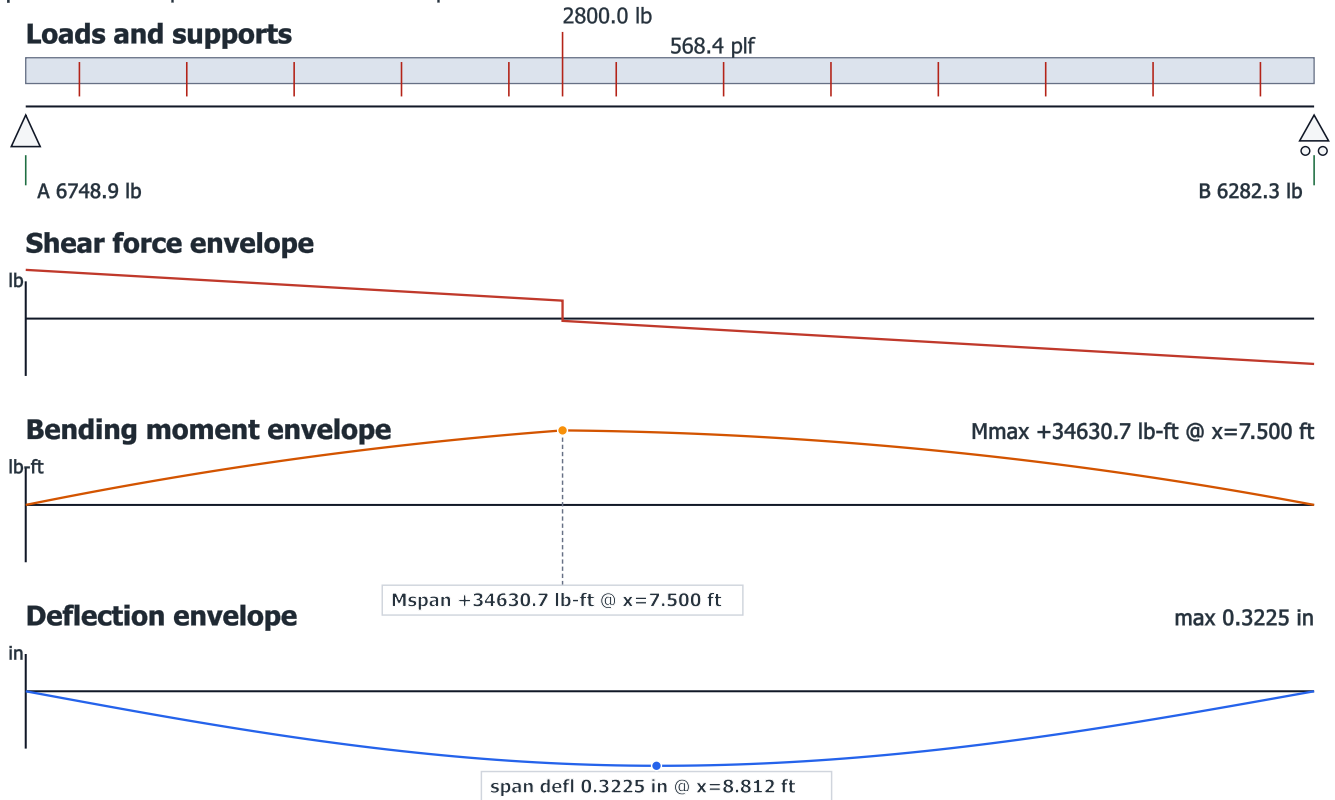
Check	Status	Demand	Capacity	DCR
Flexure	PASS	34.6 kip-ft	139.5 kip-ft	0.248
Shear	PASS	6.7 kip	84.2 kip	0.080
Deflection	PASS	0.512 in	0.600 in	0.853

**LTB and bracing checks**

Check	Status	Demand	Capacity	DCR
Compression flange compactness	PASS	8.540	9.152	0.933
Web compactness	PASS	47.200	90.553	0.521
Effective Lb	PASS	4.0 ft	5.3 ft	0.000

**SBCP beam diagrams**

Span 18.000 ft | Total load 13031.2 lb | Max M at x = 7.500 ft



SBCP Beam – Steel Beam

Steel W-shape design

Code edition: AISC-360-22-LRFD

Span: 18.000 ft

Shape: W12X26

Material: Fy 50.0 ksi

Self weight omitted: no

## Steel W-shape design

Status: PASS

Governing check: deflection

Governing DCR: 0.853

Flexure status: PASS [governing limit state: Yielding]

Flexure DCR: 0.248

Shear status: PASS [AISC 360 shear yielding for W-shape web; provide Cv for shear-buckling cases]

Shear DCR: 0.080

Deflection status: PASS [computed from span and user-selected deflection ratio]

Deflection DCR: 0.853

## LTB and bracing checks

Status: PASS

Governing check: flange\_compactness

Governing DCR: 0.933

Compression flange compactness status: PASS [classification: COMPACT;  $\lambda \leq \lambda_p$ ]

Compression flange compactness DCR: 0.933

Web compactness status: PASS [classification: COMPACT;  $\lambda \leq \lambda_p$ ]

Web compactness DCR: 0.521

Effective Lb status: PASS [ $L_b \leq L_p$ ; LTB reduction is not required]

Effective Lb DCR: 0.000

## Analysis summary

Envelope maximum moment: 77983.5 lb-ft [Eq. 2.3-2 1.2D + 1.6L]

Envelope maximum shear: 15224.8 lb [Eq. 2.3-2 1.2D + 1.6L]

Service deflection used for DCR: 0.3225 in

## Reactions

Left reaction: 6748.9 lb

Right reaction: 6282.3 lb

Total applied load: 13031.2 lb

## Calculation trace

Detailed calculation trace: SBCP Beam – Steel Beam

Steel W-shape design

Code edition: AISC-360-22-LRFD

Span: 18.000 ft

Shape: W12X26

Material: Fy 50.0 ksi

Self weight omitted: no

## Steel W-shape design

Status: PASS

Governing check: deflection

Governing DCR: 0.853

Flexure status: PASS [governing limit state: Yielding]

Flexure DCR: 0.248

Shear status: PASS [AISC 360 shear yielding for W-shape web; provide Cv for shear-buckling cases]

Shear DCR: 0.080

Deflection status: PASS [computed from span and user-selected deflection ratio]

Deflection DCR: 0.853

## LTB and bracing checks

Status: PASS

Governing check: flange\_compactness

Governing DCR: 0.933

Compression flange compactness status: PASS [classification: COMPACT;  $\lambda \leq \lambda_p$ ]

Compression flange compactness DCR: 0.933

Web compactness status: PASS [classification: COMPACT;  $\lambda \leq \lambda_p$ ]

Web compactness DCR: 0.521

Effective Lb status: PASS [ $L_b \leq L_p$ ; LTB reduction is not required]

Effective Lb DCR: 0.000

## Analysis summary

Envelope maximum moment: 77983.5 lb-ft [Eq. 2.3-2 1.2D + 1.6L]

Envelope maximum shear: 15224.8 lb [Eq. 2.3-2 1.2D + 1.6L]

Service deflection used for DCR: 0.3225 in

## Reactions

Left reaction: 6748.9 lb

Right reaction: 6282.3 lb

Total applied load: 13031.2 lb

## Calculation trace

Detailed calculation trace: Input summary

Calculation type: Steel beam

Code edition: AISC-360-22-LRFD Load combinations: ASCE 7-22 LRFD

Shape: W12X26 Span: 18.000 ft

Material: Fy 50.0 ksi E 29000 ksi Cb 1.000

Section values: d 12.200 in bf 6.490 in tw 0.230 in tf 0.380 in

Properties: Ix 204.000 in<sup>4</sup> Sx 33.400 in<sup>3</sup> Zx 37.200 in<sup>3</sup> ry 1.510 in rts 1.750 in

Self-weight: 26.0 plf

Governing load combination: Eq. 2.3-1 1.4D

Bracing: Blocking/joist bracing

Load inputs

Load 1: Uniform load

Line loads: D 380.0 plf, L 500.0 plf

Load 2: Point load

D 2000.0 lb, L 2400.0 lb at 7.500 ft

**Unfactored load-case analysis**

Each row is the beam solved with only that load case at factor 1.0.

Case	RA lb	RB lb	V  lb	M  lb-ft	defl  in
Dead	4820.7	4487.3	4820.7	24736.2	0.2304
Live	5900.0	5500.0	5900.0	30187.5	0.2815

**LRFD load combinations applied**

Source: ASCE 7-22 Section 2.3 strength design combinations; rain, fluids, earth pressure, and tornado loads are not modeled in this MVP.

Eq.	Combination	Gov	RA lb	RB lb	Load lb	V lb	M lb-ft	defl in
2.3-1	1.4D	*	6748.9	6282.3	13031.2	6748.9	34630.7	
0.3225	0.853							
2.3-2	1.2D + 1.6L	RVM	15224.8	14184.8	29409.6	15224.8	77983.5	
0.7269	0.853							

Envelope governs: R-left Eq. 2.3-2 1.2D + 1.6L = 15224.8 lb; R-right Eq. 2.3-2 1.2D + 1.6L = 14184.8 lb

Envelope governs: V Eq. 2.3-2 1.2D + 1.6L = 15224.8 lb; M Eq. 2.3-2 1.2D + 1.6L = 77983.5 lb-ft

Gov flags: R reaction, V shear, M moment, \* governing DCR.

**Beam DCR checks**

Check	Status	Demand	Units	Capacity	Units	DCR
Flexure	PASS	34.6	kip-ft	139.5	kip-ft	0.248
Shear	PASS	6.7	kip	84.2	kip	0.080
Deflection	PASS	0.512	in	0.600	in	0.853

**LTB and bracing checks**

Check	Status	Demand	Units	Capacity	Units	DCR
Compression flange compactness	PASS	8.540		9.152		0.933
classification: COMPACT; $\lambda \leq \lambda_p$						
Web compactness	PASS	47.200		90.553		0.521
classification: COMPACT; $\lambda \leq \lambda_p$						
Effective Lb	PASS	4.0	ft	5.3	ft	0.000
Lb $\leq$ Lp; LTB reduction is not required						

**AISC 360-22 Chapter F flexure**

Governing limit state: Yielding

Mp 155.000 kip-ft My 139.167 kip-ft Lp 5.334 ft Lr 14.884 ft Effective Lb 4.000 ft

Mn(yielding) 155.000 kip-ft Mn(LTB) 155.000 kip-ft Mn(FLB) 0.000 kip-ft phi Mn 139.500 kip-ft

Compactness

 Compression flange:  $\lambda$  8.540  $\lambda_p$  9.152  $\lambda_r$  24.083 COMPACT

 Web:  $\lambda$  47.200  $\lambda_p$  90.553  $\lambda_r$  137.274 COMPACT

**Reactions by load type, unfactored (lb)**

Case	Left	Right	Total
Dead	4820.7	4487.3	9308.0
Live	5900.0	5500.0	11400.0

Analysis results

Envelope maximum moment: 77983.5 lb-ft      Governing Eq. 2.3-2 1.2D + 1.6L

DCR-governing maximum moment: 34630.7 lb-ft      Vmax 6748.9 lb

Service deflection used for DCR: 0.5119 in      Allowable L/360: 0.6000 in

## Warnings

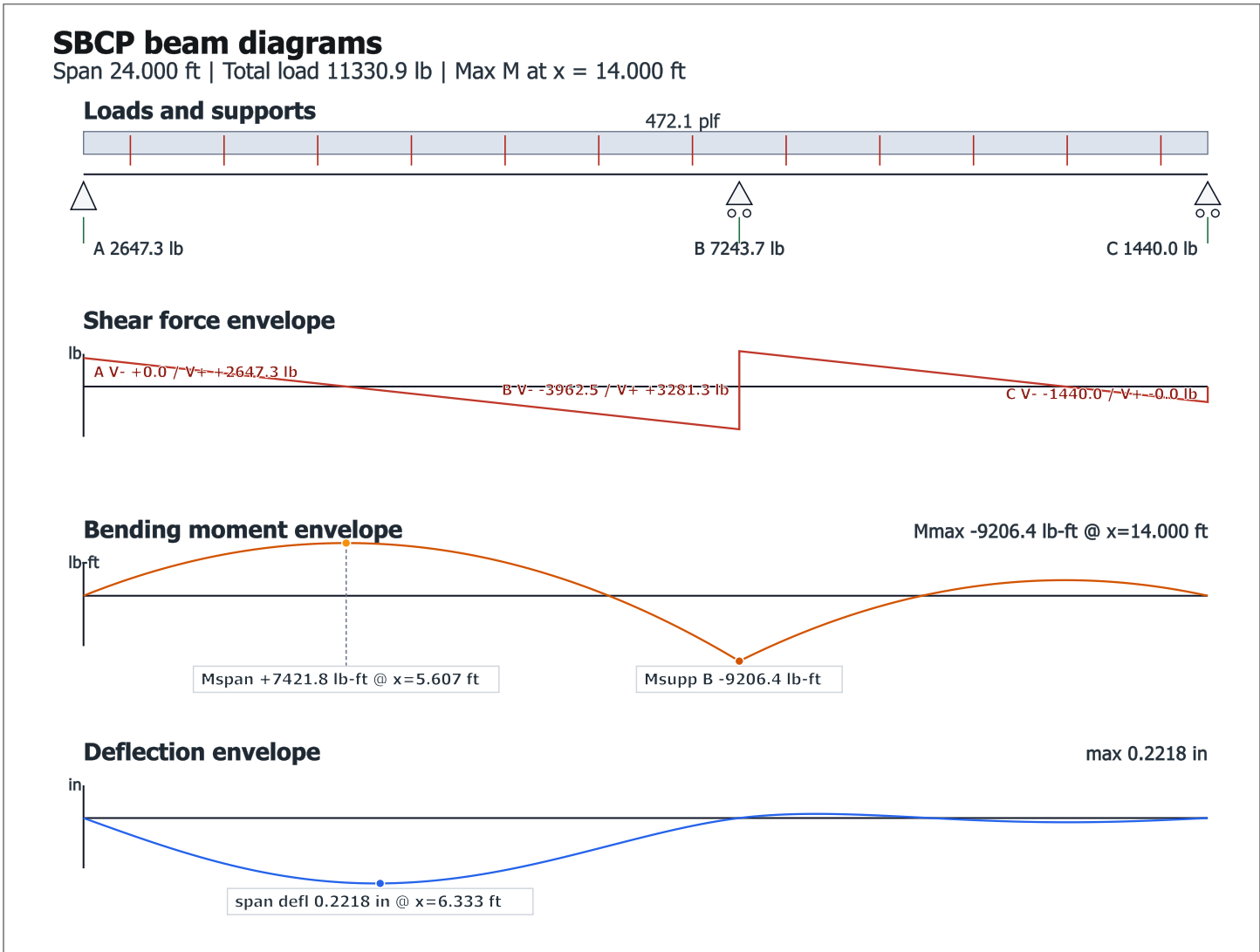
- Blocking/joist bracing does not check 2x axial capacity or wood connections; use 16 in o.c. max for joists framing into the W-shape face and 4 ft o.c. max for parallel joists with blocking, or consider checking the steel beam as fully unbraced.



<b>Project</b>	Maple Street Residence - Addition		
<b>Address</b>	1427 NW Maple St, Bend, OR		
<b>Member</b>	MB-1 Hallway Beam		
<b>Engineer</b>	Demo Engineer	<b>License</b>	PE-00000

**PASS    Multi-span wood design    Governing DCR 0.517    span\_1\_bending**
**Analysis summary**

<b>Design</b>	PASS   DCR 0.517 ...	<b>Span 2 shear</b>	DCR 0.416   PASS	<b>Diagram  V max</b>	3962.5 lb
<b>Diagram combo</b>	ASD Eq. 16-9 D + L	<b>Span 2 total defl...</b>	DCR 0.029   PASS	<b>Diagram defl</b>	0.2218 in
<b>Span 1 bending</b>	DCR 0.517   PASS	<b>Envelope  M max</b>	9206.4 lb-ft    E...	<b>Reaction A</b>	x = 0.000 ft    2...
<b>Span 1 shear</b>	DCR 0.502   PASS	<b>Envelope  V max</b>	3962.5 lb    Eq. ...	<b>Reaction B</b>	x = 14.000 ft    ...
<b>Span 1 total defl...</b>	DCR 0.317   PASS	<b>Envelope defl</b>	0.2218 in    Eq. ...	<b>Reaction C</b>	x = 24.000 ft    ...
<b>Span 2 bending</b>	DCR 0.517   PASS	<b>Diagram  M max</b>	9206.4 lb-ft		



SBCP Beam – Wood Multi-Span

Rectangular wood multi-span ASD design

Code edition: NDS-2018-ASD

Spans: 14.000 ft + 10.000 ft

Section: 3.500 in x 11.875 in

Self weight omitted: no

## Rectangular wood multi-span ASD design

Status: PASS

Governing check: span\_1\_bending

Governing DCR: 0.517

Span 1 bending status: PASS [Governing Eq. 16-9 D + L]

Span 1 bending DCR: 0.517

Span 1 shear status: PASS [Governing Eq. 16-9 D + L]

Span 1 shear DCR: 0.502

Span 1 total deflection status: PASS [Governing Eq. 16-9 D + L]

Span 1 total deflection DCR: 0.317

Span 2 bending status: PASS [Governing Eq. 16-9 D + L]

Span 2 bending DCR: 0.517

Span 2 shear status: PASS [Governing Eq. 16-9 D + L]

Span 2 shear DCR: 0.416

Span 2 total deflection status: PASS [Governing Eq. 16-9 D + L]

Span 2 total deflection DCR: 0.029

## Analysis summary

Envelope maximum moment: 9206.4 lb-ft [Eq. 16-9 D + L]

Envelope maximum shear: 3962.5 lb [Eq. 16-9 D + L]

Envelope maximum deflection: 0.2218 in [Eq. 16-9 D + L]

Left reaction envelope: 2647.3 lb [Eq. 16-9 D + L]

Right reaction envelope: 1440.0 lb [Eq. 16-9 D + L]

## Calculation trace

Detailed calculation trace: SBCP Beam – Wood Multi-Span

Rectangular wood multi-span ASD design

Code edition: NDS-2018-ASD

Spans: 14.000 ft + 10.000 ft

Section: 3.500 in x 11.875 in

Self weight omitted: no

## Rectangular wood multi-span ASD design

Status: PASS

Governing check: span\_1\_bending

Governing DCR: 0.517

Span 1 bending status: PASS [Governing Eq. 16-9 D + L]

Span 1 bending DCR: 0.517

Span 1 shear status: PASS [Governing Eq. 16-9 D + L]

Span 1 shear DCR: 0.502

Span 1 total deflection status: PASS [Governing Eq. 16-9 D + L]

Span 1 total deflection DCR: 0.317

Span 2 bending status: PASS [Governing Eq. 16-9 D + L]

Span 2 bending DCR: 0.517

Span 2 shear status: PASS [Governing Eq. 16-9 D + L]

Span 2 shear DCR: 0.416

Span 2 total deflection status: PASS [Governing Eq. 16-9 D + L]

Span 2 total deflection DCR: 0.029

#### ## Analysis summary

Envelope maximum moment: 9206.4 lb-ft [Eq. 16-9 D + L]

Envelope maximum shear: 3962.5 lb [Eq. 16-9 D + L]

Envelope maximum deflection: 0.2218 in [Eq. 16-9 D + L]

Left reaction envelope: 2647.3 lb [Eq. 16-9 D + L]

Right reaction envelope: 1440.0 lb [Eq. 16-9 D + L]

#### ## Calculation trace

Detailed calculation trace: SBCP Multi-Span Beam Analysis

Status: PASS Governing DCR 0.517 Span 1 bending

Calculation type: Multi-span wood beam design V1

Code edition: NDS-2018-ASD Load combinations: ASCE 7-16 / IBC 1605.3.1 ASD

Spans: A-B 14.000 ft, B-C 10.000 ft, total 24.000 ft

Support model: A pinned, B roller, C roller (rotations released at all nodes; free nodes have no vertical restraint)

Section: 3.500 in x 11.875 in I = 488.413 in<sup>4</sup>

E: 2000000 psi

Allowables: Fb 2600 psi, Fv 285 psi

Material/source: Manual entry

Self weight: 12.1 plf

Load inputs

Load 1: Uniform load

Line loads: D 180.0 plf, L 280.0 plf

#### Design checks

Span 1 bending: fb from span moment envelope = 1343.032 psi; Fb = 2600.000 psi; DCR = 0.517 (PASS)

Governing Eq. 16-9 D + L

Span 1 shear: fv from span shear envelope = 143.006 psi; Fv = 285.000 psi; DCR = 0.502 (PASS)

Governing Eq. 16-9 D + L

Span 1 total deflection: max span deflection envelope = 0.222 in; L/240 = 0.700 in; DCR = 0.317 (PASS)

Governing Eq. 16-9 D + L

Span 2 bending: fb from span moment envelope = 1343.032 psi; Fb = 2600.000 psi; DCR = 0.517 (PASS)

Governing Eq. 16-9 D + L

Span 2 shear: fv from span shear envelope = 118.421 psi; Fv = 285.000 psi; DCR = 0.416 (PASS)

Governing Eq. 16-9 D + L

Span 2 total deflection: max span deflection envelope = 0.014 in; L/240 = 0.500 in; DCR = 0.029 (PASS)

Governing Eq. 16-9 D + L

#### Unfactored load-case analysis

Each row is the beam solved with only that load case at factor 1.0.

Case	R1 lb	R2 lb	V  lb	M  lb-ft	defl  in
Dead	1077.3	586.0	1612.5	3746.4	0.0903
Live	1570.0	854.0	2350.0	5460.0	0.1316

Reactions by load case

Dead: A=1077.3 lb B=2947.7 lb C=586.0 lb

Live: A=1570.0 lb B=4296.0 lb C=854.0 lb

#### ASD load combination analysis

Load-case diagrams are superimposed with ASD factors; envelope governs are tracked separately for V, M, deflection, and reactions.

Eq.	Combination	Gov	R1 lb	R2 lb	V  lb	M  lb-ft	defl  in
16-8	D		1077.3	586.0	1612.5	3746.4	0.0903
16-9	D + L	RVMD	2647.3	1440.0	3962.5	9206.4	0.2218

Envelope governs: R1 Eq. 16-9 D + L = 2647.3 lb; R2 Eq. 16-9 D + L = 1440.0 lb

Envelope governs: V Eq. 16-9 D + L = 3962.5 lb; M Eq. 16-9 D + L = 9206.4 lb-ft; deflection Eq. 16-9 D + L = 0.2218 in

Gov flags: R reaction, V shear, M moment, D deflection.

Reaction envelope by support

A max |R| = 2647.3 lb from Eq. 16-9 D + L

B max |R| = 7243.7 lb from Eq. 16-9 D + L

C max |R| = 1440.0 lb from Eq. 16-9 D + L

#### Analysis envelope results

Diagram display combination: ASD Eq. 16-9 D + L

Reactions

A at x = 0.000 ft: 2647.3 lb

B at x = 14.000 ft: 7243.7 lb

C at x = 24.000 ft: 1440.0 lb

Total applied load: 11330.9 lb

Envelope maximum shear: 3962.5 lb Governing Eq. 16-9 D + L

Diagram-combination shear: +3281.3 / -3962.5 lb |V|max = 3962.5 lb

Envelope maximum moment: 9206.4 lb-ft Governing Eq. 16-9 D + L

Diagram-combination moment: +7421.8 / -9206.4 lb-ft |M|max = 9206.4 lb-ft

Envelope maximum deflection: 0.2218 in Governing Eq. 16-9 D + L

Diagram-combination deflection: 0.2218 in

Support moment maximum: B at x = 14.000 ft: -9206.4 lb-ft

Span moment maximum: x = 5.607 ft: +7421.8 lb-ft

Span deflection maximum: x = 6.333 ft: 0.2218 in

#### Design trace

##### Trace

Support count: 3.000 number of vertical supports

Total beam length: 24.000 ft sum(span lengths)

Total applied load: 11330.938 lb sum(load case values x load factors)

Reaction A: 2647.258 lb stiffness analysis support reaction

Reaction B: 7243.706 lb stiffness analysis support reaction

Reaction C: 1439.973 lb stiffness analysis support reaction



## SBCP Beam — Wood Multi-Span

Member: MB-1 Hallway Beam continued

Date: 2026-06-09

Build: 0.1.0-alpha.134+92adc95

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Maximum absolute moment: 9206.387 lb-ft     $\max(\text{abs}(M_{\text{max}}), \text{abs}(M_{\text{min}}))$

Maximum absolute shear: 3962.456 lb     $\max(\text{abs}(V_{\text{max}}), \text{abs}(V_{\text{min}}))$

Maximum deflection: 0.222 in     $\max(\text{abs}(\text{stiffness displacement shape functions}))$

### ## Warnings

- Multi-span wood DCR V1 checks prismatic vertical-load bending, support shear, and total deflection per span; bearing, shear-at-d, stability, and live-only deflection remain review items.