

# RB Engineers, Inc.

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JOB: IMANI  
PROJECT #:21-8457  
BY: R.B. / MJT  
DATE: 12/30/2021

PAGE G1 OF 93

## STRUCTURAL COMPUTATIONS FOR

2405 74<sup>TH</sup> AVE SE,  
MERCER ISLAND, WA

### BASIS FOR DESIGN:

CODE: INTERNATIONAL BUILDING CODE (2018 EDITION)  
WIND: 100 MPH, EXPOSURE "B"  $K_{zt} = 1.2$   
SEISMIC:  $S_s = 1.60$ ,  $S_1 = 0.57$  (SITE CLASS D)  
ROOF SNOW: 25 PSF  
ALLOWABLE SOIL BEARING PRESSURE: 2500 PSF PER SOILS REPORT

### INDEX TO COMPUTATIONS:

GENERAL	_____	G1 – G3
LATERAL	_____	L1 – L22
BEAMS	_____	B1 – B48
FOOTING	_____	F1 – F7
RET. WALL	_____	R1 – R13

RB ENGINEERS, INC. IS  
NOT RESPONSIBLE FOR THE SITE,  
SOILS, WEATHER PROOFING, TRUSSES  
AND/OR EXISTING CONDITIONS.



EXPIRES: Feb 20 22

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Project:	IMANI	By:	RB/MJT
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**LOADING CRITERIA FOR ROOF AND/OR CEILING**

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- Main Roof Area
- Canopy or Mansard Roof
- Ceiling Only
- Other

Item	Material	Load PSF
Roofing	Composition	2.2
Sheathing or Decking	15/32 CDX	1.5
Insulation		2.8
Ceiling	5/8 GWB	2.6
Fixtures		1.0
Framing	Truss	2.3
Misc.		0.6
Sprinkler (Only If A>4000 sqft)		2

**TOTAL DEAD LOAD = 13 PSF**

**LIVE LOADS**

- Snow Load - 25 psf - non reducible
- Ceiling Only - 10 psf
- Increase in Fb and Fv of 15% allowed for duration of load

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**LOADING CRITERIA FOR FLOOR**

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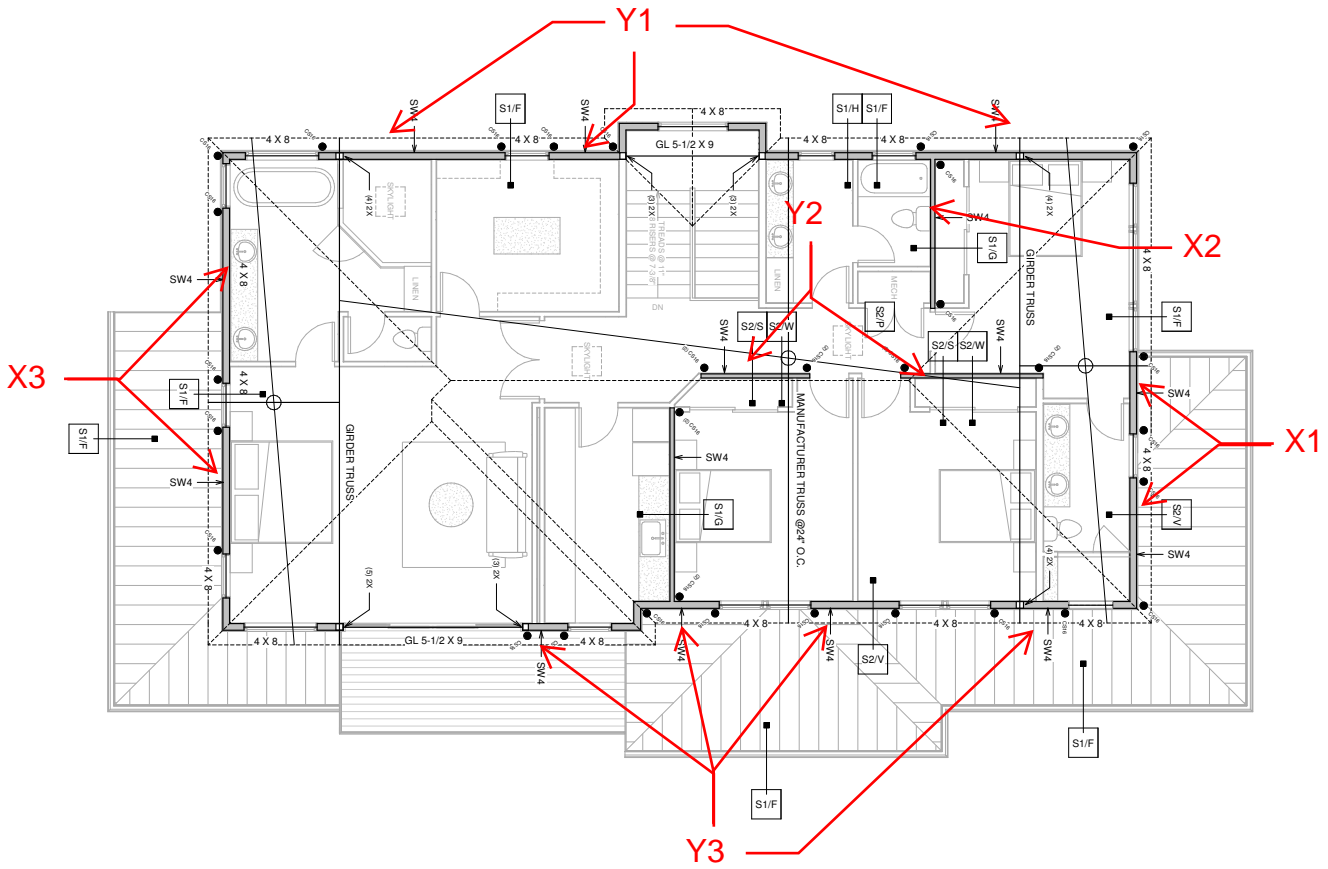
Item	Material	Load PSF
Floor Covering	Carpet and Pad	3.0
Floor Sheathing	3/4" T&G CDX	2.3
Ceiling	1/2" GWB	2.2
Fixtures		1.0
Framing	TJI's	3.0
Misc		1.5
Sprinkler (Only If A>4000 sqft)		2

**TOTAL DEAD LOAD = 13 PSF**

**LIVE LOADS**

- Residential - 40 psf (reducible)
- Office - 50 psf (reducible)
- Assembly - 100 psf (non-reducible)
- Corridors and Exits - 100 psf (reducible)
- Storage - 125 psf (non-reducible)

# SHEARWALL KEY PLAN



## MILTON LAM ARCHITECTS

ARCHITECTURAL ARCHITECTS  
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MILTON LAM 202.303.7677  
MLO@MLA10.COM  
Client Name: IMANI  
Project Address: 4025 7th Ave SE  
MERCER ISLAND, WA 98040

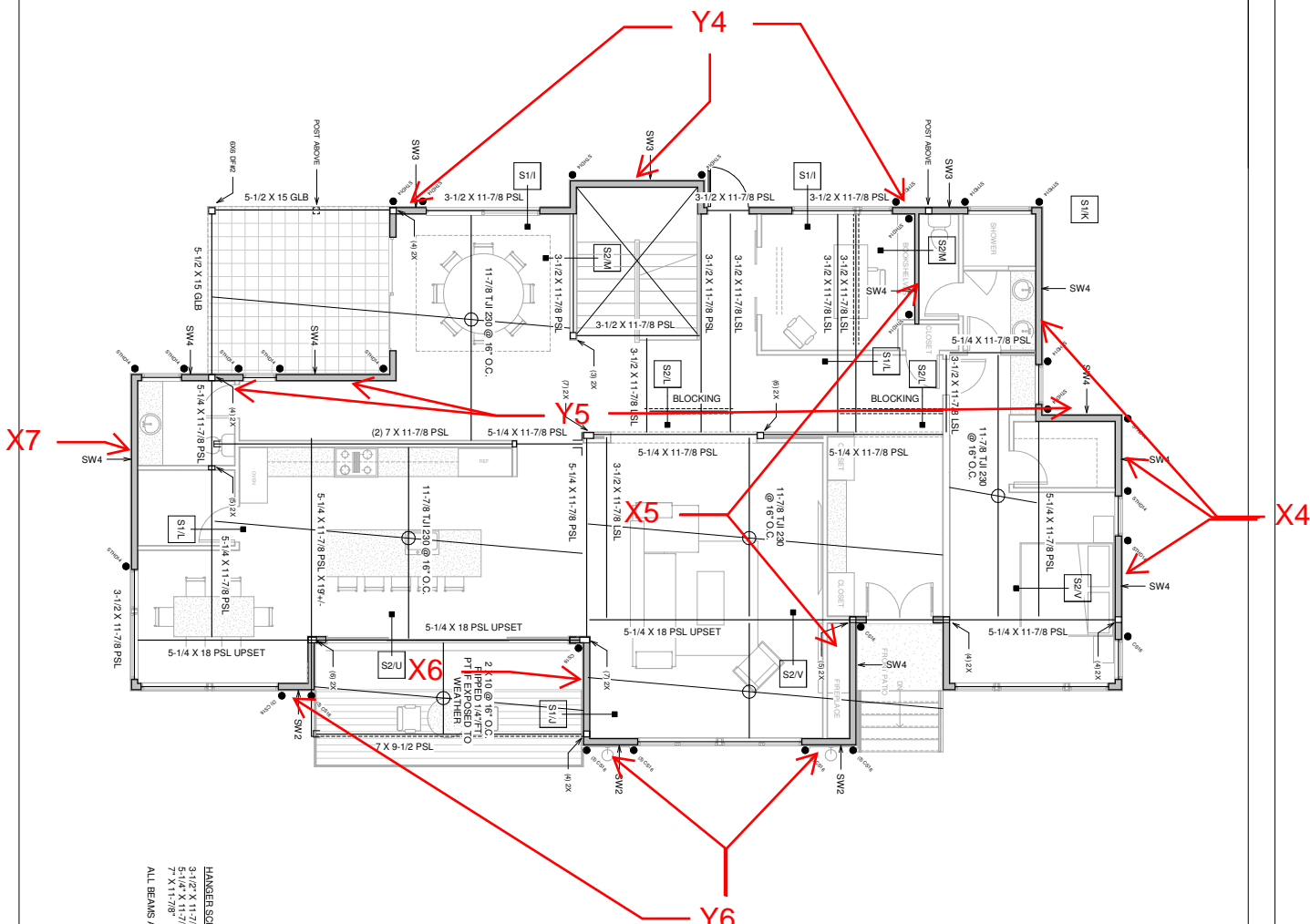
No.	Description	DWG.

IMANI  
MERCER ISLAND  
ROOF FRAMING PLAN

Project Number: 22224  
Date: 12/22/21  
Drawn by: GJB  
Checked by: M.L.A.  
Scale: 1/4" = 1'-0"

SFP3

**SHEARWALL KEY PLAN**

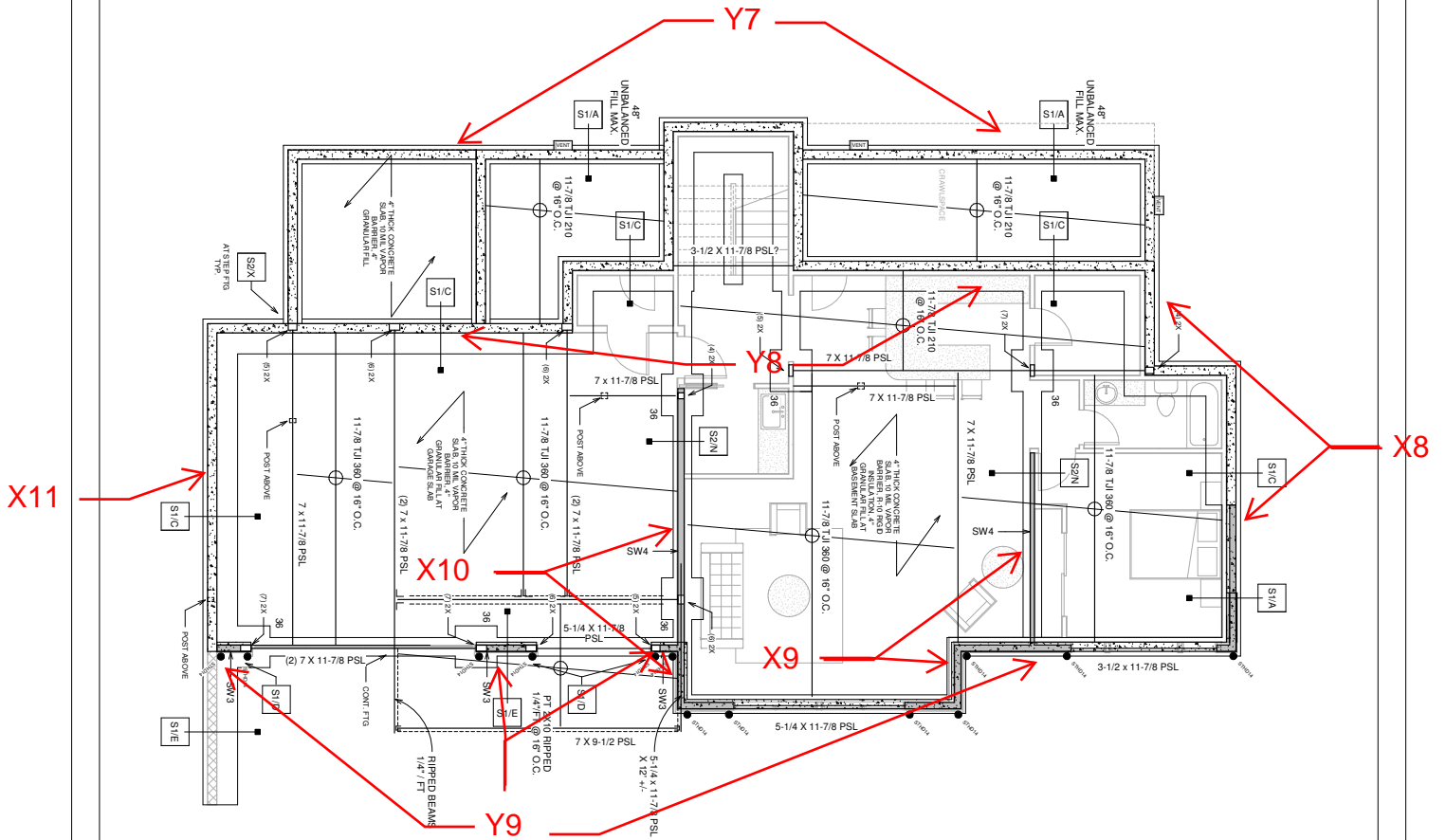


**HANGER SCHEDULE**  
 3-1/2 X 11-7/8 HQS#12  
 7 X 11-7/8 HQS#28/12  
 ALL BEAMS ARE FLUSH UNO.



<b>PROJECT INFORMATION</b> Project Number: 22224 Date: 12/22/21 Drawn by: M.L.R. Checked by: M.L.R. Scale: 1/4" = 1'-0"		<b>CLIENT INFORMATION</b> IMANI MERCER ISLAND UPPER FLOOR FRAMING PLAN		<b>ARCHITECTURAL ARCHITECTS</b> MILTON LAM ARCHITECTS PROJECT: 203 KINGSTON RD MILTON LAM 206 303 7977 M.L.A. 206 303 7977 M.L.R. 206 303 7977 Client Name: IMANI Project Address: 4623 27th Ave SE MERCER ISLAND, WA 98040																			
<table border="1"> <thead> <tr> <th>No.</th> <th>Description</th> <th>Date</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	No.	Description	Date																Project Name: IMANI Project Number: 22224 Date: 12/22/21 Drawn by: M.L.R. Checked by: M.L.R. Scale: 1/4" = 1'-0"				
No.	Description	Date																					

# SHEARWALL KEY PLAN



- HANGER SCHEDULE**
- 3-1/2" X 1-1/8" - HQU5412
  - 5-1/4" X 1-1/8" - HQU555/12
  - 7" X 1-1/8" - HQU5725/12
- ALL BEAMS ARE FLUSH UNO.
- 24 □ 24" X 24" X 3" W/ (3) #4 B.E.W.
  - 30 □ 30" X 30" X 3" W/ (4) #4 B.E.W.
  - 36 □ 36" X 36" X 3" W/ (5) #4 B.E.W.



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 Client/Name: IMANI

Project Address: 1423 31st Ave SE  
 MERCER ISLAND, WA 98040

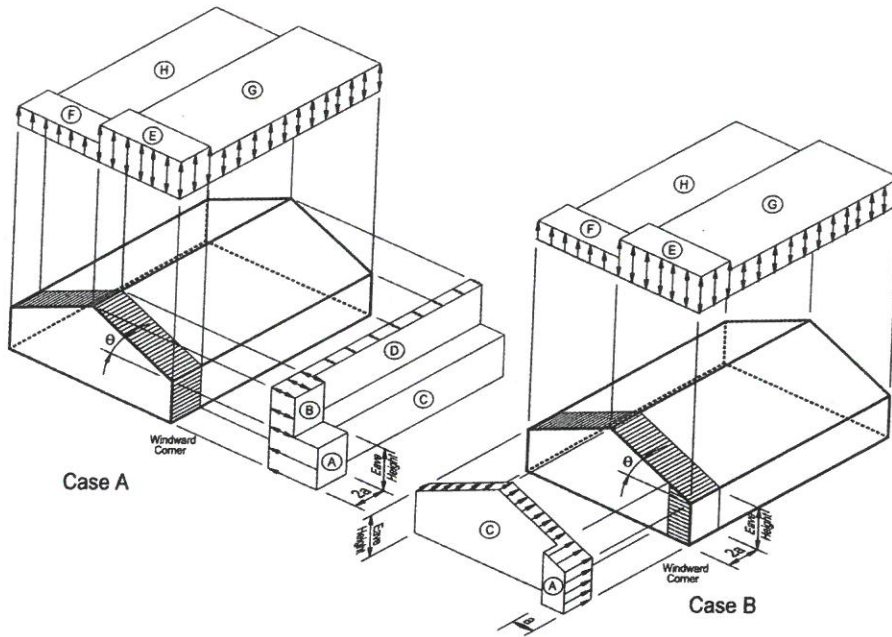
No.	Description	Qty

Project Number: 23224  
 Date: 12/22/21  
 Drawn by: JLB  
 Checked by: M.L.A.

**SFP1**

Scale: 1/4" = 1'-0"

**Diagrams**



**Notation**

- a* 10% of least horizontal dimension or  $0.4h$ , whichever is smaller, but not less than either 4% of least horizontal dimension or 3 ft (0.9 m).  
**EXCEPTION:** For buildings with  $\theta = 0$  to  $7^\circ$  and a least horizontal dimension greater than 300 ft (90 m), dimension *a* shall be limited to a maximum of 0.8 m.
- h* Mean roof height, in ft (m), except that eave height shall be used for roof angles  $< 10^\circ$ .
- $\theta$  Angle of plane of roof from horizontal, in degrees.

**Notes**

1. Pressures shown are applied to the horizontal and vertical projections, for Exposure B, at  $h = 30$  ft ( $h = 9.1$  m). Adjust to other exposures and heights with adjustment factor  $\lambda$ .
2. The load patterns shown shall be applied to each corner of the building in turn as the reference corner (See Fig. 28.3-1).
3. For Case B, use  $\theta = 0^\circ$ .
4. Load cases 1 and 2 must be checked for  $25^\circ < \theta \leq 45^\circ$ . Load case 2 at  $25^\circ$  is provided only for interpolation between  $25^\circ$  and  $30^\circ$ .
5. Plus and minus signs signify pressures acting toward and away from the projected surfaces, respectively.
6. For roof slopes other than those shown, linear interpolation is permitted.
7. The total horizontal load shall not be less than that determined by assuming  $p_s = 0$  in Zones B and D.
8. Where Zone E or G falls on a roof overhang on the windward side of the building, use  $E_{OH}$  and  $G_{OH}$  for the pressure on the horizontal projection of the overhang. Overhangs on the leeward and side edges shall have the basic zone pressure applied.
9. Unit conversions for tables:

**Adjustment Factor for Building Height and Exposure,  $\lambda$**

Mean roof height (ft)	Exposure		
	B	C	D
15	1.00	1.21	1.47
20	1.00	1.29	1.55
25	1.00	1.35	1.61
30	1.00	1.40	1.66
35	1.05	1.45	1.70
40	1.09	1.49	1.74
45	1.12	1.53	1.78
50	1.16	1.56	1.81
55	1.19	1.59	1.84
60	1.22	1.62	1.87

Note: Unit conversions for tables: 1.0 ft = 0.3048 m; 1.0 lb/ft<sup>2</sup> = 0.0479 kN/m<sup>2</sup>; 1 mph = 1.6 km/h

**FIGURE 28.5-1 Main Wind Force Resisting System, Part 2 [ $h \leq 60$  ft ( $h \leq 18.3$  m)]: Design Wind Pressures for Enclosed Buildings—Walls and Roofs**

continues

Simplified Design Wind Pressure, $P_{s30}$ (psf) for Exposure B at $h = 30$ ft ( $h = 9.1$ m)												
Basic Wind Speed (mph)	Roof Angle (degrees)	Load Case	Zones									
			Horizontal Pressures				Vertical Pressures				Overhangs	
			A	B	C	D	E	F	G	H	$E_{OH}$	$G_{OH}$
85	0 to 5°	1	11.5	-5.9	7.6	-3.5	-13.8	-7.8	-9.6	-6.1	-19.3	-15.1
	10°	1	12.9	-5.4	8.6	-3.1	-13.8	-8.4	-9.6	-6.5	-19.3	-15.1
	15°	1	14.4	-4.8	9.6	-2.7	-13.8	-9.0	-9.6	-6.9	-19.3	-15.1
	20°	1	15.9	-4.2	10.6	-2.3	-13.8	-9.6	-9.6	-7.3	-19.3	-15.1
	25°	1	14.4	2.3	10.4	2.4	-6.4	-8.7	-4.6	-7.0	-11.9	-10.1
		2	—	—	—	—	-2.4	-4.7	-0.7	-3.0	—	—
30 to 45	1	12.9	8.8	10.2	7.0	1.0	-7.8	0.3	-6.7	-4.5	-5.2	
	2	12.9	8.8	10.2	7.0	5.0	-3.9	4.3	-2.8	-4.5	-5.2	
90	0 to 5°	1	12.8	-6.7	8.5	-4.0	-15.4	-8.8	-10.7	-6.8	-21.6	-16.9
	10°	1	14.5	-6.0	9.6	-3.5	-15.4	-9.4	-10.7	-7.2	-21.6	-16.9
	15°	1	16.1	-5.4	10.7	-3.0	-15.4	-10.1	-10.7	-7.7	-21.6	-16.9
	20°	1	17.8	-4.7	11.9	-2.6	-15.4	-10.7	-10.7	-8.1	-21.6	-16.9
	25°	1	16.1	2.6	11.7	2.7	-7.2	-9.8	-5.2	-7.8	-13.3	-11.4
		2	—	—	—	—	-2.7	-5.3	-0.7	-3.4	—	—
30 to 45	1	14.4	9.9	11.5	7.9	1.1	-8.8	0.4	-7.5	-5.1	-5.8	
	2	14.4	9.9	11.5	7.9	5.6	-4.3	4.8	-3.1	-5.1	-5.8	
95	0 to 5°	1	14.3	-7.4	9.5	-4.4	-17.2	-9.8	-12.0	-7.6	-24.1	-18.8
	10°	1	16.1	-6.7	10.7	-3.9	-17.2	-10.5	-12.0	-8.1	-24.1	-18.8
	15°	1	18.0	-6.0	12.0	-3.4	-17.2	-11.2	-12.0	-8.6	-24.1	-18.8
	20°	1	19.8	-5.2	13.2	-2.9	-17.2	-12.0	-12.0	-9.1	-24.1	-18.8
	25°	1	18.0	2.9	13.0	3.0	-8.0	-10.9	-5.8	-8.7	-14.9	-12.7
		2	—	—	—	—	-3.0	-5.9	-0.8	-3.8	—	—
30 to 45	1	16.1	11.0	12.8	8.8	1.2	-9.8	0.4	-8.4	-5.6	-6.5	
	2	16.1	11.0	12.8	8.8	6.2	-4.8	5.4	-3.4	-5.6	-6.5	
100	0 to 5°	1	15.9	-8.2	10.5	-4.9	-19.1	-10.8	-13.3	-8.4	-26.7	-20.9
	10°	1	17.9	-7.4	11.9	-4.3	-19.1	-11.6	-13.3	-8.9	-26.7	-20.9
	15°	1	19.9	-6.6	13.3	-3.8	-19.1	-12.4	-13.3	-9.5	-26.7	-20.9
	20°	1	22.0	-5.8	14.6	-3.2	-19.1	-13.3	-13.3	-10.1	-26.7	-20.9
	25°	1	19.9	3.2	14.4	3.3	-8.8	-12.0	-6.4	-9.7	-16.5	-14.0
		2	—	—	—	—	-3.4	-6.6	-0.9	-4.2	—	—
30 to 45	1	17.8	12.2	14.2	9.8	1.4	-10.8	0.5	-9.3	-6.3	-7.2	
	2	17.8	12.2	14.2	9.8	6.9	-5.3	5.9	-3.8	-6.3	-7.2	

FIGURE 28.5-1 (Continued). Main Wind Force Resisting System, Part 2 [ $h \leq 60$  ft ( $h \leq 18.3$  m)]: Design Wind Pressures for Enclosed Buildings—Walls and Roofs

continues



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**LATERAL WIND FORCES**  
**ENVELOPE PROCEDURE (ASCE 7-16 Chapter 28)**

Design Wind Pressures

Roof Pitch:	3:17 (10°)	Wind Speed:	100 mph
Wind Exposure:	B $\lambda = 1.0$ ASCE 7-16 p.316	A:	17.9
Minimum Pressure:	16 psf (wall) 28.5.4	C:	11.9
Minimum Pressure:	8 psf (roof) 28.5.4	B:	0.0
Kzt:	1.2	D:	0.0

(ASCE 7-16) Using Allowable Stress Design, 2.4.5 Basic Combinations option 7: 0.6 D + 0.6 W

**X – X Direction**

$$\begin{aligned} \Sigma F_w \text{ Roof} = & 17.9x(2x4.5x12.5) + 11.9x(4.5x37.5) /1000 = \\ & 4.02 \qquad \qquad \qquad 4.02 \times 1.20 K_{zt} \times 0.6 = \qquad \qquad \qquad 2.90 \text{ kip} \end{aligned}$$

$$\begin{aligned} \Sigma F_w \text{ Upper} = & 17.9x(2x(4.5x12.5+5.5x15)) + 11.9x(4.5x37.5+5.5x45) /1000 = \\ & 9.94 \qquad \qquad \qquad 9.94 \times 1.20 K_{zt} \times 0.6 = \qquad \qquad \qquad 7.16 \text{ kip} \end{aligned}$$

$$\begin{aligned} \Sigma F_w \text{ Lower} = & 17.9x(2x10x15) + 11.9x(10x45) /1000 = \\ & 10.73 \qquad \qquad \qquad 10.73 \times 1.20 K_{zt} \times 0.6 = \qquad \qquad \qquad 7.72 \text{ kip} \end{aligned}$$

$$\text{Roof Min} = [(112.5+168.75)x16+(140)x8]x1.20x0.6 = \boxed{4.05} \text{ kip}$$

$$\text{Upper Min} = [(278+417)x16+(0+0)x8]x1.20x0.6 = \boxed{8.01} \text{ kip}$$

$$\text{Main Min} = [(300+450)x16+(0+0)x8]x1.20x0.6 = \boxed{8.64} \text{ kip}$$

**Y – Y Direction**

$$\begin{aligned} \Sigma F_w \text{ Roof} = & 17.9x(2x4.5x7) + 11.9x(4.5x21) /1000 = \\ & 2.25 \qquad \qquad \qquad 2.25 \times 1.20 K_{zt} \times 0.6 = \qquad \qquad \qquad 1.62 \text{ kip} \end{aligned}$$

$$\Sigma F_w \text{ Upper} = 17.9x(2x(4.5x7+5.5x8.5)) + 11.9x(4.5x21+5.5x25.5) /1000 =$$

$$5.60 \qquad 5.60 \times 1.20 \text{ Kzt} \times 0.6 = \qquad 4.03 \text{ kip}$$

$$\Sigma \text{ Fw Lower} = 17.9 \times (2 \times 6 \times 8.5) + 11.9 \times (6 \times 25.5) / 1000 =$$

$$3.65 \qquad 3.65 \times 1.20 \text{ Kzt} \times 0.6 = \qquad 2.63 \text{ kip}$$

$$\text{Roof Min} = [(63+94.5) \times 16 + (73) \times 8] \times 1.20 \times 0.6 = \boxed{2.23} \text{ kip}$$

$$\text{Upper Min} = [(156.5+235) \times 16 + (0+0) \times 8] \times 1.20 \times 0.6 = \boxed{4.51} \text{ kip}$$

$$\text{Main Min} = [(102+153) \times 16 + (0+0) \times 8] \times 1.20 \times 0.6 = \boxed{2.94} \text{ kip}$$

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### QUAKE FORCES (ASCE 7-16)

Site Class "D" (Table 11.4.2)

$S_s = 1.6$  - Critical Values per Latest SEAOC website;

$S_1 = 0.57$  - Critical Values per Latest SEAOC website;

$F_a = 1.0$  per Table 11.4-1

$F_v = 1.8$  per Table 11.4-2

$$S_{ms} = F_a * S_s = 1.0 (1.6) = 1.6 \quad (11.4-1)$$

$$S_{m1} = F_v * S_1 = 1.8 (0.57) = 1.03 \quad (11.4-2)$$

$$S_{ds} = 2/3 * S_{ms} = 2/3 (1.6) = 1.07 \quad (11.4-3), \text{ Seismic Design Category "D", Table 11.6-1}$$

$$S_{d1} = 2/3 * S_{m1} = 2/3 (1.03) = .69 \quad (11.4-4); \text{ Seismic Design Category D, Table 11.6-2}$$

SEISMIC RESPONSE COEFFICIENT: Use Section (12.8.1.1) ASCE 7-16 Except as Noted

$$T_o = 0.2 (S_{d1}/S_{ds}) = 0.13 \text{ SEC} \quad \text{Section 11.4.6}$$

$$T_s = S_{d1} / S_{ds} = 0.64 \text{ SEC} \quad \text{Section 11.4.6}$$

$$T_{struc} = C_t * (H_n)^{3/4} = 0.020 (25.3)^{3/4} = 0.23 \text{ SEC} \quad (12.8-7); C_t=.02, \text{ Table 12.8-2}$$

Where  $T_o \leq T_{struc} \leq T_s$ ;  $S_a = S_{ds} = 1.07$  Section 11.4.6, item 2

$R = 6.5$  for Wood Shear Walls per ASCE 7-16 Table 12.2-1, item 15

$I_e = 1.0$  Section 11.5.1, Table 1.5-1 and 1.5-2)

$$C_s = S_{ds} / (R/I) = 1.07 / (6.5/1) = 0.165 \quad (12.8-2)$$

$C_s = 0.16$
--------------

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**LATERAL QUAKE FORCES**

Cs:	0.16	$\rho$ :	1.0
Roof Area:	2280 feet <sup>2</sup>	Roof Dead Load:	13 psf
Upper Area:	3330 feet <sup>2</sup>	Floor Dead Load:	13 psf
Main Area:	2115 feet <sup>2</sup>	Wall Dead Load:	8 psf

ASCE 7-16 Using Allowable Stress Design, 2.4.5 Basic Combination option 10: 0.6 D + 0.7 E<sub>h</sub>-0.7E<sub>v</sub>  
 ASCE 7-16 Table 12.2-1: Overstrength factor,  $\Omega = 2.5$

**DEAD LOAD OF STRUCTURE**

$$\text{Roof Weight} = 2280 \times (13+8) = 47.88 \text{ kip}$$

$$\text{Upper Weight} = 3330 \times (13+8) = 69.93 \text{ kip}$$

$$\text{Main Weight} = 2115 \times (13+8) = 44.42 \text{ kip}$$


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$$162.23 \text{ kip}$$

$$V_{\text{base}} = C_s \times \Sigma \text{Weight} = 0.16 \times 162.23 = 25.96 \text{ kip}$$

$$V_{\text{asd}} = V_{\text{base}} \times 0.7 \times \rho = 18.17 \text{ kip}$$

**LATERAL FORCES**

	WEIGHT	HEIGHT	WEIGHT x HEIGHT
Roof:	47.88 kip	29 Feet	1388.52
Upper:	69.93 kip	20 Feet	1398.60
Main:	44.42 kip	9 Feet	399.74
			<hr/> 3186.86

$$F_q \text{ Roof: } 18.17 \times (1388.52/3186.86) = 7.92 \text{ kip}$$

$$F_q \text{ Upper: } 18.17 \times (1398.60/3186.86) = 7.97 \text{ kip}$$

$$F_q \text{ Main: } 18.17 \times (399.74/3186.86) = 2.28 \text{ kip}$$

Therefore Wind governs in X-X direction @ Main, quake governs all else.

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**WIND FORCES ON SHEAR WALLS****Shearwalls in X – X Direction**

$$\text{Fw X – X @ Roof:} \quad 4.05 \quad \text{kips} \qquad 4.05 \text{ k} / 62.5 \text{ ft} = \quad 109.4 \quad \text{\#Ft}$$

$$\text{V @ X 1} = (4.05/62.5) \times (14/2) = \quad \frac{0.45}{9'+5.5'} = \quad 31 \quad \frac{\#}{\text{Ft}}$$

SW-4

$$\text{V @ X 2} = (4.05/62.5) \times (14/2 + 48.5/2) = \quad \frac{2.02}{12'} = \quad 169 \quad \frac{\#}{\text{Ft}}$$

SW-4

$$\text{V @ X 3} = (4.05/62.5) \times (31/2) = \quad \frac{1.57}{8.5'+11.5'} = \quad 79 \quad \frac{\#}{\text{Ft}}$$

SW-4

$$\text{Fw X – X @ Upper:} \quad 8.01 \quad \text{kips} \qquad 8.01 \text{ k} / 37 \text{ ft} = \quad 216.4 \quad \text{\#Ft}$$

$$\text{V @ X 4} = (8.01/74) \times (6+10/2) + 0.45 = \quad \frac{1.64}{11.75'+6'+8'} = \quad 64 \quad \frac{\#}{\text{Ft}}$$

SW-4

$$\text{V @ X 5} = (8.01/74) \times (10/2 + 4 + 20/2) + 2.02 = \quad \frac{4.08}{8.5'+8'} = \quad 247 \quad \frac{\#}{\text{Ft}}$$

SW-4

$$\text{V @ X 6} = (8.01/74) \times (20/2 + 34/2) = \quad \frac{2.92}{8'} = \quad 365 \quad \frac{\#}{\text{Ft}}$$

SW-4

WITHIN 5% OK.

$$\text{V @ X 7} = (8.01/74) \times (34/2) + 1.57 = \quad \frac{3.41}{14.5'} = \quad 235 \quad \frac{\#}{\text{Ft}}$$

SW-4

$$\text{Fw X - X @ Main:} \quad 8.64 \quad \text{kips} \quad 8.64 \text{ k} / 74 \text{ ft} = 233.5 \quad \text{\#/Ft}$$

$$\text{V @ X 8} = (8.64/74) \times (6+8.5/2) \quad \frac{2.84}{(21'+15.5')(12''/x8'')} = 78 \quad \frac{\#}{\text{Ft}}$$

$$\boxed{\text{CONC}} + 1.64 =$$

$$\text{V @ X 9} = (8.64/74) \times (8.5/2+5+20/2) \quad \frac{6.33}{14'+4'} = 351 \quad \frac{\#}{\text{Ft}}$$

$$\boxed{\text{SW-4}} + 4.08 =$$

WITHIN 5% OK.

$$\text{V @ X 10} = (8.64/74) \times (20/2+34.5/2) \quad \frac{6.10}{18.5'+4'} = 271 \quad \frac{\#}{\text{Ft}}$$

$$\boxed{\text{SW-4}} + 2.92 =$$

$$\text{V @ X 11} = (8.64/74) \times (34.5/2) \quad \frac{5.42}{(23.5')(12''/x8'')} = 2 \quad \text{psi}$$

$$\boxed{\text{CONC}} + 3.41 =$$


---

**RB Engineers, Inc.**

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Phone: (425) 822-3009

Email: rbe1992@gmail.com

Project: IMANI	By: RB/MJT
Client: -	Date: 9/17/21
Subject: Lateral	Page: L12/

**WIND FORCES ON SHEAR WALLS****Shearwalls in Y – Y Direction**

$$\text{Fw Y – Y @ Roof:} \quad 2.23 \quad \text{kips} \qquad 2.23 \text{ k} / 34.5 \text{ ft} = \quad 55.2 \quad \text{\#/Ft}$$

$$\text{V @ Y 1} = (2.23/34.5) \times (2+15/2) = \frac{0.62}{12.5'+4.75'+15'} = 19 \quad \frac{\#}{\text{Ft}}$$

(1.25-0.125x(9.1/3))x450 #/Ft = 392 #/Ft capacity per table 4.3.4 ANSI/AF+PA SDPWS

$$\text{V @ Y 2} = (2.23/34.5) \times (15/2+16/2) = \frac{1.00}{8.25'+6.25'} = 69 \quad \frac{\#}{\text{Ft}}$$

$$\text{V @ Y 3} = (2.23/34.5) \times (16/2+1.5) = \frac{0.62}{10'+6'+5.5'+3.25'} = 29 \quad \frac{\#}{\text{Ft}}$$

$$\text{Fw Y – Y @ Upper:} \quad 4.51 \quad \text{kips} \qquad 4.51 \text{ k} / 40 \text{ ft} = \quad 112.8 \quad \text{\#/Ft}$$

$$\text{V @ Y 4} = (4.51/42) \times (2+12.5/2) + 0.62 = \frac{1.50}{5.5'+10'+2.75'} = 82 \quad \frac{\#}{\text{Ft}}$$

(1.25-0.125x(10/2.75))x450 #/Ft = 375 #/Ft capacity per table 4.3.4 ANSI/AF+PA SDPWS

$$\text{V @ Y 5} = (4.51/42) \times (12.5/2+3+20/2) + 1.00 = \frac{3.07}{6'+9'+5'} = 154 \quad \frac{\#}{\text{Ft}}$$

WITHIN 5% OK.

$$\text{V @ Y 6} = (4.51/42) \times (20/2+4) + 0.62 = \frac{2.12}{2.75'+4'+4'} = 197 \quad \frac{\#}{\text{Ft}}$$

$$\text{Fw Y – Y @ Main:} \quad 2.94 \quad \text{kips} \qquad 2.94 \text{ k} / 40 \text{ ft} = \quad 73.4 \quad \text{\#/Ft}$$

$$\text{V @ Y 7} = (2.94/40) \times (12/2) = \frac{1.94}{\phantom{0}} = 0 \quad \text{psi}$$

$$\boxed{\text{CONC}} + 1.50 = \frac{(25'+26')(12"/'x8")}{\text{Concrete wall treated as regular shear wall for conservative purposes}}$$

$$\frac{V @ Y 8 = (2.94/40) \times (12/2 + 3 + 20.5/2)}{\boxed{\text{CONC}} + 3.07} = \frac{3.81}{(25.5'+6')(12"/'x8")} = 1 \text{ psi}$$

$$\frac{V @ Y 9 = (2.94/40) \times (20.5/2 + 4)}{\boxed{\text{CONC}} + 2.12} = \frac{3.10}{2(24"x8') + (16"x8')} < 4.2\text{k LRP Capacity.}$$

LRP : 2 x 1675 lb + 850 lb = 4200 lb Capacity.

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Project: IMANI	By: RB/MJT
Client: -	Date: 9/17/21
Subject: Lateral	Page: L14/

**QUAKE FORCES ON SHEAR WALLS****Shearwalls in X – X Direction**

$$\text{Fw X – X @ Roof: } 7.92 \text{ kips} \qquad 7.92 \text{ k} / 62.5 \text{ ft} = 126.7 \text{ \#/Ft}$$

$$\text{V @ X 1} = (7.92/62.5) \times (14/2) = \frac{0.89}{9'+5.5'} = 61 \frac{\#}{\text{Ft}}$$

SW-4

$$\text{V @ X 2} = (7.92/62.5) \times (14/2 + 48.5/2) = \frac{3.96}{12'} = 330 \frac{\#}{\text{Ft}}$$

SW-4

$$\text{V @ X 3} = (7.92/62.5) \times (31/2) = \frac{3.07}{8.5'+11.5'} = 154 \frac{\#}{\text{Ft}}$$

SW-4

$$\text{Fw X – X @ Upper: } 7.97 \text{ kips} \qquad 7.97 \text{ k} / 74 \text{ ft} = 107.8 \text{ \#/Ft}$$

$$\text{V @ X 4} = (7.97/74) \times (6+10/2) + 0.89 = \frac{2.07}{11.75'+6'+8'} = 80 \frac{\#}{\text{Ft}}$$

SW-4

$$\text{V @ X 5} = (7.97/74) \times (10/2 + 4 + 20/2) + 3.96 = \frac{6.01}{8.5'+8'} = 364 \frac{\#}{\text{Ft}}$$

SW-4

$$\text{V @ X 6} = (7.97/74) \times (20/2 + 34/2) = \frac{2.91}{8'} = 364 \frac{\#}{\text{Ft}}$$

SW-4

WITHIN 5% OK.

$$\text{V @ X 7} = (7.97/74) \times (34/2) + 3.07 = \frac{4.90}{14.5'} = 338 \frac{\#}{\text{Ft}}$$

SW-4

---


$$\text{Fw X - X @ Main:} \quad 2.28 \quad \text{kips} \quad 2.28 \text{ k} / 74 \text{ ft} = 61.6 \quad \#/\text{Ft}$$

$$\text{V @ X 8} = (2.28/74) \times (6+8.5/2) \quad \frac{2.39}{(21'+15.5')(12"/\text{ft} \times 8")} = 65 \quad \frac{\#}{\text{Ft}}$$

$$\boxed{\text{CONC}} + 2.07 =$$

$$\text{V @ X 9} = (2.28/74) \times (8.5/2+5+20/2) \quad \frac{6.60}{14'+4'} = 367 \quad \frac{\#}{\text{Ft}}$$

$$\boxed{\text{SW-4}} + 6.01 =$$

WITHIN 5% OK.

$$\text{V @ X 10} = (2.28/74) \times (20/2+34.5/2) \quad \frac{3.75}{18.5'+4'} = 167 \quad \frac{\#}{\text{Ft}}$$

$$\boxed{\text{SW-4}} + 2.91 =$$

$$\text{V @ X 11} = (2.05/74) \times (34.5/2) \quad \frac{5.43}{(23.5')(12"/\text{ft} \times 8")} = 2 \quad \text{psi}$$

$$\boxed{\text{CONC}} + 4.43 =$$


---

**RB Engineers, Inc.**

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Project: IMANI	By: RB/MJT
Client: -	Date: 9/17/21
Subject: Lateral	Page: L16/

**QUAKE FORCES ON SHEAR WALLS****Shearwalls in Y – Y Direction**

$$\text{Fw Y – Y @ Roof:} \quad 7.92 \quad \text{kips} \qquad 7.92 \text{ k} / 34.5 \text{ ft} = \quad 229.5 \quad \text{\#/Ft}$$

$$\text{V @ Y 1} = (7.92/34.5) \times (2+15/2) = \frac{2.18}{12.5'+4.75'+15'} = 68 \quad \frac{\#}{\text{Ft}}$$

(1.25-0.125x(9.1/3))x450 #/Ft = 392 #/Ft capacity per table 4.3.4 ANSI/AF+PA SDPWS

$$\text{V @ Y 2} = (7.92/34.5) \times (15/2+16/2) = \frac{3.56}{8.25'+6.25'} = 245 \quad \frac{\#}{\text{Ft}}$$

$$\text{V @ Y 3} = (7.92/34.5) \times (16/2+1.5) = \frac{2.18}{10'+6'+5.5'+3.25'} = 101 \quad \frac{\#}{\text{Ft}}$$

$$\text{Fw Y – Y @ Upper:} \quad 7.97 \quad \text{kips} \qquad 7.97 \text{ k} / 42 \text{ ft} = \quad 189.9 \quad \text{\#/Ft}$$

$$\text{V @ Y 4} = (7.97/42) \times (2+12.5/2) + 2.18 = \frac{3.75}{5.5'+10'+2.75'} = 205 \quad \frac{\#}{\text{Ft}}$$

(1.25-0.125x(10/2.75))x450 #/Ft = 375 #/Ft capacity per table 4.3.4 ANSI/AF+PA SDPWS

$$\text{V @ Y 5} = (7.97/42) \times (12.5/2+3+20/2) + 4.45 = \frac{7.21}{6'+9'+5'} = 361 \quad \frac{\#}{\text{Ft}}$$

WITHIN 5% OK.

$$\text{V @ Y 6} = (7.97/42) \times (20/2+4) + 2.18 = \frac{4.84}{2.75'+4'+4'} = 450 \quad \frac{\#}{\text{Ft}}$$

(1.25-0.125x(10/2.75))x585 #/Ft = 490 #/Ft capacity per table 4.3.4 ANSI/AF+PA SDPWS

$$\text{Fw Y – Y @ Main:} \quad 2.28 \quad \text{kips} \qquad 2.05 \text{ k} / 40 \text{ ft} = \quad 57.0 \quad \text{\#/Ft}$$

$$\text{V @ Y 7} = (2.05/40) \times (12/2) + 3.75 = \frac{4.09}{(25'+26')(12''/x8'')} = 1 \quad \text{psi}$$

$$\frac{V @ Y 8 = (2.05/40) \times (12/2 + 3 + 20.5/2)}{\text{CONC} + 1.18} = \frac{7.78}{(25.5' + 6')(12" / \times 8")} = 3 \text{ psi}$$

$$\frac{V @ Y 9 = (2.05/40) \times (20.5/2 + 4)}{\text{CONC} + 4.84 - 4.20} = \frac{1.40}{8'} = 175 \frac{\#}{\text{Ft}}$$

2(24"x8')+(16"x8') LRP : 2 x 1675 lb + 850 lb = 4200 lb Capacity.

---

Project: IMANI	By: RB/MJT
Client: -	Date: 9/17/21
Subject: Lateral	Page: L18/

**CHECK OVERTURNING FOR:**

X 2 (Quake)

L =	12	ft
P =	330	lb/ft
P x L =	330x12	

3.96 kip

MoT = 3.96x9.1 = 36.04 kip - ft

S<sub>ds</sub> = 1.07 From Cs Calculations

.7(0.2\*S<sub>ds</sub>) = 0.15

MR = [(0.35+0.39)x0.5x12+0.14x12] = 6.09 kip - ft

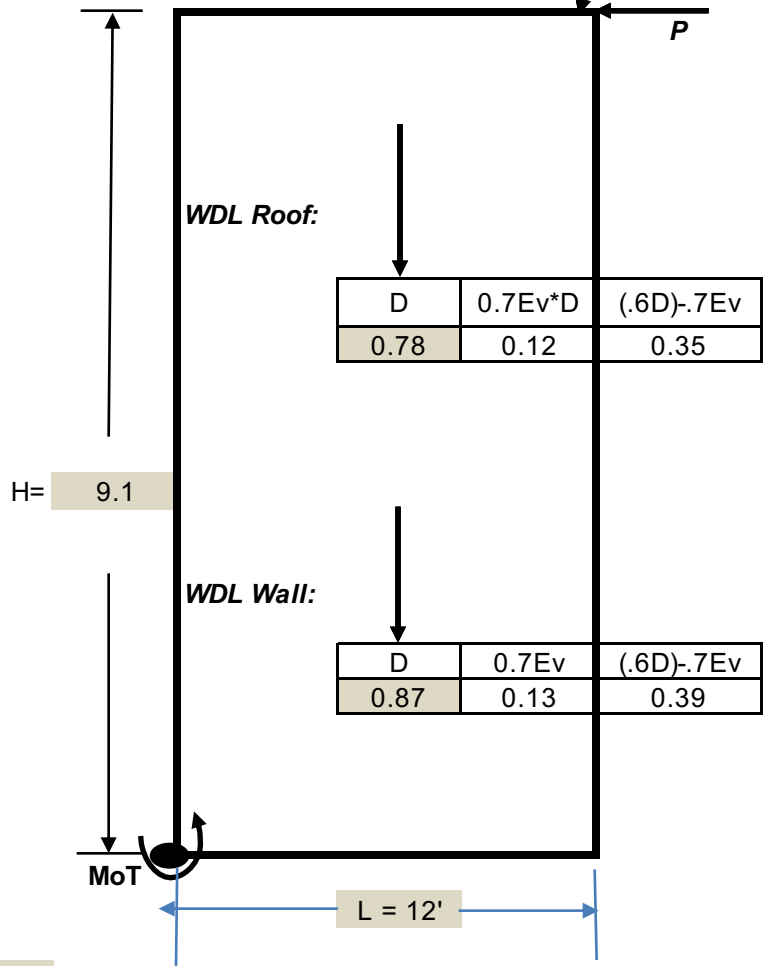
F = MoT - MR / L = 2.50 kip

Positive # : Hold down required  
 Negative # : No Hold down Required

TLRF = 5 ft (conservative)

P<sub>adj</sub> =

D	0.7Ev*D	(.6D)-.7Ev
0.3	0.04	0.14



Therefore use (2)CS16 hold downs at each end

Project: IMANI	By: RB/MJT
Client: -	Date: 9/17/21
Subject: Lateral	Page: <b>L19/</b>

**CHECK OVERTURNING FOR:**

X 5 (Quake)

L =	8	ft
P =	364	lb/ft
P x L =	364x8	

2.91 kip

TLRF = 5 ft (conservative)

*P*adj =

D	0.7Ev*D	(.6D)-.7Ev
0.6	0.09	0.27

MoT = 2.91x10 = 29.12 kip - ft

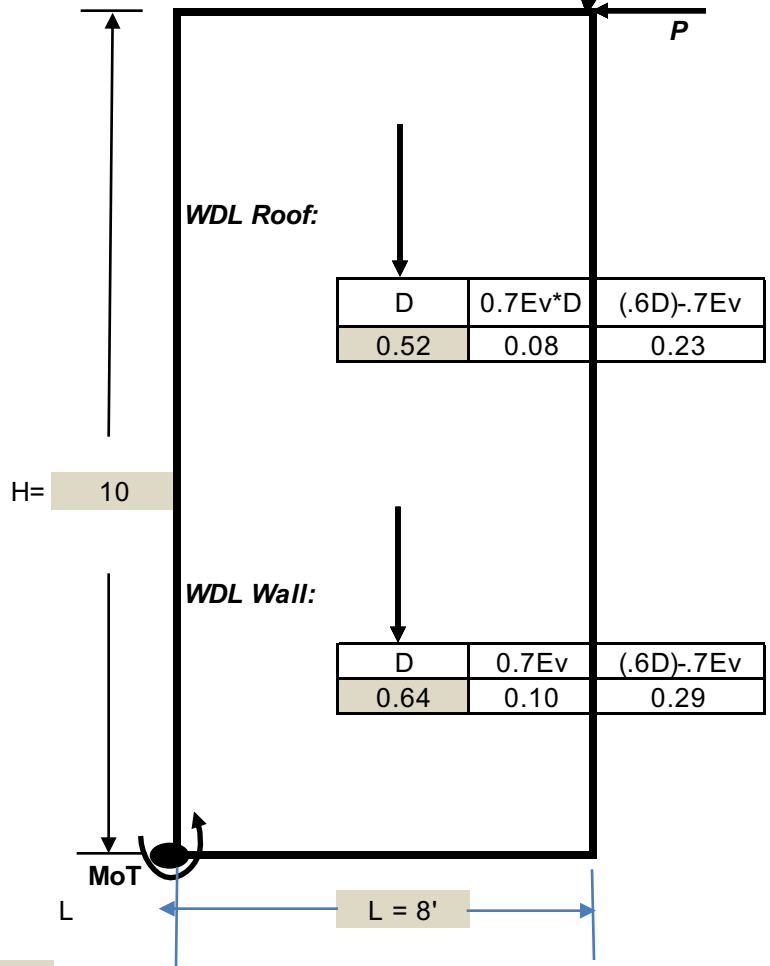
S<sub>ds</sub> = 1.07 From Cs Calculations

.7(0.2\*S<sub>ds</sub>) = 0.15

MR = [(0.23+0.29)x0.5x8+0.27x8] = 4.25 kip - ft

F = MoT - MR / L = 3.11 kip

Positive # : Hold down required  
 Negative # : No Hold down Required



Therefore use (2)CS16 hold downs at each end Within 5%

Project: IMANI	By: RB/MJT
Client: -	Date: 9/17/21
Subject: Lateral	Page: L20/

**CHECK OVERTURNING FOR:**

X 9 (Wind)

L =	14	ft
P =	367	lb/ft
P x L =	367x14	

5.14 kip

TLRF = 5 ft (conservative)

<i>P</i> <sub>adj</sub> =	D	0.7E <sub>v</sub> *D	(.6D)-.7E <sub>v</sub>
	0.9	0.16	0.38

MoT = 5.14x9.1 = 46.76 kip - ft

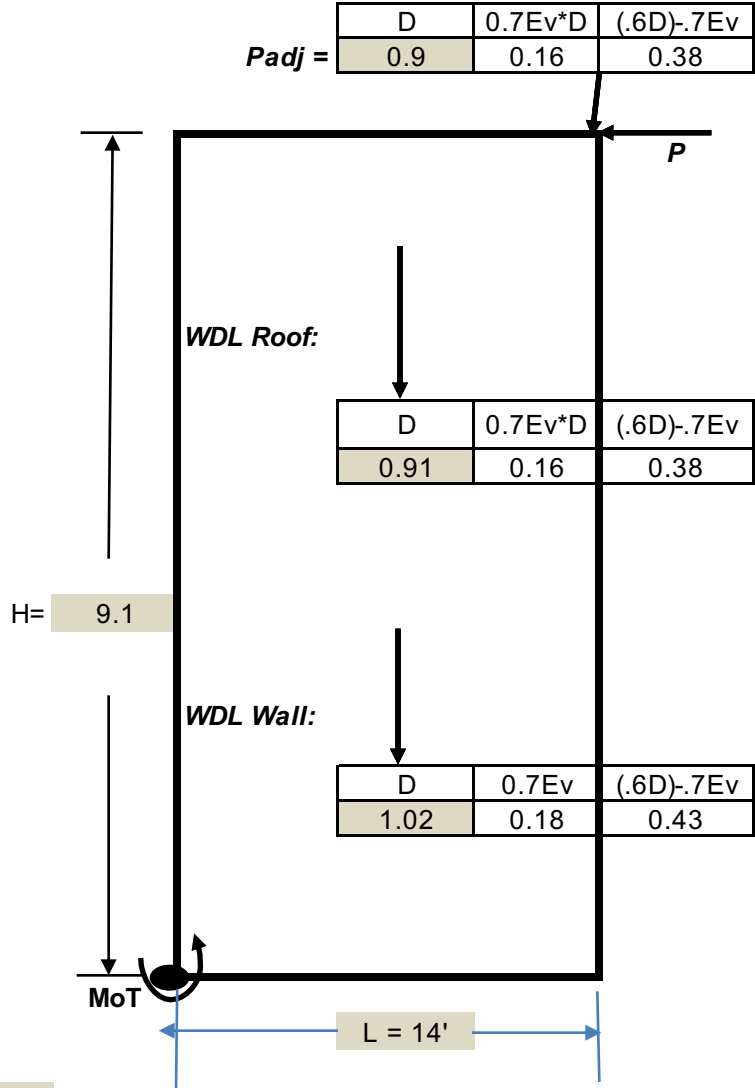
S<sub>ds</sub> = 1.28 From Cs Calculations

.7(0.2\*S<sub>ds</sub>) = 0.18

MR = [(0.38).43)x0.5x14+0.38x14] = 10.98 kip - ft

F =  $\frac{MoT - MR}{L}$  = 2.56 kip

Positive # : Hold down required  
 Negative # : No Hold down Required



Therefore use (1)STHD14 hold downs at each end

Project: IMANI	By: RB/MJT
Client: -	Date: 9/17/21
Subject: Lateral	Page: <b>L21/</b>

**CHECK OVERTURNING FOR:**

Y2 (Quake)

L =	6.25	ft
P =	245	lb/ft
P x L =	245x6.25	

1.53 kip

TLRF = 5 ft (conservative)

<i>P</i> adj =	D	0.7Ev*D	(.6D)-.7Ev
	0.3	0.05	0.13

MoT = 1.53x9.1 = 13.93 kip - ft

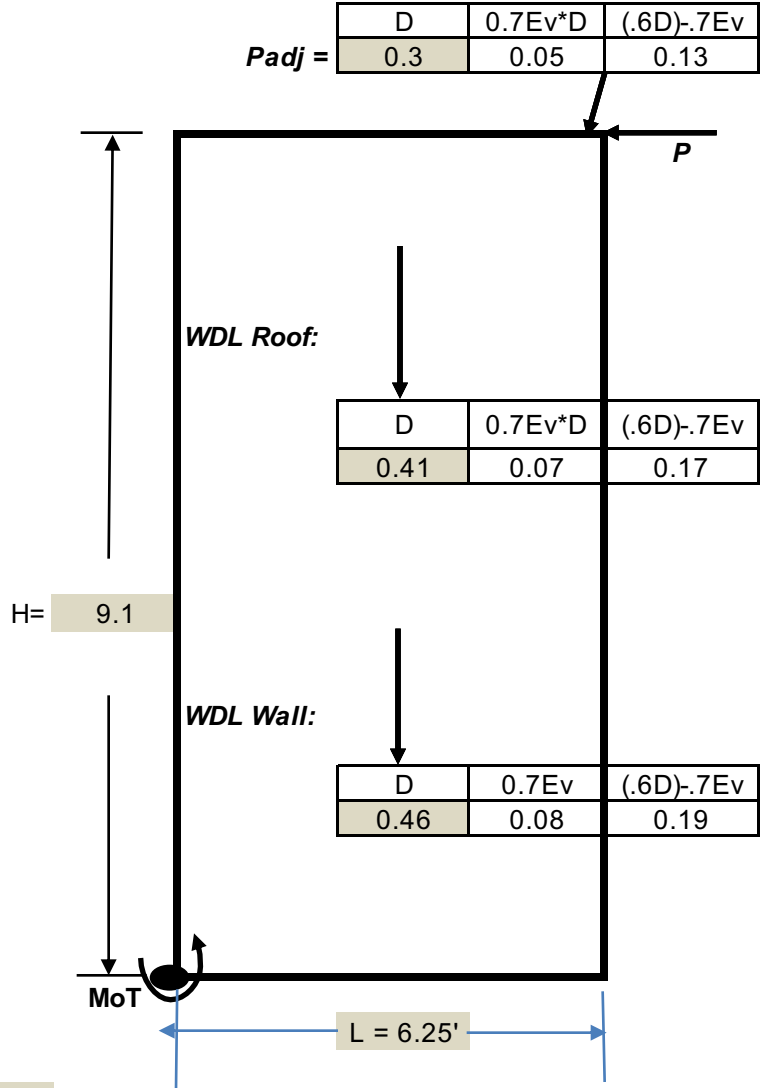
S<sub>ds</sub> = 1.28 From Cs Calculations

.7(0.2\*S<sub>ds</sub>) = 0.18

MR = [(0.17+0.19)x0.5x6.25+0.14x6.25] = 1.92 kip - ft

F = MoT - MR / L = 1.92 kip

Positive # : Hold down required  
 Negative # : No Hold down Required



Therefore use (1)CS16 hold downs at each end



Project: IMANI	By: RB/MJT
Client: -	Date: 9/17/21
Subject: Lateral	Page: <b>L22/22</b>

**CHECK OVERTURNING FOR:**

Y6 (Quake)

L =	2.75	ft
P =	450	lb/ft
P x L =	440x2.75	

1.24 kip

TLRF = 5 ft (conservative)

<i>P</i> <sub>adj</sub> =	D	0.7E <sub>v</sub> *D	(.6D)-.7E <sub>v</sub>
	0.6	0.11	0.25

MoT = 1.24x10 = 12.38 kip - ft

S<sub>ds</sub> = 1.28 From Cs Calculations

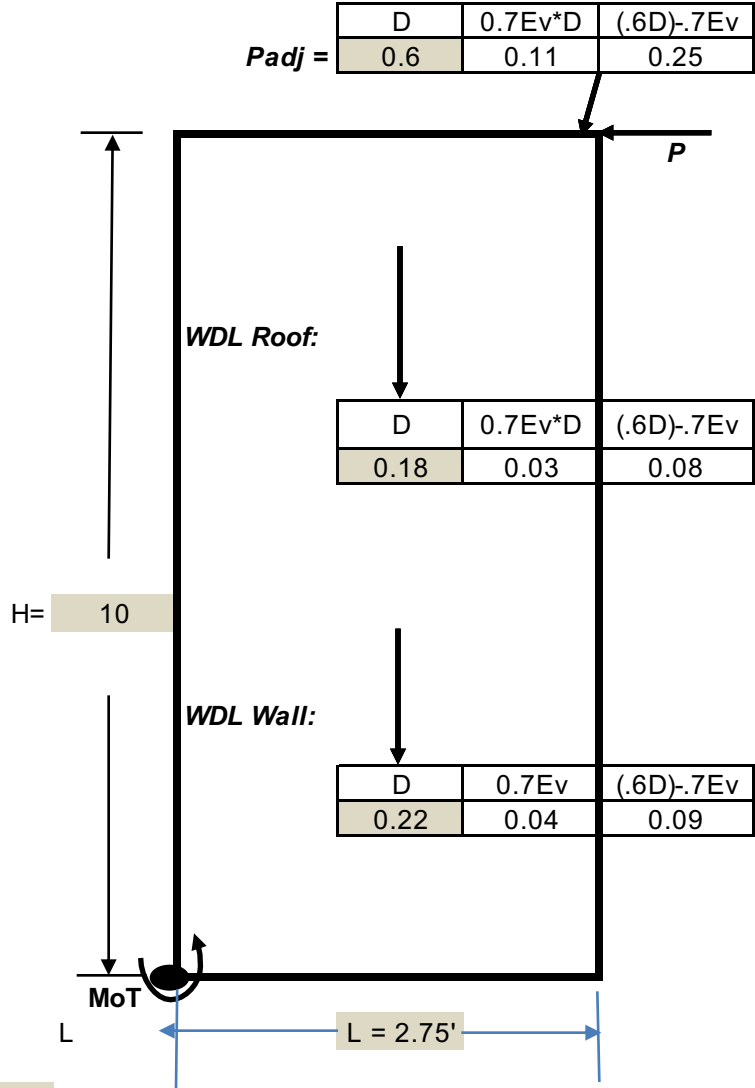
.7(0.2\*S<sub>ds</sub>) = 0.18

MR = [(0.08+0.09)x0.5x2.75+0.25x2.75] = 0.93 kip - ft

F =  $\frac{MoT - MR}{L}$  = 3.74 kip

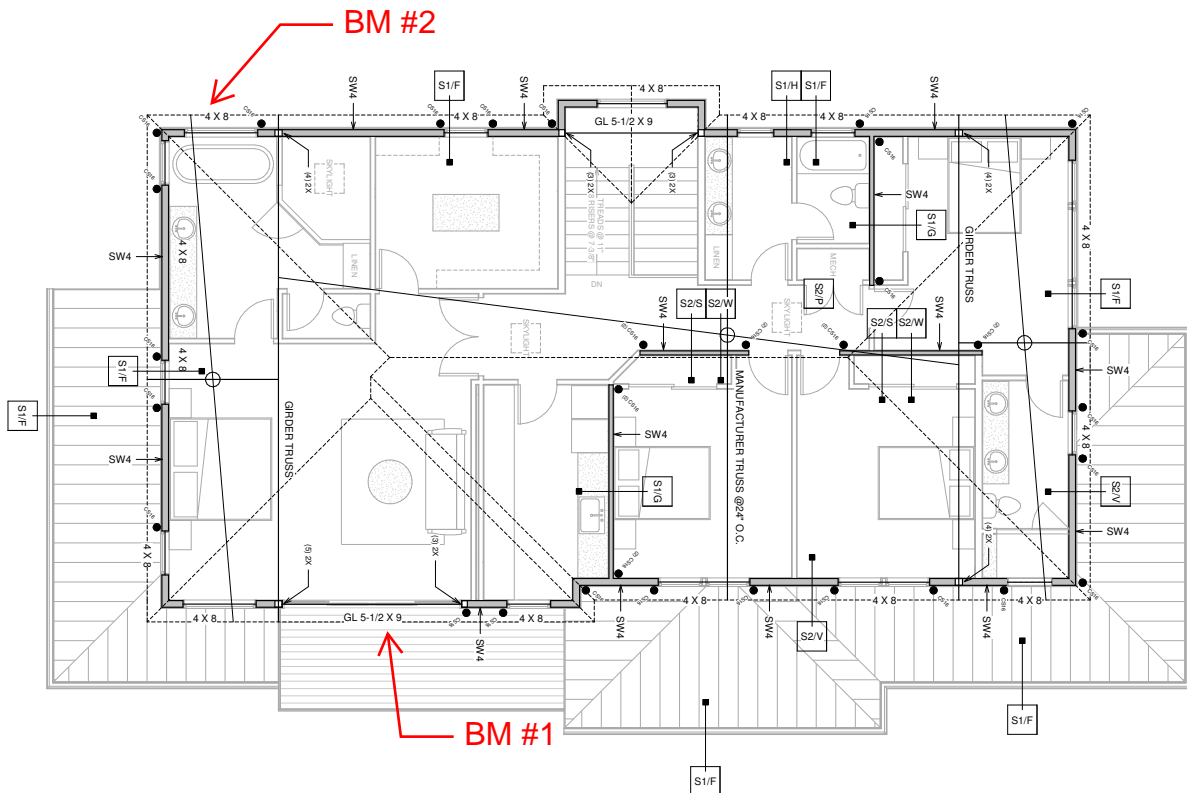
Positive # : Hold down required

Negative # : No Hold down Required



Therefore use (2)CS16 or STHD14 hold downs at each end

## BEAM KEY PLAN



**MILTON LAM  
ARCHITECTS**

ARCHITECTURAL ARCHITECTS  
PO BOX 523, KIRKLAND, WA 98083  
COMMERCIAL ARCHITECTS  
MILTON LAM 365 3037267  
MILTON LAM 365 3037267  
MLA@MLA110.COM  
Client Name: IMANI  
Project Address: 1423 17th Ave SE  
KIRKLAND, WA 98040

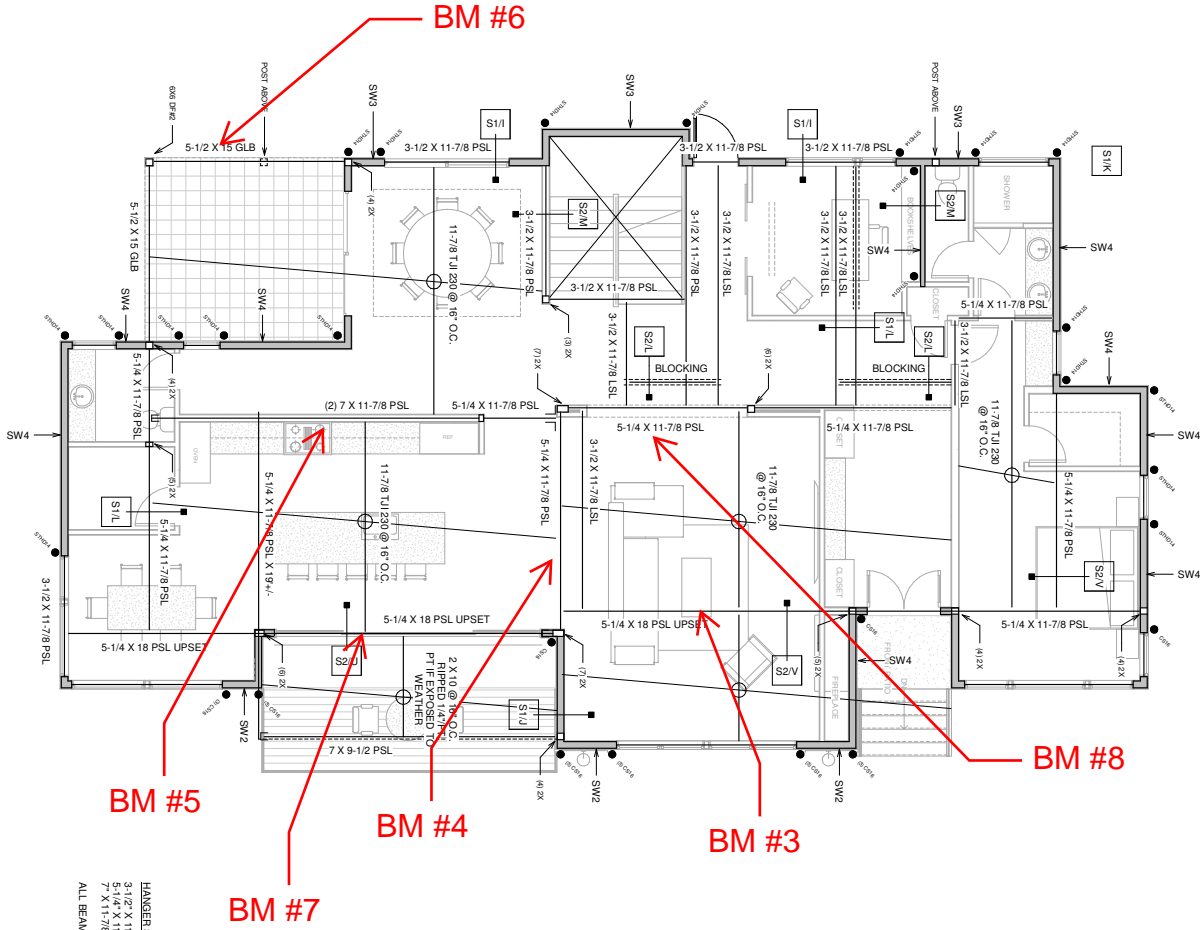
No.	Description	Date

**IMANI**  
MERCER ISLAND

**ROOF FRAMING PLAN**  
SFP3

Project Number: 23224  
Date: 12/22/21  
Drawn By: LTB  
Checked by: M.L.A.  
Scale: 1/4" = 1'-0"

**BEAM KEY PLAN**



HANGER SCHEDULE  
 3-1/2 X 11-7/8 - HQS412  
 5-1/4 X 11-7/8 - HQS412  
 7 X 11-7/8 - HQS72912  
 ALL BEAMS ARE FLUSH UNO.



**MILTON LAM ARCHITECTS**

ARCHITECTURAL ARCHITECTS  
 PO BOX 523, KIRKLAND, WA 98083  
 CONTACT  
 MILTON LAM 362-303787  
 M.L.A. @ MILTONLAM.COM  
 CHARTERS  
 B.A.M.  
 Project Address  
 1420 37th Ave SE  
 MERCER ISLAND, WA 98060

No.	Description	Date

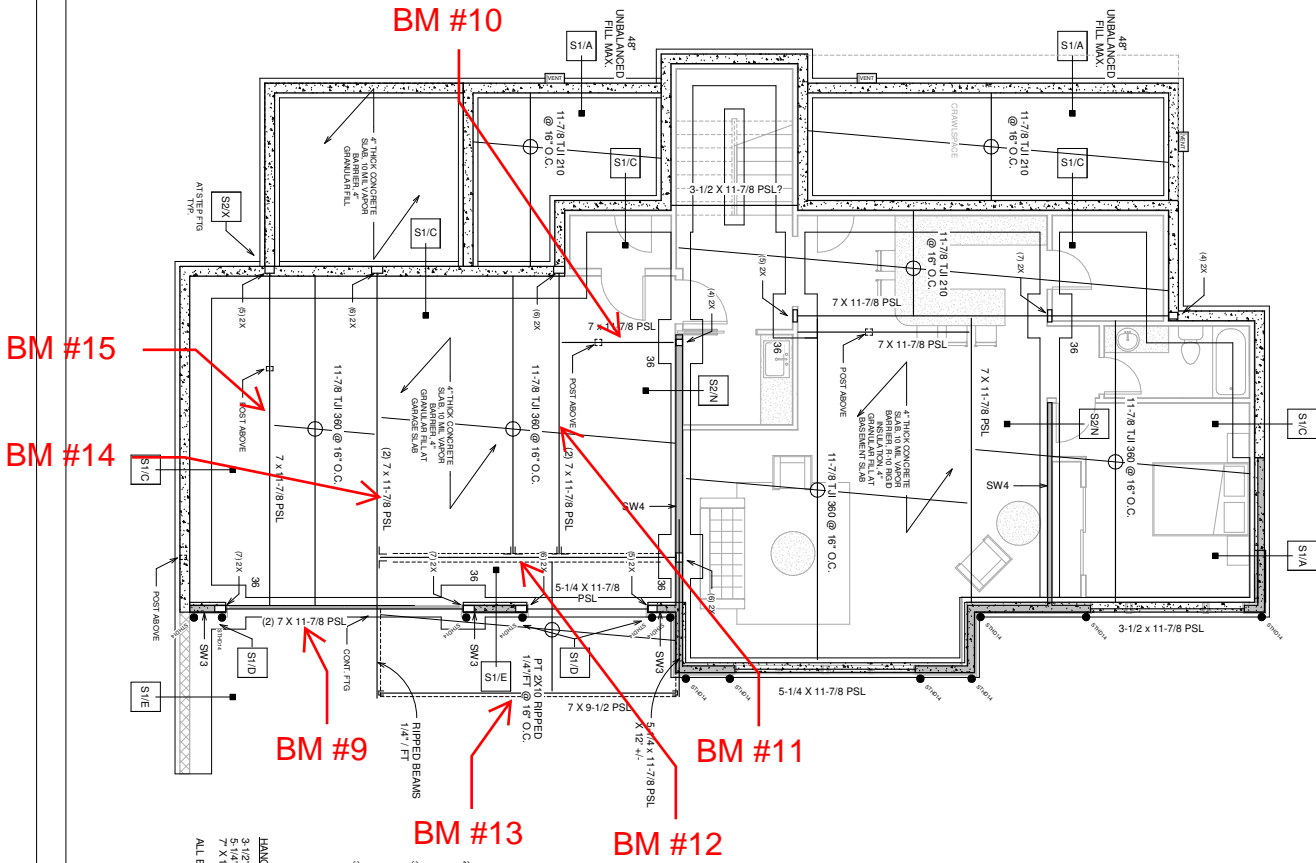
IMANI  
 MERCER ISLAND  
 UPPER FLOOR FRAMING  
 PLAN

Project Number: 23224  
 Date: 1/22/21  
 Drawn by: M.L.A.  
 Checked by: M.L.A.

**SFP2**

Scale: 1/4" = 1'-0"

# BEAM KEY PLAN



**BEAM SCHEDULE**

3-1/2 X 11-7/8" - HQJ5412	36
5-1/4 X 11-7/8" - HQJ555/12	30
7 X 11-7/8" - HQJ5725/12	36
ALL BEAMS ARE FLUSH UNO.	



**MILTON LAM ARCHITECTS**

ARCHITECTURAL ARCHITECTS  
 1200 1/2 AVENUE SE  
 PORTLAND, OREGON 97202

CONTACT: MILTON LAM 503.303.7877  
 M.LAM@MLA-ARCH.COM  
 CHAIRPERSON: MILTON LAM

PROJECT ADDRESS: 1425 1/2 AVENUE SE  
 MERCER ISLAND, WA 98040

NO.	DESCRIPTION	DATE

**FOUNDATION PLAN**

PROJECT NO: 21224  
 DATE: 12/21/18  
 DRAWN BY: M.L.A.  
 CHECKED BY: M.L.A.

**SFP1**

1/4" = 1'-0"

**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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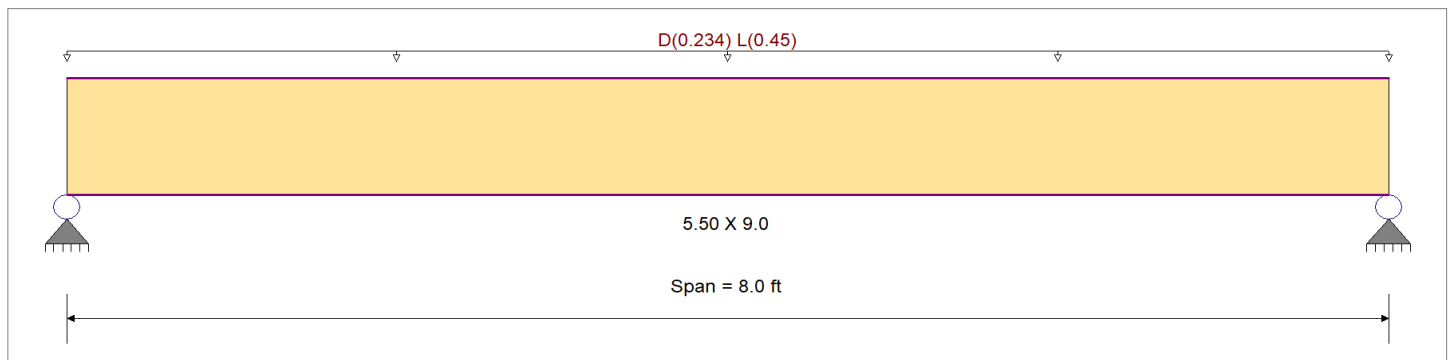
**DESCRIPTION: BM #1**

**CODE REFERENCES**

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

**Material Properties**

Analysis Method : Allowable Stress Design	Fb +	2,400.0 psi	<i>E : Modulus of Elasticity</i>	
Load Combination : ASCE 7-16	Fb -	1,850.0 psi	Ebend- xx	1,800.0ksi
	Fc - Prll	1,650.0 psi	Eminbend - xx	950.0ksi
Wood Species : DF/DF	Fc - Perp	650.0 psi	Ebend- yy	1,600.0ksi
Wood Grade : 24F-V4	Fv	265.0 psi	Eminbend - yy	850.0ksi
	Ft	1,100.0 psi	Density	31.210pcf
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling				



**Applied Loads**

Service loads entered. Load Factors will be applied for calculations.

Uniform Load : D = 0.0130, L = 0.0250 ksf, Tributary Width = 18.0 ft

**DESIGN SUMMARY**

**Design OK**

<b>Maximum Bending Stress Ratio</b>	=	<b>0.368</b> : 1	<b>Maximum Shear Stress Ratio</b>	=	<b>0.256</b> : 1
Section used for this span		<b>5.50 X 9.0</b>	Section used for this span		<b>5.50 X 9.0</b>
fb: Actual	=	884.36 psi	fv: Actual	=	67.78 psi
Fb: Allowable	=	2,400.00 psi	Fv: Allowable	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	4.000ft	Location of maximum on span	=	7.270ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
<b>Maximum Deflection</b>					
Max Downward Transient Deflection	0.069 in	Ratio = 1384	>=360	Span: 1 : L Only	
Max Upward Transient Deflection	0 in	Ratio = 0	<360	n/a	
Max Downward Total Deflection	0.105 in	Ratio = 910	>=240	Span: 1 : +D+L	
Max Upward Total Deflection	0 in	Ratio = 0	<240	n/a	

**Maximum Forces & Stresses for Load Combinations**

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values						
			M	V	C <sub>d</sub>	C <sub>F/V</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	F'b	V	fv	F'v				
D Only	Length = 8.0 ft	1	0.140	0.097	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.87	302.55	2160.00	0.00	0.00	0.00	0.00	0.00	238.50
+D+L	Length = 8.0 ft	1	0.368	0.256	1.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	5.47	884.36	2400.00	0.00	0.00	0.00	0.00	0.00	265.00
+D+0.750L	Length = 8.0 ft	1	0.246	0.171	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	4.57	738.91	3000.00	0.00	0.00	0.00	0.00	0.00	331.25
+0.60D	Length = 8.0 ft	1	0.047	0.033	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.12	181.53	3840.00	0.00	0.00	0.00	0.00	0.00	424.00

**Overall Maximum Deflections**

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.1054	4.029		0.0000	0.000

**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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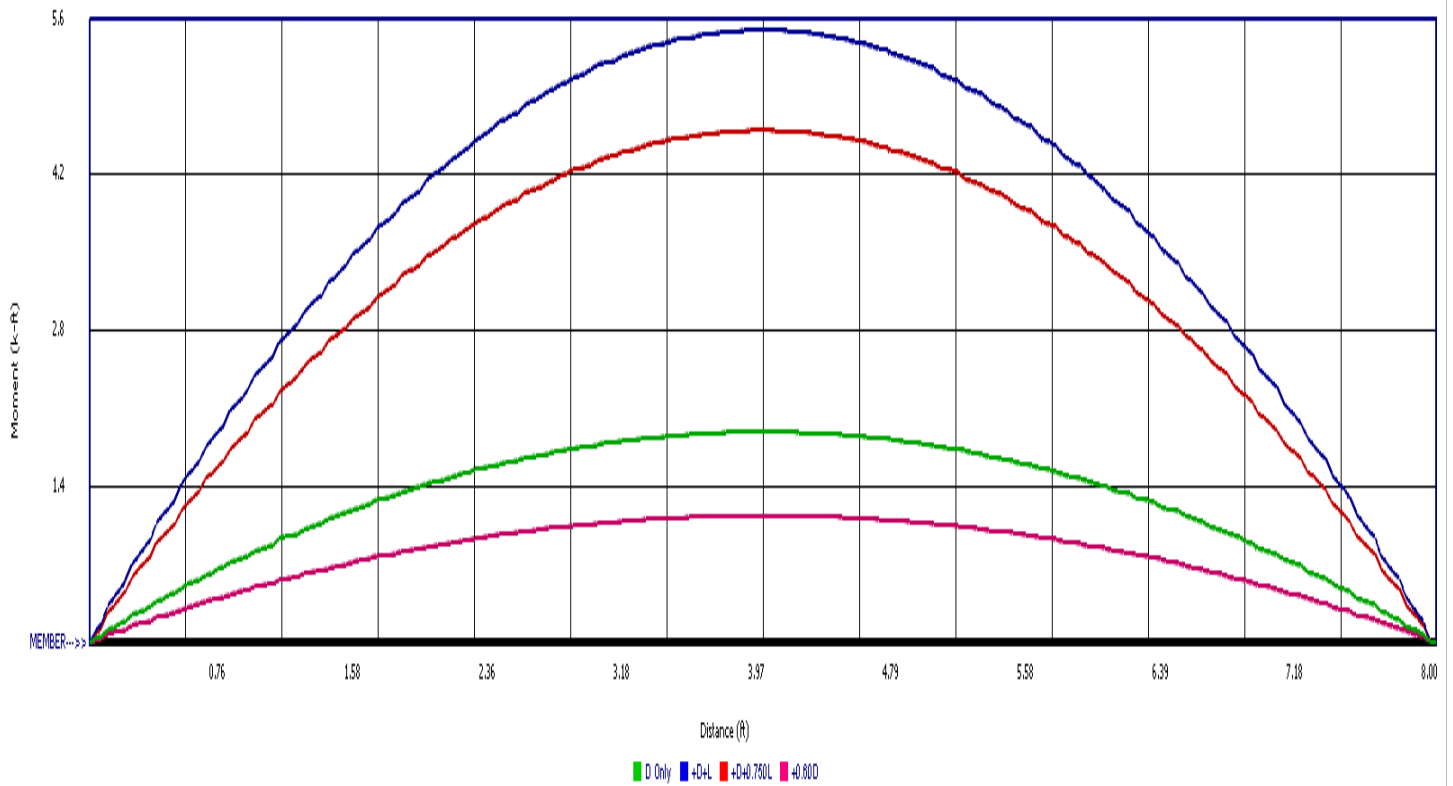
**DESCRIPTION: BM #1**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	2.736	2.736
Overall MINimum	1.800	1.800
D Only	0.936	0.936
+D+L	2.736	2.736
+D+0.750L	2.286	2.286
+0.60D	0.562	0.562
L Only	1.800	1.800



Wood Beam

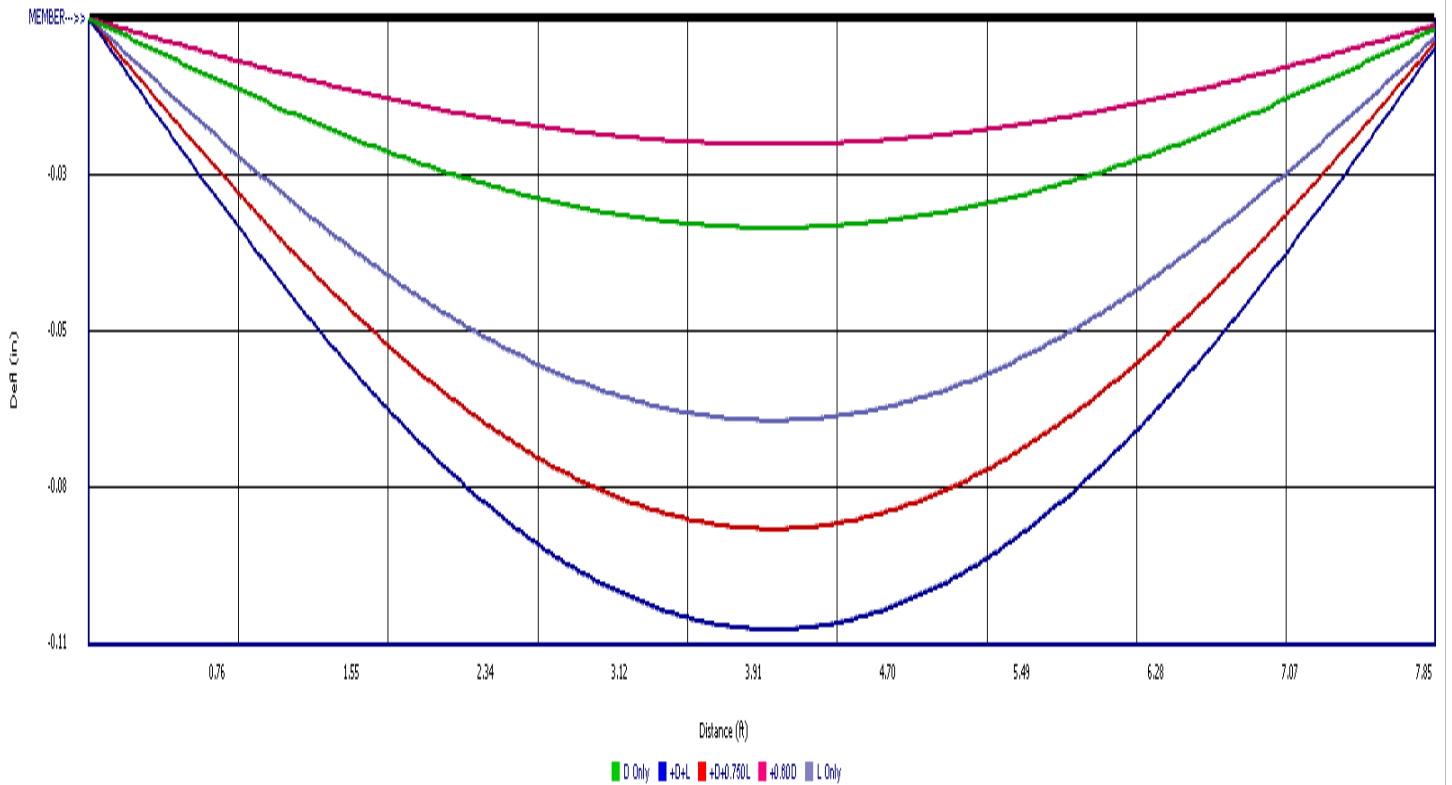
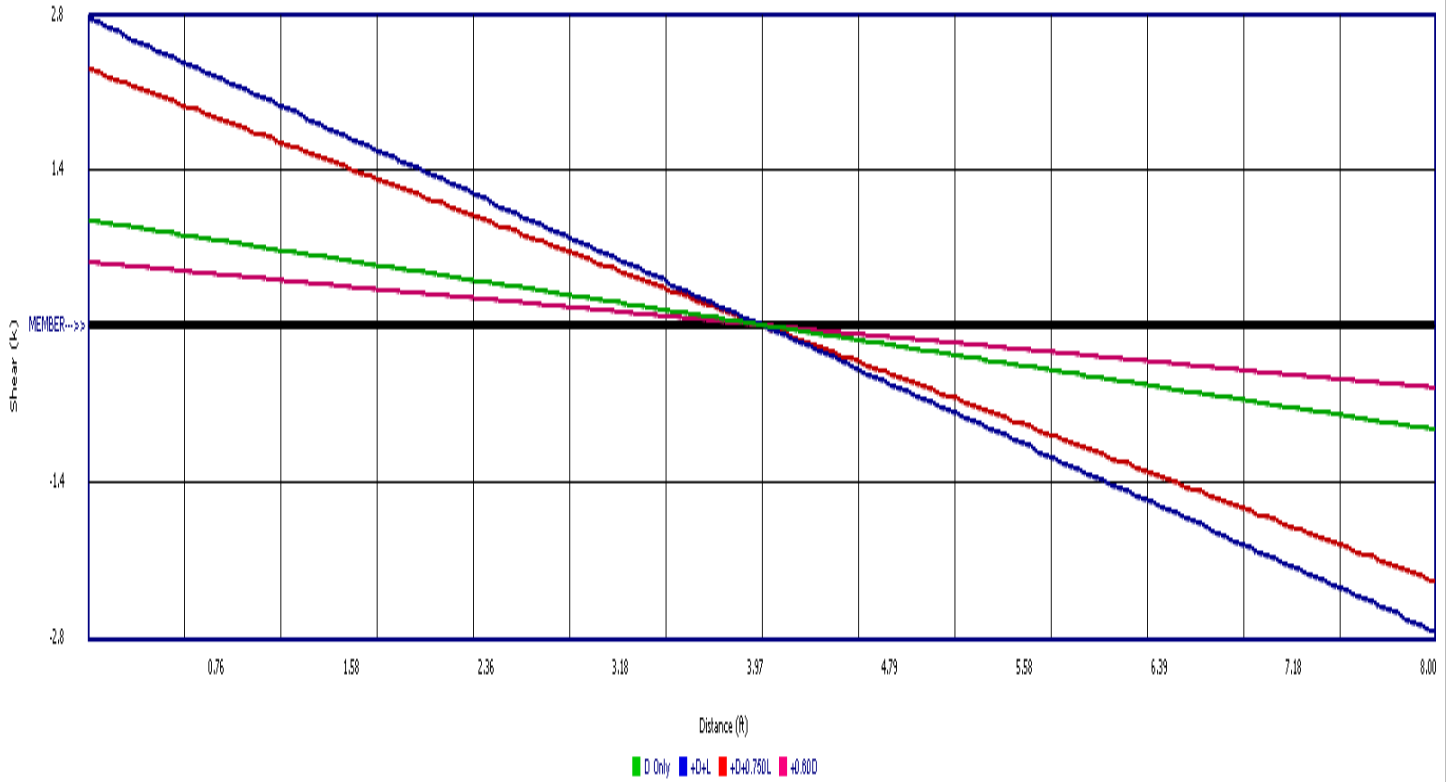
Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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DESCRIPTION: BM #1



**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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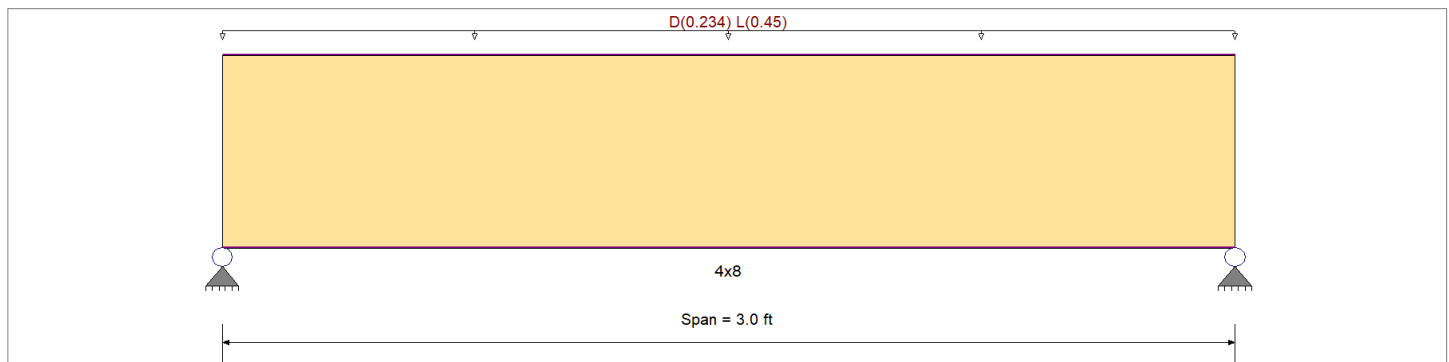
**DESCRIPTION:** BM #2

**CODE REFERENCES**

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

**Material Properties**

Analysis Method : Allowable Stress Design	Fb +	900 psi	<i>E : Modulus of Elasticity</i>	
Load Combination : ASCE 7-16	Fb -	900 psi	Ebend- xx	1600ksi
	Fc - Prll	1350 psi	Eminbend - xx	580ksi
Wood Species : Douglas Fir-Larch	Fc - Perp	625 psi		
Wood Grade : No.2	Fv	180 psi		
	Ft	575 psi	Density	31.21 pcf
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling				



**Applied Loads**

Service loads entered. Load Factors will be applied for calculations.

Uniform Load : D = 0.0130, L = 0.0250 ksf, Tributary Width = 18.0 ft

**DESIGN SUMMARY**

**Design OK**

<b>Maximum Bending Stress Ratio</b>	=	<b>0.257</b> : 1	<b>Maximum Shear Stress Ratio</b>	=	<b>0.202</b> : 1
Section used for this span		<b>4x8</b>	Section used for this span		<b>4x8</b>
fb: Actual	=	301.16 psi	fv: Actual	=	36.30 psi
Fb: Allowable	=	1,170.00 psi	Fv: Allowable	=	180.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	1.500ft	Location of maximum on span	=	0.000ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
<b>Maximum Deflection</b>					
Max Downward Transient Deflection	0.005 in	Ratio = 7760 >=360	Span: 1 : L Only		
Max Upward Transient Deflection	0 in	Ratio = 0 <360	n/a		
Max Downward Total Deflection	0.007 in	Ratio = 5105 >=240	Span: 1 : +D+L		
Max Upward Total Deflection	0 in	Ratio = 0 <240	n/a		

**Maximum Forces & Stresses for Load Combinations**

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values							
			M	V	C <sub>d</sub>	C <sub>F/V</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	F'b	V	fv	F'v					
D Only	Length = 3.0 ft	1	0.098	0.077	0.90	1.300	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.26	103.03	1053.00	0.00	0.00	0.00	0.21	12.42	162.00
+D+L	Length = 3.0 ft	1	0.257	0.202	1.00	1.300	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.77	301.16	1170.00	0.00	0.00	0.00	0.61	36.30	180.00
+D+0.750L	Length = 3.0 ft	1	0.172	0.135	1.25	1.300	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.64	251.63	1462.50	0.00	0.00	0.00	0.51	30.33	225.00
+0.60D	Length = 3.0 ft	1	0.033	0.026	1.60	1.300	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.16	61.82	1872.00	0.00	0.00	0.00	0.13	7.45	288.00

**Overall Maximum Deflections**

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0071	1.511		0.0000	0.000



**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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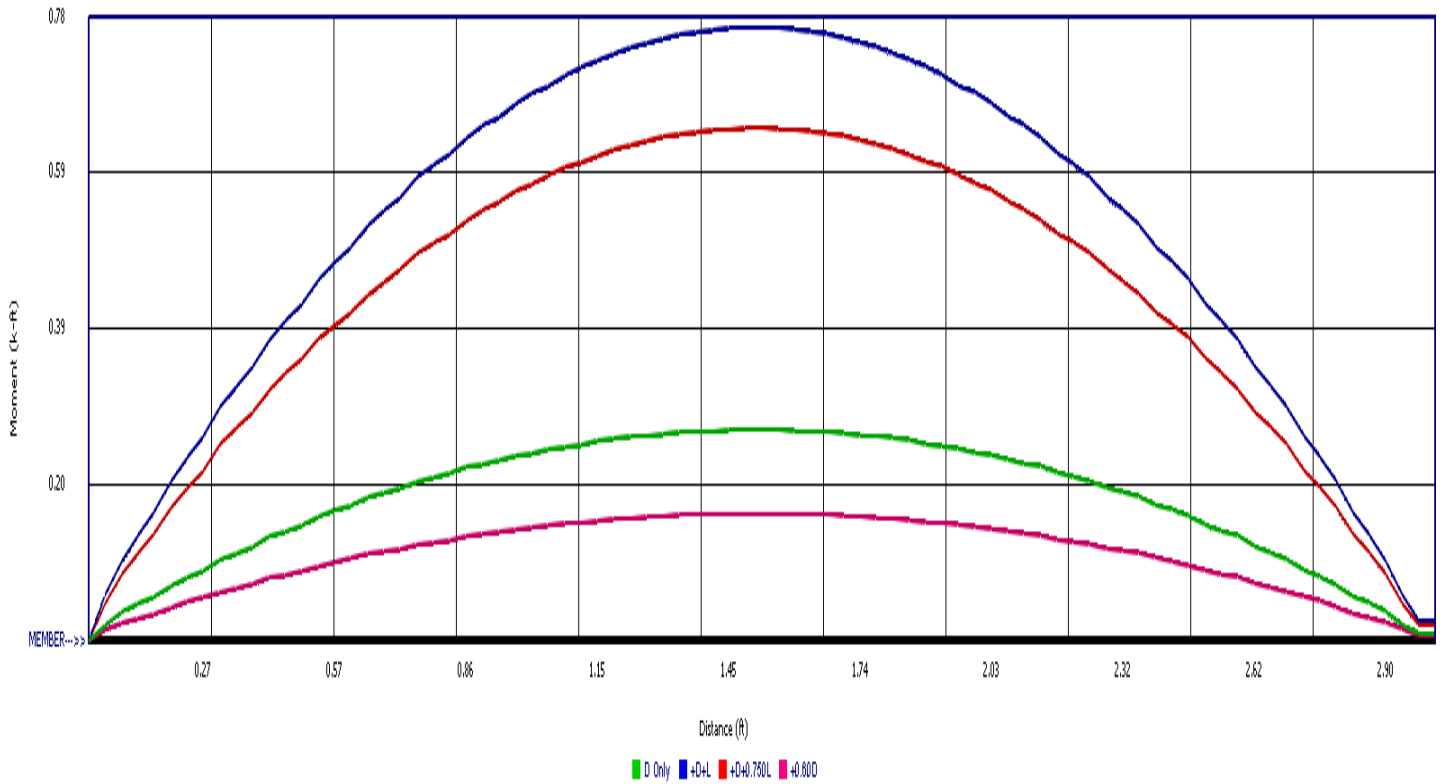
**DESCRIPTION: BM #2**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.026	1.026
Overall MINimum	0.675	0.675
D Only	0.351	0.351
+D+L	1.026	1.026
+D+0.750L	0.857	0.857
+0.60D	0.211	0.211
L Only	0.675	0.675



Wood Beam

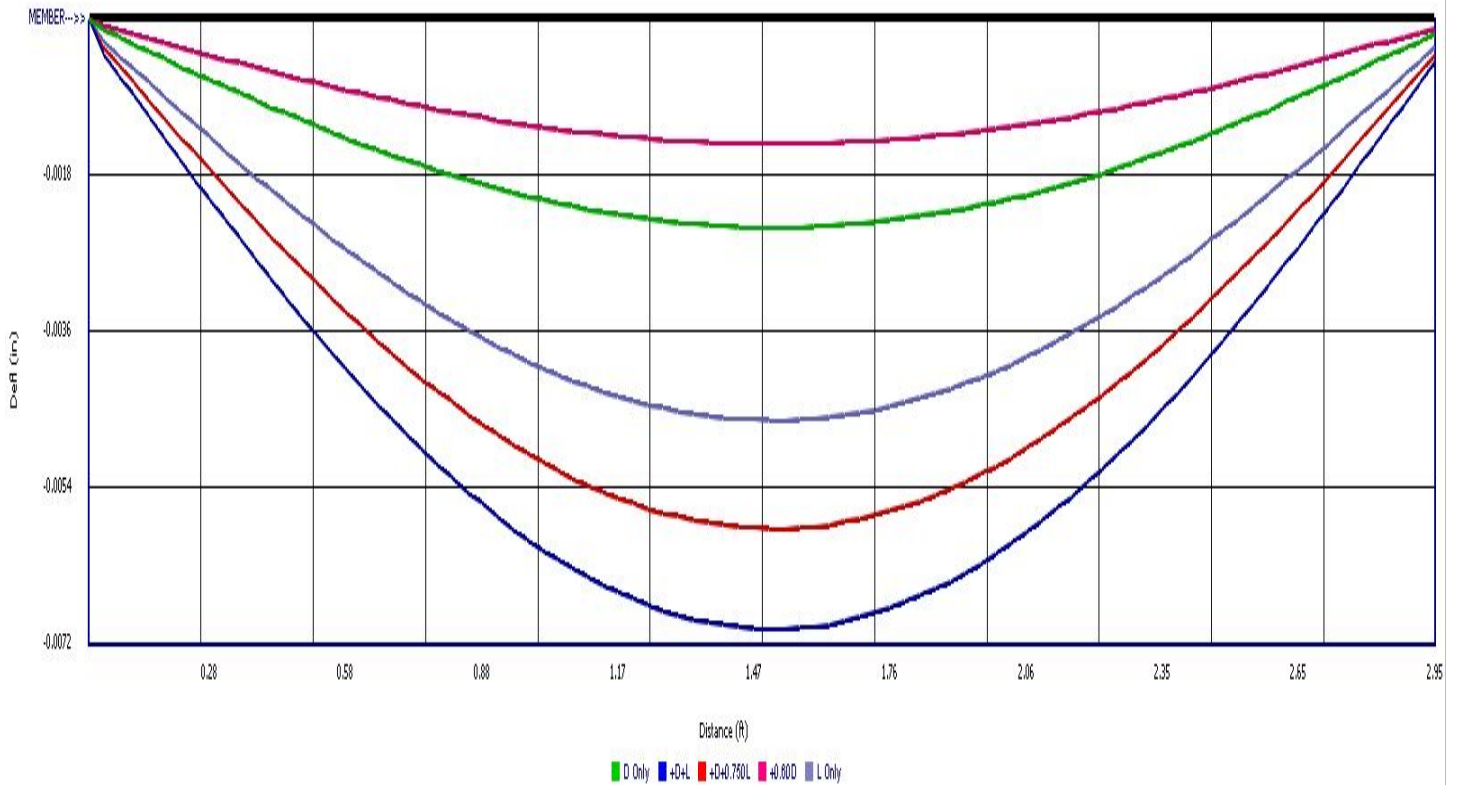
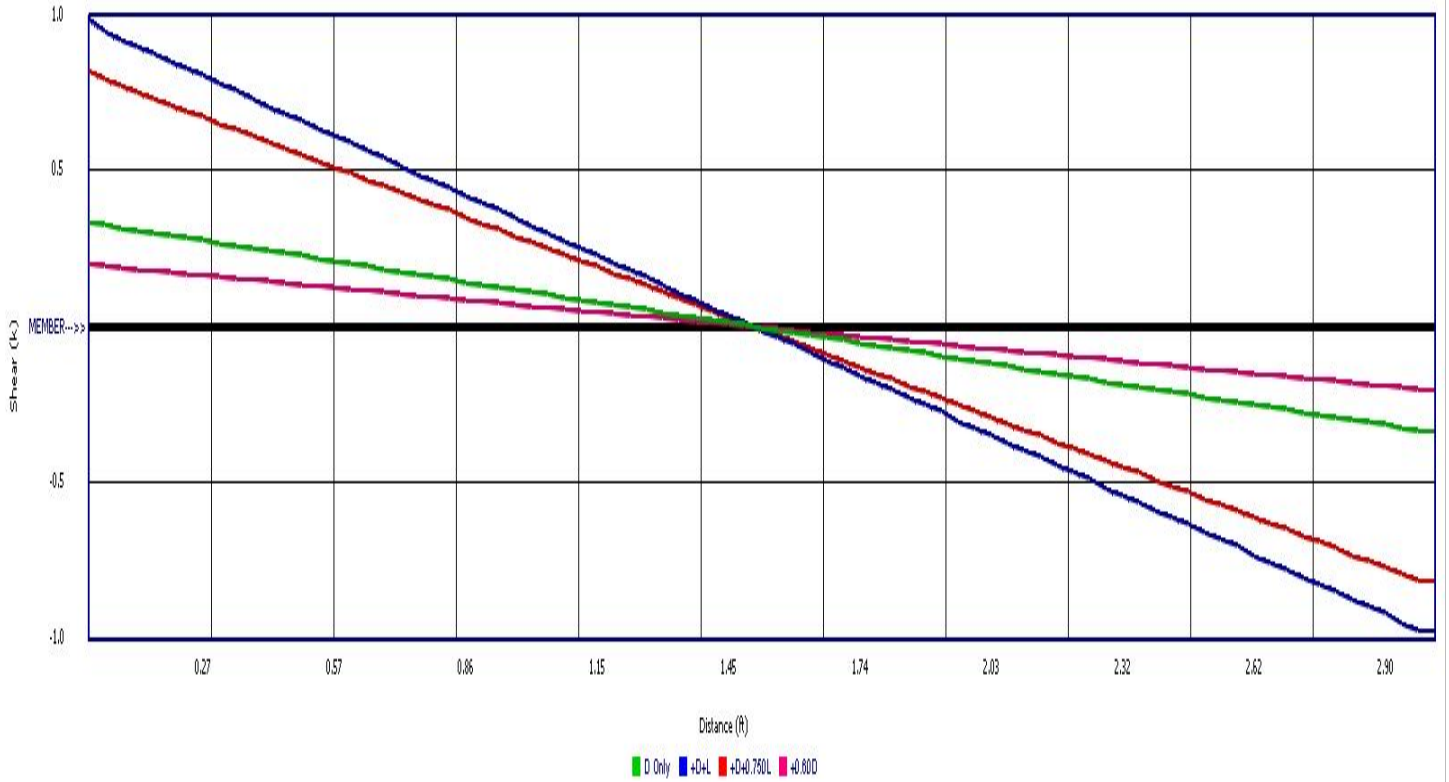
Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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DESCRIPTION: BM #2



**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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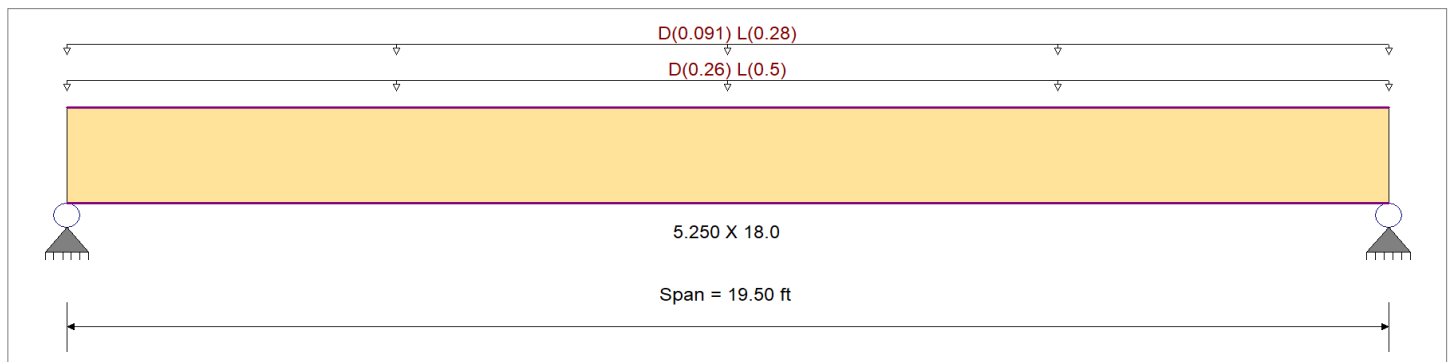
**DESCRIPTION: BM #3**

**CODE REFERENCES**

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

**Material Properties**

Analysis Method : Allowable Stress Design	Fb +	2,900.0 psi	E : Modulus of Elasticity
Load Combination : ASCE 7-16	Fb -	2,900.0 psi	Ebend- xx
	Fc - Prll	2,900.0 psi	Eminbend - xx
Wood Species : iLevel Truss Joist	Fc - Perp	750.0 psi	
Wood Grade : Parallam PSL 2.0E	Fv	290.0 psi	
	Ft	2,025.0 psi	Density
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling			45.070pcf



**Applied Loads**

Service loads entered. Load Factors will be applied for calculations.

Uniform Load : D = 0.0130, L = 0.0250 ksf, Tributary Width = 20.0 ft  
 Uniform Load : D = 0.0130, L = 0.040 ksf, Tributary Width = 7.0 ft

**DESIGN SUMMARY**

**Design OK**

<b>Maximum Bending Stress Ratio</b>	=	<b>0.785</b> : 1	<b>Maximum Shear Stress Ratio</b>	=	<b>0.511</b> : 1
Section used for this span		<b>5.250 X 18.0</b>	Section used for this span		<b>5.250 X 18.0</b>
fb: Actual	=	2,275.46 psi	fv: Actual	=	148.21 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	290.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	9.750ft	Location of maximum on span	=	18.005ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
<b>Maximum Deflection</b>					
Max Downward Transient Deflection		0.500 in Ratio = 467 >=360	Span: 1 : L Only		
Max Upward Transient Deflection		0 in Ratio = 0 <360	n/a		
Max Downward Total Deflection		0.725 in Ratio = 322 >=240	Span: 1 : +D+L		
Max Upward Total Deflection		0 in Ratio = 0 <240	n/a		

**Maximum Forces & Stresses for Load Combinations**

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values									
			M	V	C <sub>d</sub>	C <sub>F/V</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	F'b	V	fv	F'v							
D Only	Length = 19.50 ft	1	0.271	0.176	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	16.68	706.18	2610.00	0.00	0.00	0.00	2.90	45.99	261.00
+D+L	Length = 19.50 ft	1	0.785	0.511	1.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	53.76	2,275.46	2900.00	0.00	0.00	0.00	9.34	148.21	290.00
+D+0.750L	Length = 19.50 ft	1	0.519	0.338	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	44.49	1,883.14	3625.00	0.00	0.00	0.00	7.73	122.65	362.50
+0.60D	Length = 19.50 ft	1	0.091	0.059	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	10.01	423.71	4640.00	0.00	0.00	0.00	1.74	27.60	464.00

**Overall Maximum Deflections**

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.7252	9.821		0.0000	0.000

**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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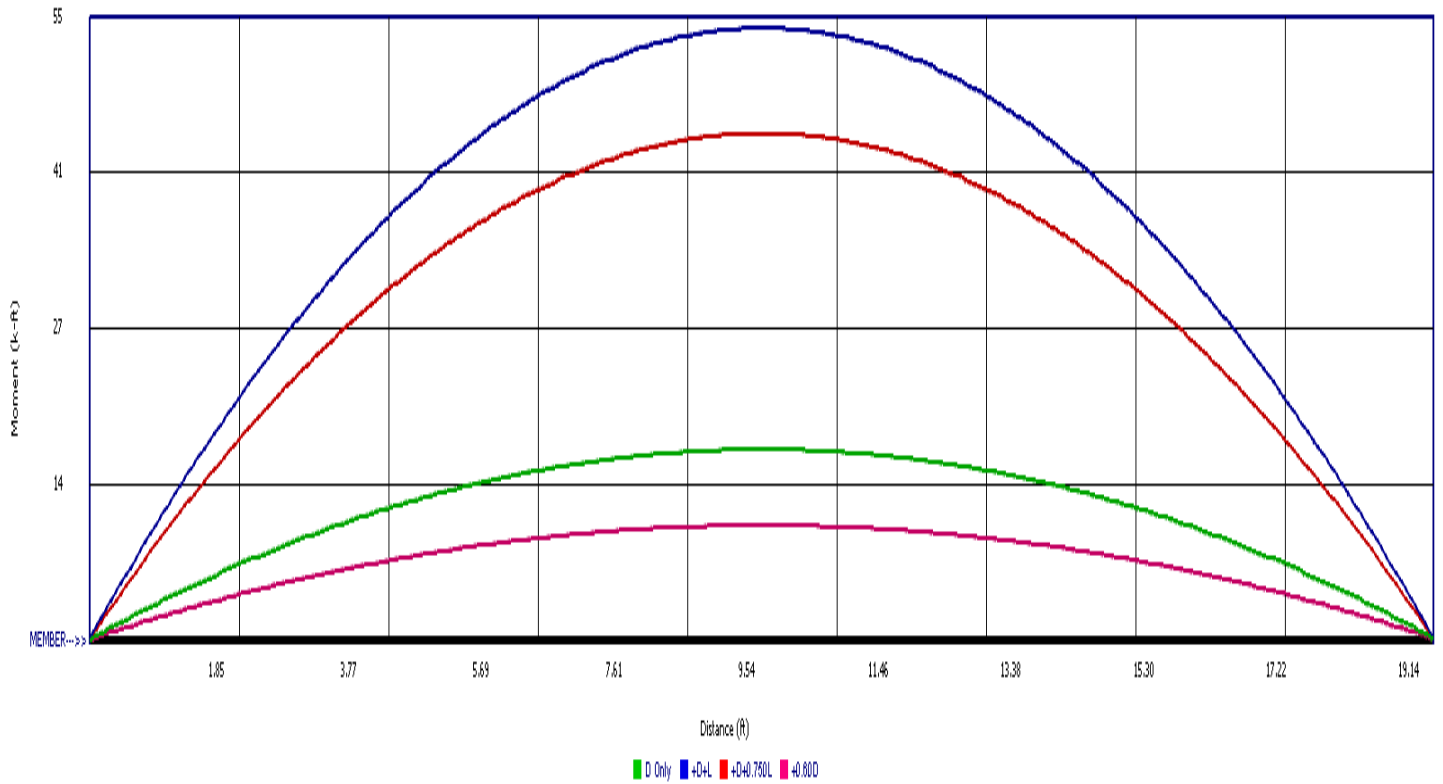
**DESCRIPTION: BM #3**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	11.027	11.027
Overall MINimum	7.605	7.605
D Only	3.422	3.422
+D+L	11.027	11.027
+D+0.750L	9.126	9.126
+0.60D	2.053	2.053
L Only	7.605	7.605



**Wood Beam**

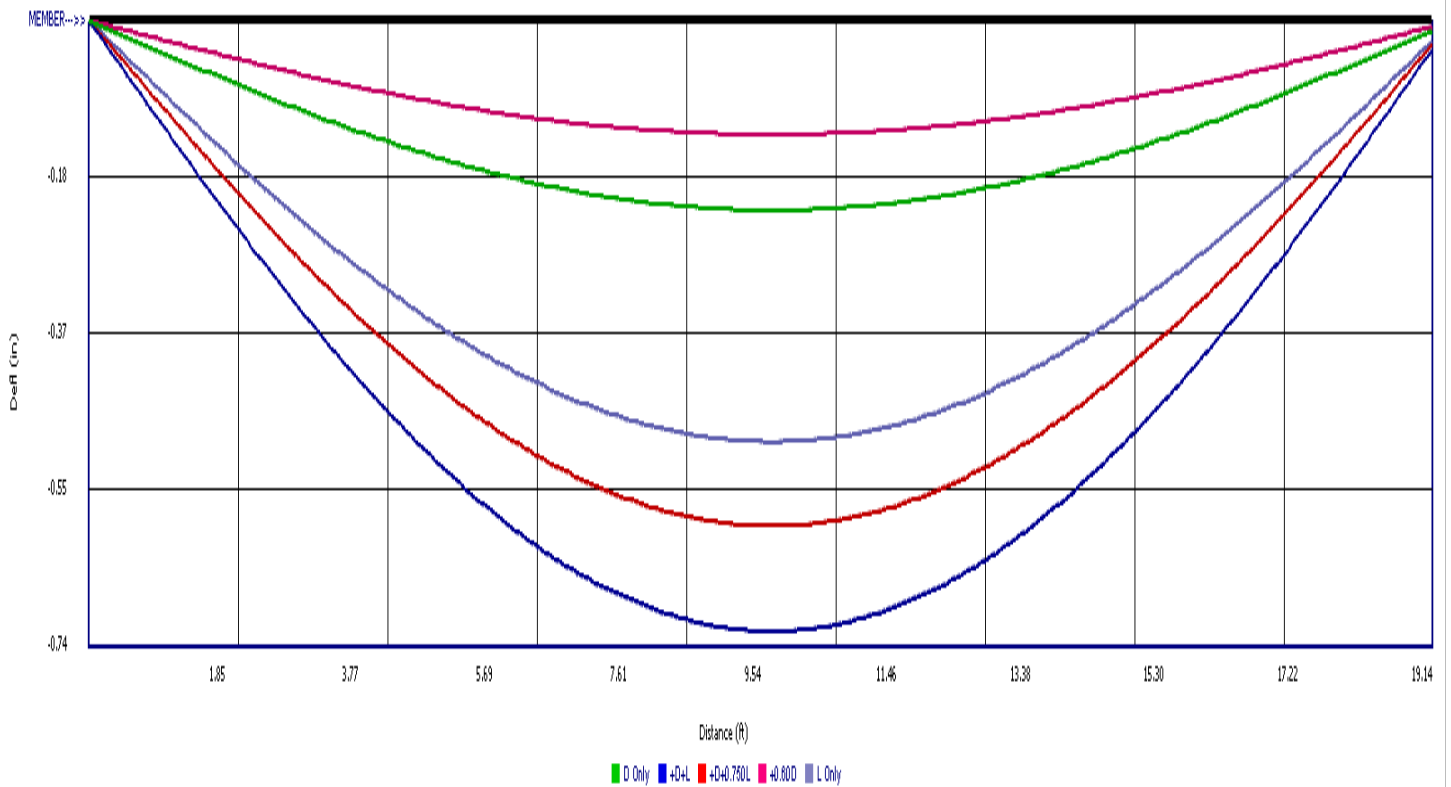
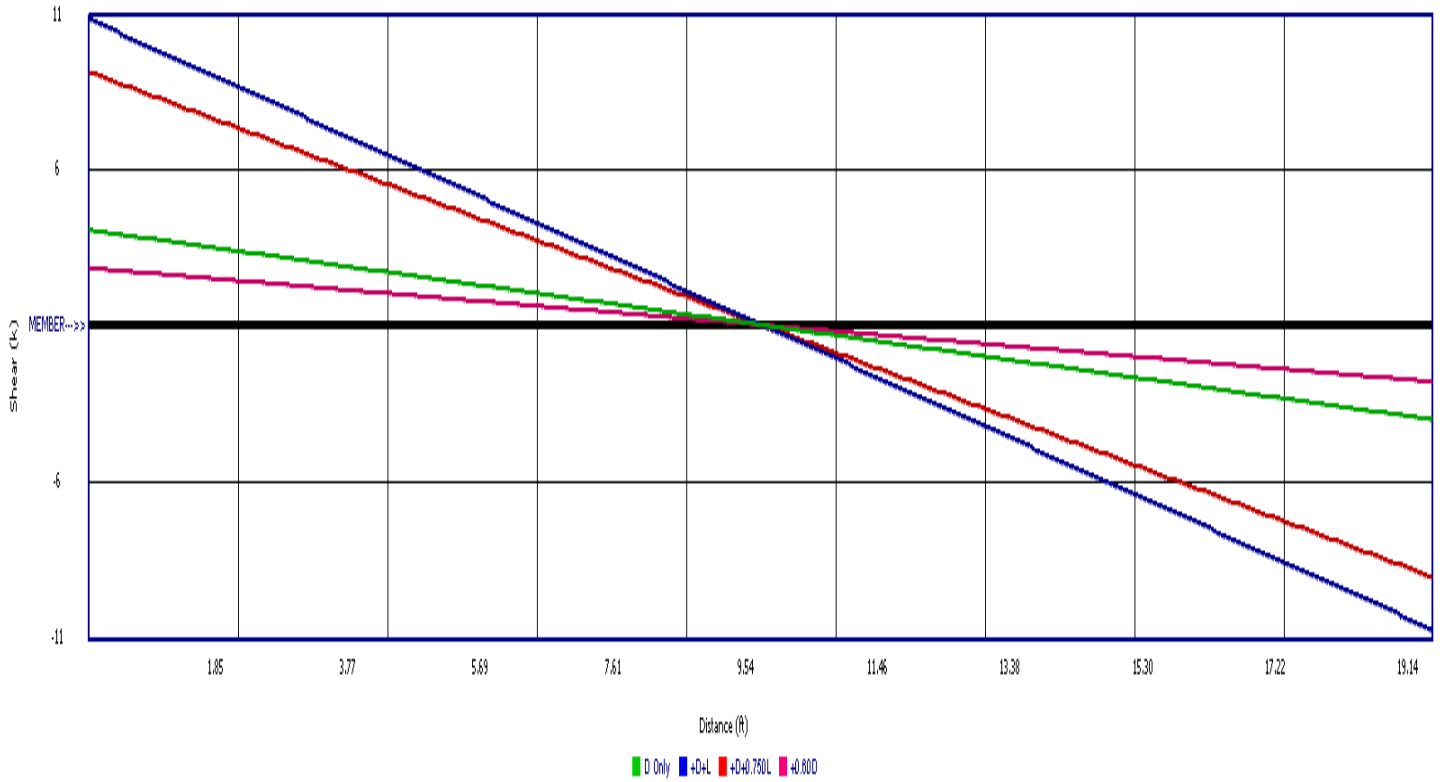
Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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**DESCRIPTION: BM #3**



**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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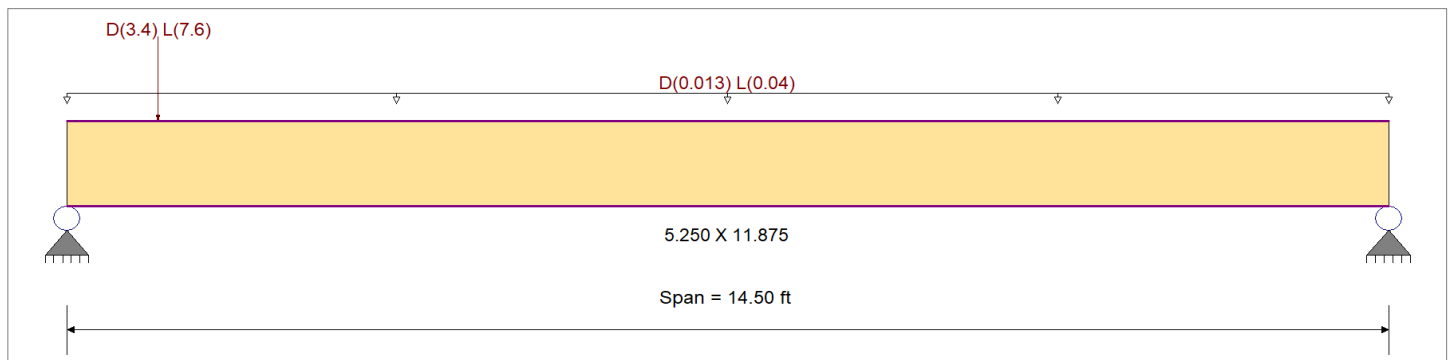
**DESCRIPTION: BM #4**

**CODE REFERENCES**

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

**Material Properties**

Analysis Method : Allowable Stress Design	Fb +	2,900.0 psi	E : Modulus of Elasticity	
Load Combination : ASCE 7-16	Fb -	2,900.0 psi	Ebend- xx	2,000.0ksi
	Fc - Prll	2,900.0 psi	Eminbend - xx	1,016.54ksi
Wood Species : iLevel Truss Joist	Fc - Perp	750.0 psi		
Wood Grade : Parallam PSL 2.0E	Fv	290.0 psi		
	Ft	2,025.0 psi	Density	45.070pcf
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling				



**Applied Loads**

Service loads entered. Load Factors will be applied for calculations.

Point Load : D = 3.40, L = 7.60 k @ 1.0 ft  
 Uniform Load : D = 0.0130, L = 0.040 ksf, Tributary Width = 1.0 ft

**DESIGN SUMMARY**

**Design OK**

<b>Maximum Bending Stress Ratio</b>	=	<b>0.355</b> : 1	<b>Maximum Shear Stress Ratio</b>	=	<b>0.877</b> : 1
Section used for this span		<b>5.250 X 11.875</b>	Section used for this span		<b>5.250 X 11.875</b>
fb: Actual	=	1,030.58 psi	fv: Actual	=	254.44 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	290.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	1.005ft	Location of maximum on span	=	0.000ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
<b>Maximum Deflection</b>					
Max Downward Transient Deflection		0.148 in Ratio = 1177 >=360	Span: 1 : L Only		
Max Upward Transient Deflection		0 in Ratio = 0 <360	n/a		
Max Downward Total Deflection		0.211 in Ratio = 826 >=240	Span: 1 : +D+L		
Max Upward Total Deflection		0 in Ratio = 0 <240	n/a		

**Maximum Forces & Stresses for Load Combinations**

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values						
			M	V	C <sub>d</sub>	C <sub>F/V</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	F'b	V	fv	F'v				
D Only	Length = 14.50 ft	1	0.121	0.299	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.25	316.31	2610.00	0.00	0.00	0.00
+D+L	Length = 14.50 ft	1	0.355	0.877	1.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	10.60	1,030.58	2900.00	10.58	254.44	290.00
+D+0.750L	Length = 14.50 ft	1	0.235	0.580	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	8.76	852.01	3625.00	8.74	210.36	362.50
+0.60D	Length = 14.50 ft	1	0.041	0.101	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.95	189.79	4640.00	1.95	46.88	464.00

**Overall Maximum Deflections**

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.2106	6.350		0.0000	0.000

**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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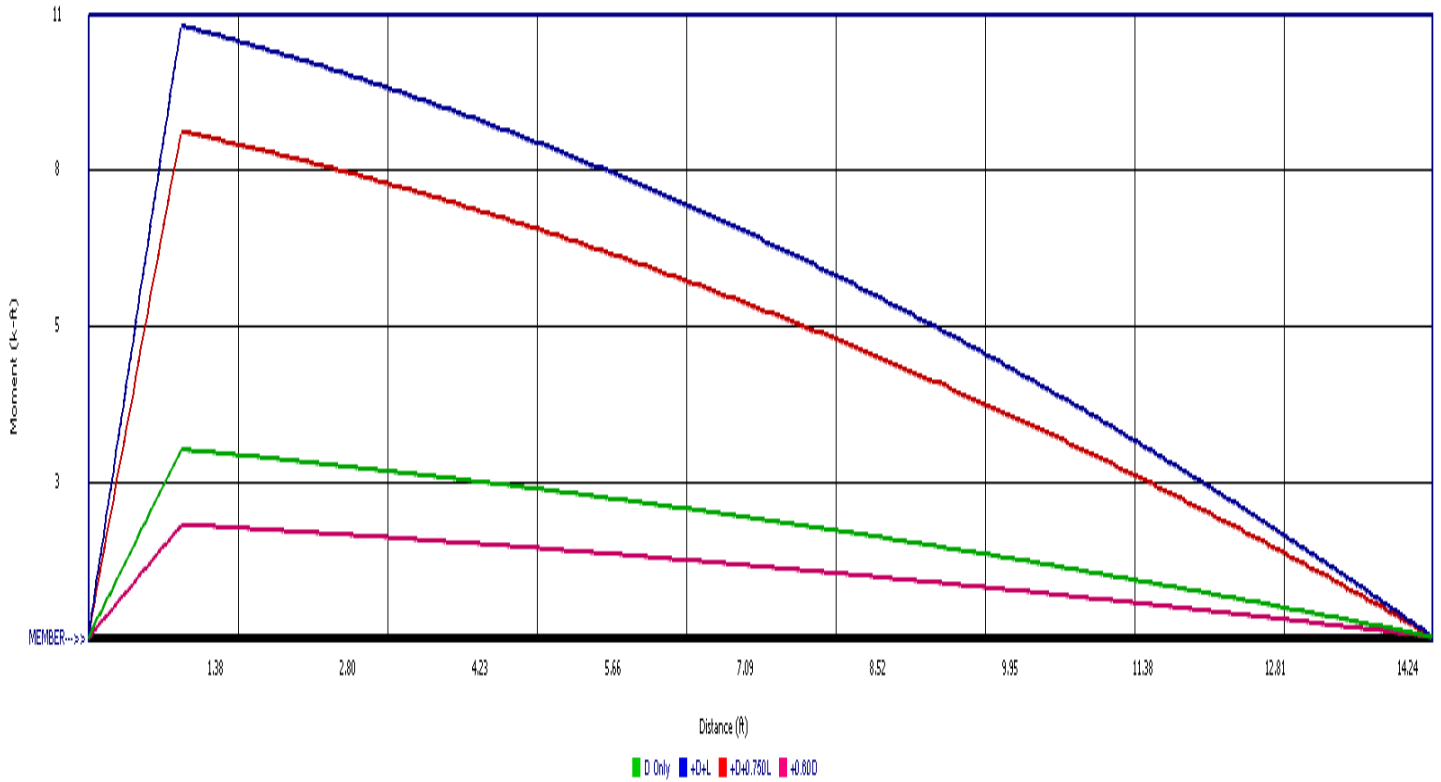
**DESCRIPTION: BM #4**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	10.626	1.143
Overall MINimum	7.366	0.814
D Only	3.260	0.329
+D+L	10.626	1.143
+D+0.750L	8.784	0.939
+0.60D	1.956	0.197
L Only	7.366	0.814



**Wood Beam**

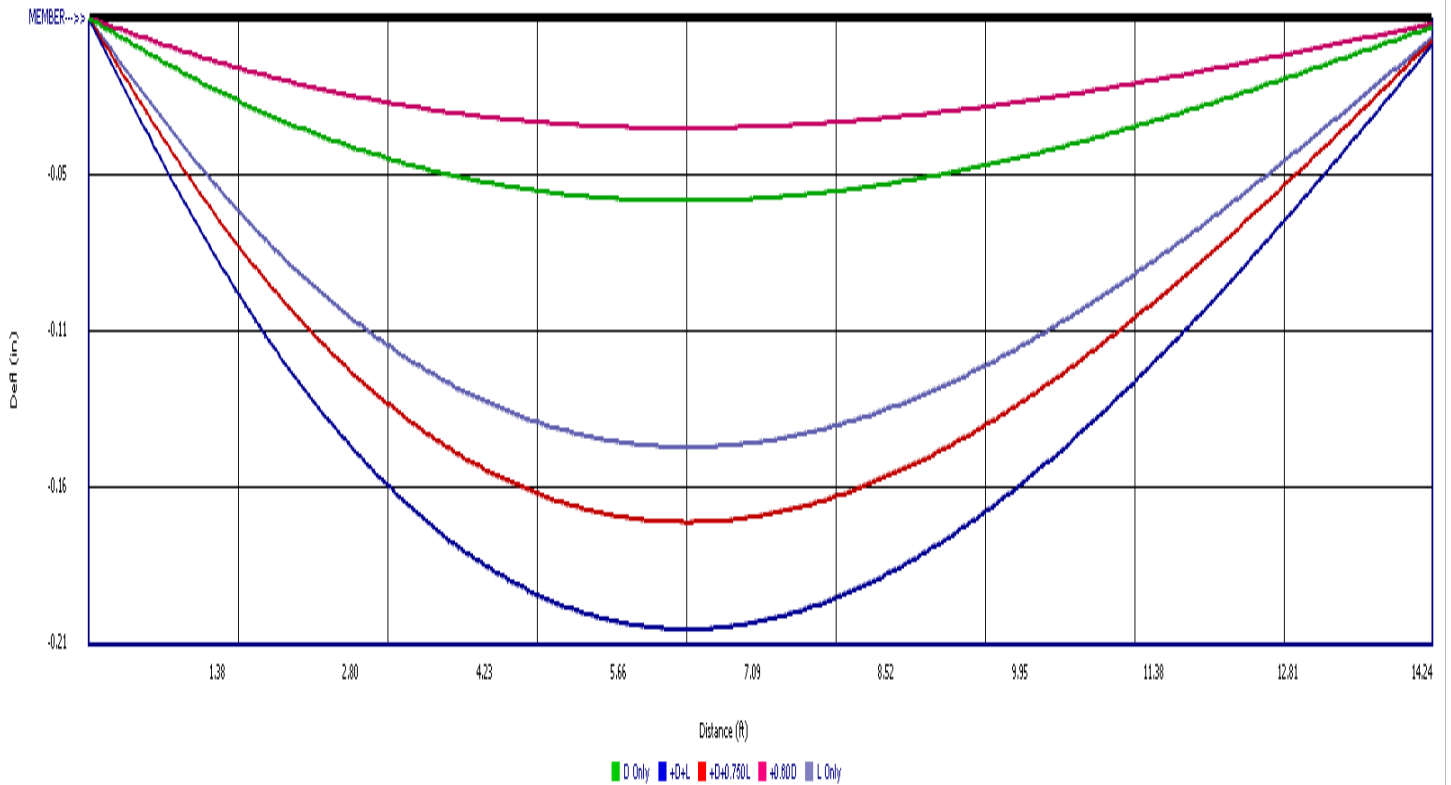
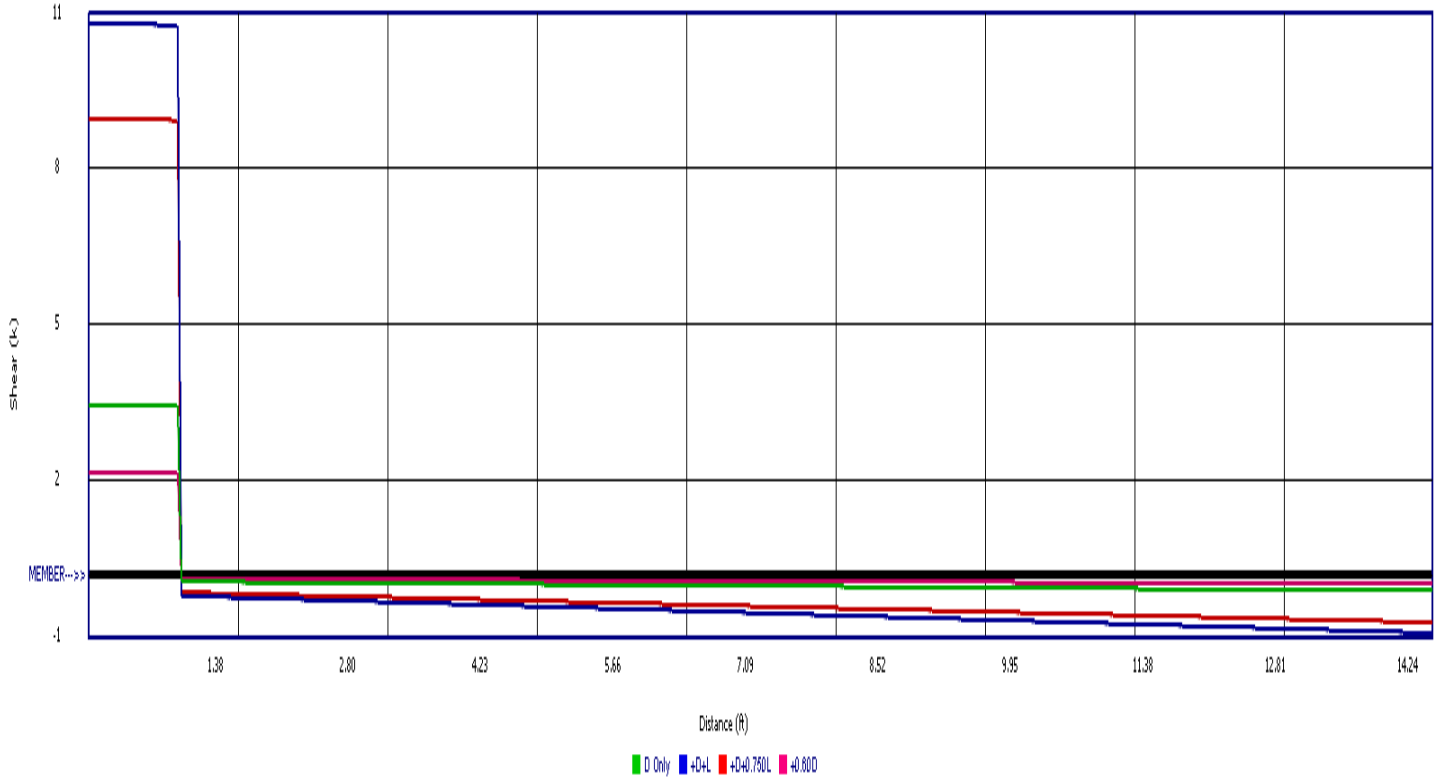
Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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**DESCRIPTION: BM #4**





**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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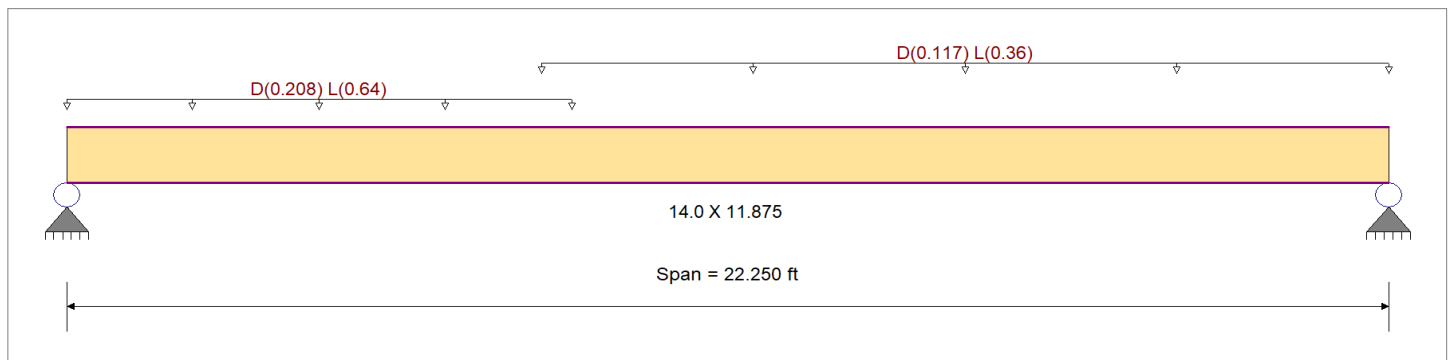
**DESCRIPTION: BM #5**

**CODE REFERENCES**

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

**Material Properties**

Analysis Method : Allowable Stress Design	Fb +	2,900.0 psi	E : Modulus of Elasticity	
Load Combination : ASCE 7-16	Fb -	2,900.0 psi	Ebend- xx	2,000.0ksi
	Fc - Prll	2,900.0 psi	Eminbend - xx	1,016.54ksi
Wood Species : iLevel Truss Joist	Fc - Perp	750.0 psi		
Wood Grade : Parallam PSL 2.0E	Fv	290.0 psi		
	Ft	2,025.0 psi	Density	45.070pcf
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling				



**Applied Loads**

Service loads entered. Load Factors will be applied for calculations.

Load for Span Number 1

Uniform Load : D = 0.0130, L = 0.040 ksf, Extent = 0.0 -->> 8.50 ft, Tributary Width = 16.0 ft  
 Uniform Load : D = 0.0130, L = 0.040 ksf, Extent = 8.0 -->> 22.250 ft, Tributary Width = 9.0 ft

**DESIGN SUMMARY**

**Design OK**

<b>Maximum Bending Stress Ratio</b>	=	<b>0.474</b> : 1	<b>Maximum Shear Stress Ratio</b>	=	<b>0.223</b> : 1
Section used for this span		<b>14.0 X 11.875</b>	Section used for this span		<b>14.0 X 11.875</b>
fb: Actual	=	1,375.04 psi	fv: Actual	=	64.80 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	290.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	9.663ft	Location of maximum on span	=	0.000ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
<b>Maximum Deflection</b>					
Max Downward Transient Deflection		0.654 in Ratio =	408 >=360	Span: 1 : L Only	
Max Upward Transient Deflection		0 in Ratio =	0 <360	n/a	
Max Downward Total Deflection		0.867 in Ratio =	308 >=240	Span: 1 : +D+L	
Max Upward Total Deflection		0 in Ratio =	0 <240	n/a	

**Maximum Forces & Stresses for Load Combinations**

Load Combination	Segment Length	Span #	Max Stress Ratios								Moment Values			Shear Values								
			M	V	C <sub>d</sub>	C <sub>F/V</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	F'b	V	fv	F'v					
D Only	Length = 22.250 ft	1	0.129	0.061	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	9.25	337.27	2610.00	0.00	0.00	0.00	1.76	15.89	261.00
+D+L	Length = 22.250 ft	1	0.474	0.223	1.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	37.70	1,375.04	2900.00	0.00	0.00	0.00	7.18	64.80	290.00
+D+0.750L	Length = 22.250 ft	1	0.308	0.145	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	30.59	1,115.60	3625.00	0.00	0.00	0.00	5.83	52.57	362.50
+0.60D	Length = 22.250 ft	1	0.044	0.021	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	5.55	202.36	4640.00	0.00	0.00	0.00	1.06	9.54	464.00

**Overall Maximum Deflections**

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.8665	10.881		0.0000	0.000

**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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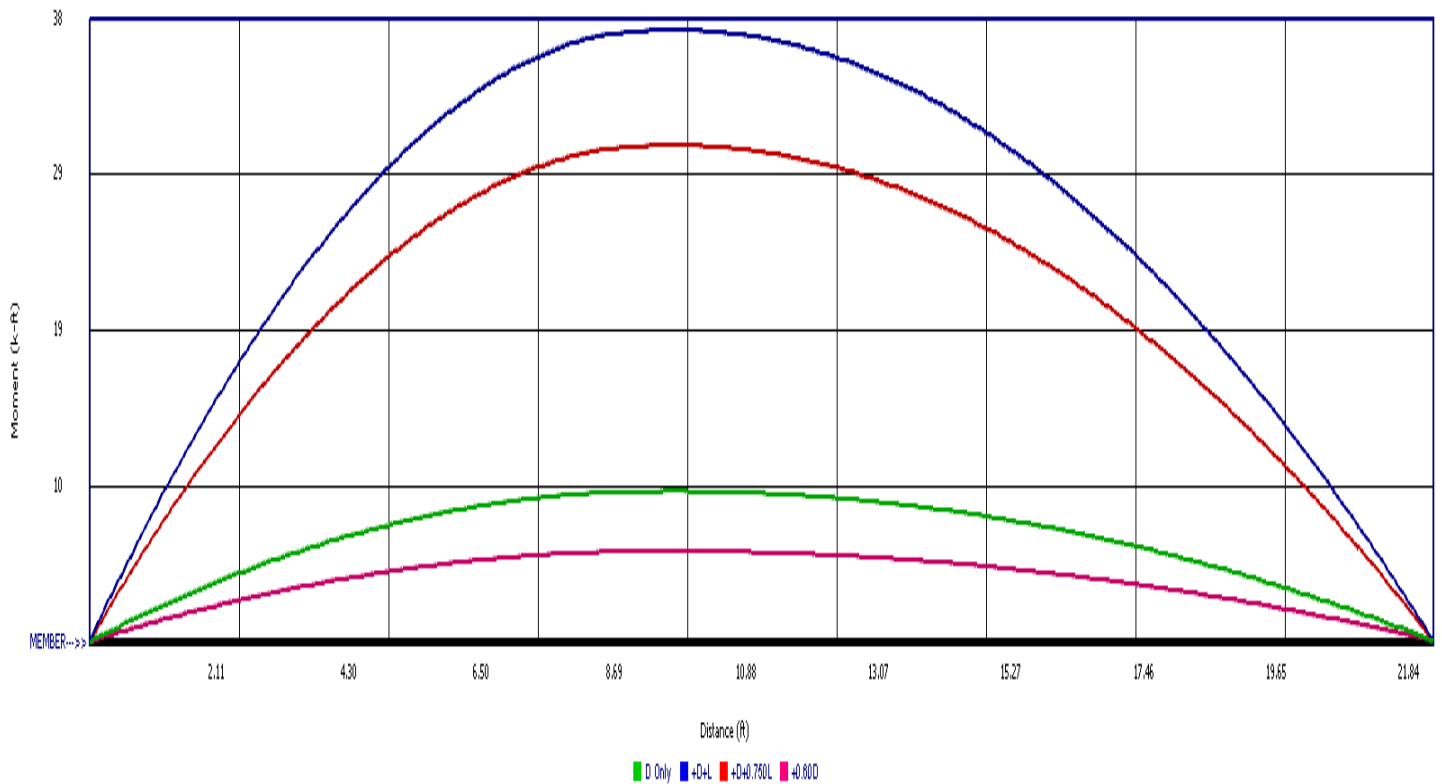
**DESCRIPTION: BM #5**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	8.008	5.997
Overall MINimum	6.044	4.526
D Only	1.964	1.471
+D+L	8.008	5.997
+D+0.750L	6.497	4.866
+0.60D	1.179	0.883
L Only	6.044	4.526



**Wood Beam**

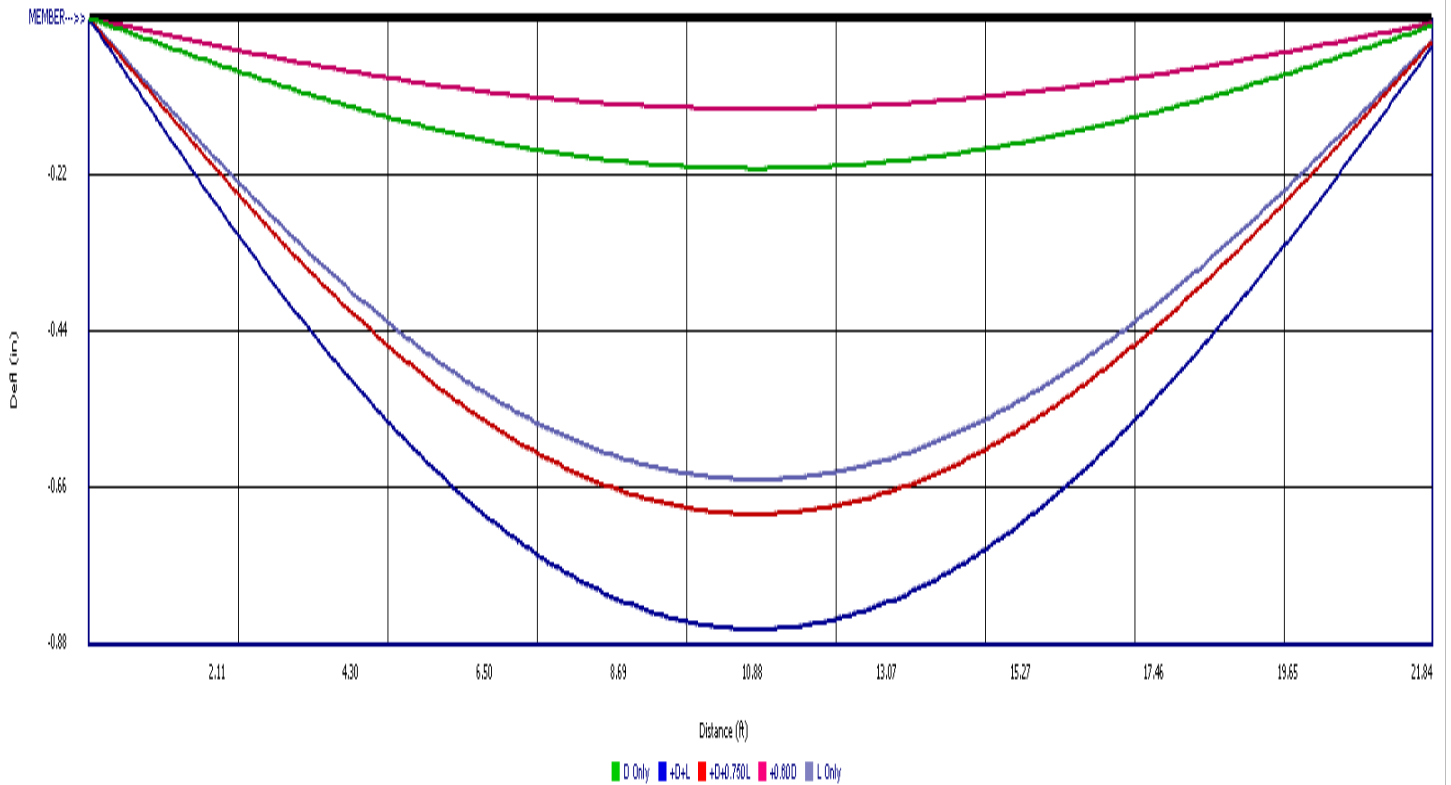
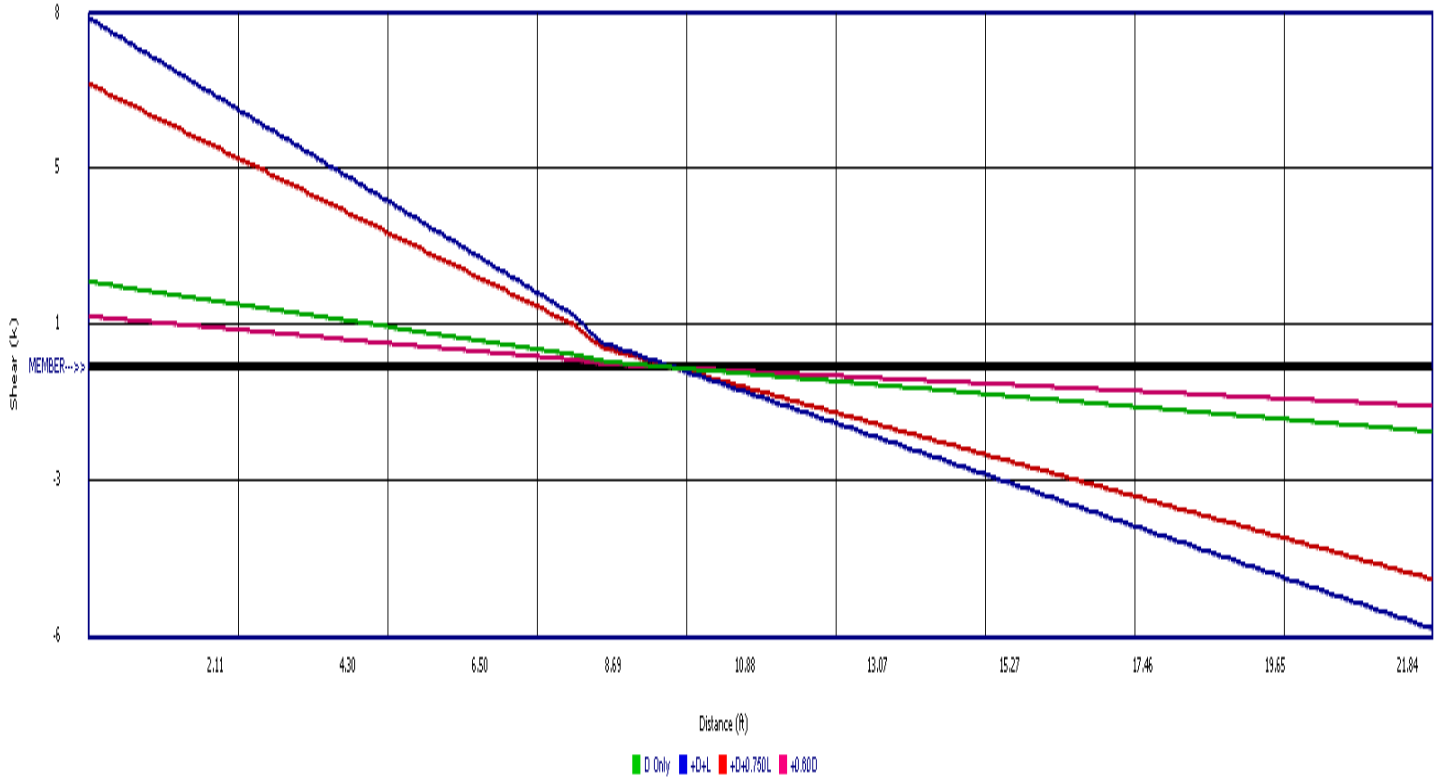
Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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**DESCRIPTION: BM #5**



**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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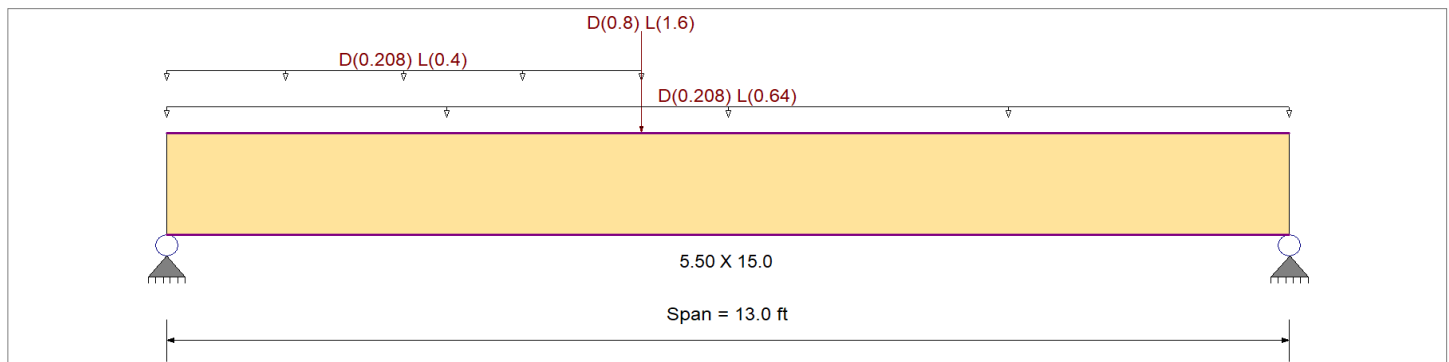
**DESCRIPTION: BM #6**

**CODE REFERENCES**

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

**Material Properties**

Analysis Method : Allowable Stress Design	Fb +	2400 psi	<i>E : Modulus of Elasticity</i>	
Load Combination : ASCE 7-16	Fb -	1850 psi	Ebend- xx	1800ksi
	Fc - Prll	1650 psi	Eminbend - xx	950ksi
Wood Species : DF/DF	Fc - Perp	650 psi	Ebend- yy	1600ksi
Wood Grade : 24F-V4	Fv	265 psi	Eminbend - yy	850ksi
	Ft	1100 psi	Density	31.21 pcf
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling				



**Applied Loads**

Service loads entered. Load Factors will be applied for calculations.

Uniform Load : D = 0.0130, L = 0.040 ksf, Tributary Width = 16.0 ft  
 Uniform Load : D = 0.0130, L = 0.0250 ksf, Extent = 0.0 -->> 5.50 ft, Tributary Width = 16.0 ft  
 Point Load : D = 0.80, L = 1.60 k @ 5.50 ft

**DESIGN SUMMARY**

**Design OK**

<b>Maximum Bending Stress Ratio</b>	=	<b>0.737</b> : 1	<b>Maximum Shear Stress Ratio</b>	=	<b>0.531</b> : 1
Section used for this span		<b>5.50 X 15.0</b>	Section used for this span		<b>5.50 X 15.0</b>
fb: Actual	=	1,769.17 psi	fv: Actual	=	140.68 psi
Fb: Allowable	=	2,400.00 psi	Fv: Allowable	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	5.504ft	Location of maximum on span	=	0.000ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
<b>Maximum Deflection</b>					
Max Downward Transient Deflection		0.228 in Ratio =	<b>683</b> >=360	Span: 1 : L Only	
Max Upward Transient Deflection		0 in Ratio =	<b>0</b> <360	n/a	
Max Downward Total Deflection		0.317 in Ratio =	<b>492</b> >=240	Span: 1 : +D+L	
Max Upward Total Deflection		0 in Ratio =	<b>0</b> <240	n/a	

**Maximum Forces & Stresses for Load Combinations**

Load Combination	Segment Length	Span #	Max Stress Ratios								Moment Values			Shear Values									
			M	V	C <sub>d</sub>	C <sub>F/V</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	F'b	V	fv	F'v						
D Only	Length = 13.0 ft	1	0.233	0.168	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	8.64	502.81	2160.00	0.00	0.00	0.00	2.20	40.04	238.50
+D+L	Length = 13.0 ft	1	0.737	0.531	1.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	30.41	1,769.17	2400.00	0.00	0.00	0.00	7.74	140.68	265.00
+D+0.750L	Length = 13.0 ft	1	0.484	0.349	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	24.97	1,452.58	3000.00	0.00	0.00	0.00	6.35	115.52	331.25
+0.60D	Length = 13.0 ft	1	0.079	0.057	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	5.19	301.69	3840.00	0.00	0.00	0.00	1.32	24.03	424.00

**Overall Maximum Deflections**

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.3169	6.358		0.0000	0.000

**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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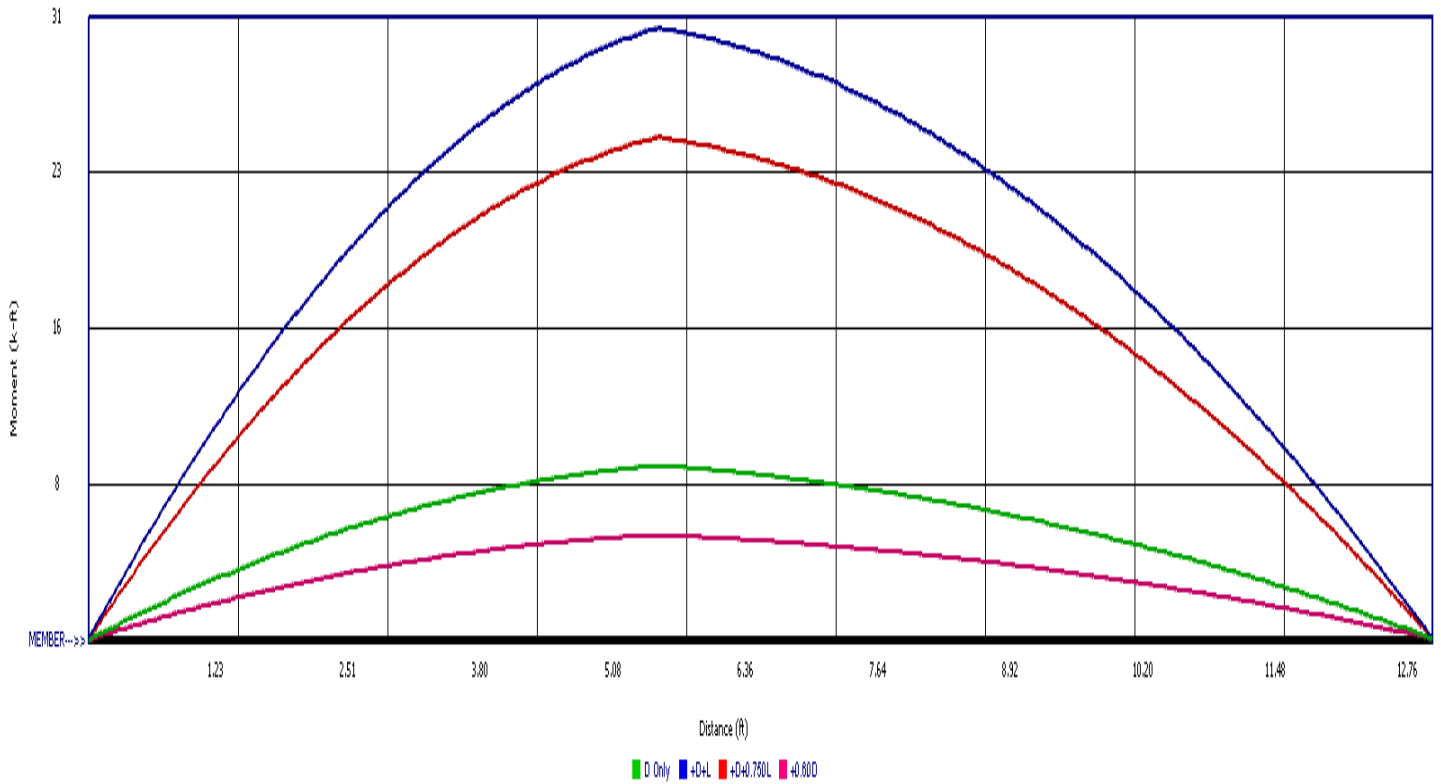
**DESCRIPTION: BM #6**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	9.533	7.235
Overall MINimum	6.818	5.302
D Only	2.716	1.932
+D+L	9.533	7.235
+D+0.750L	7.829	5.909
+0.60D	1.629	1.159
L Only	6.818	5.302



Wood Beam

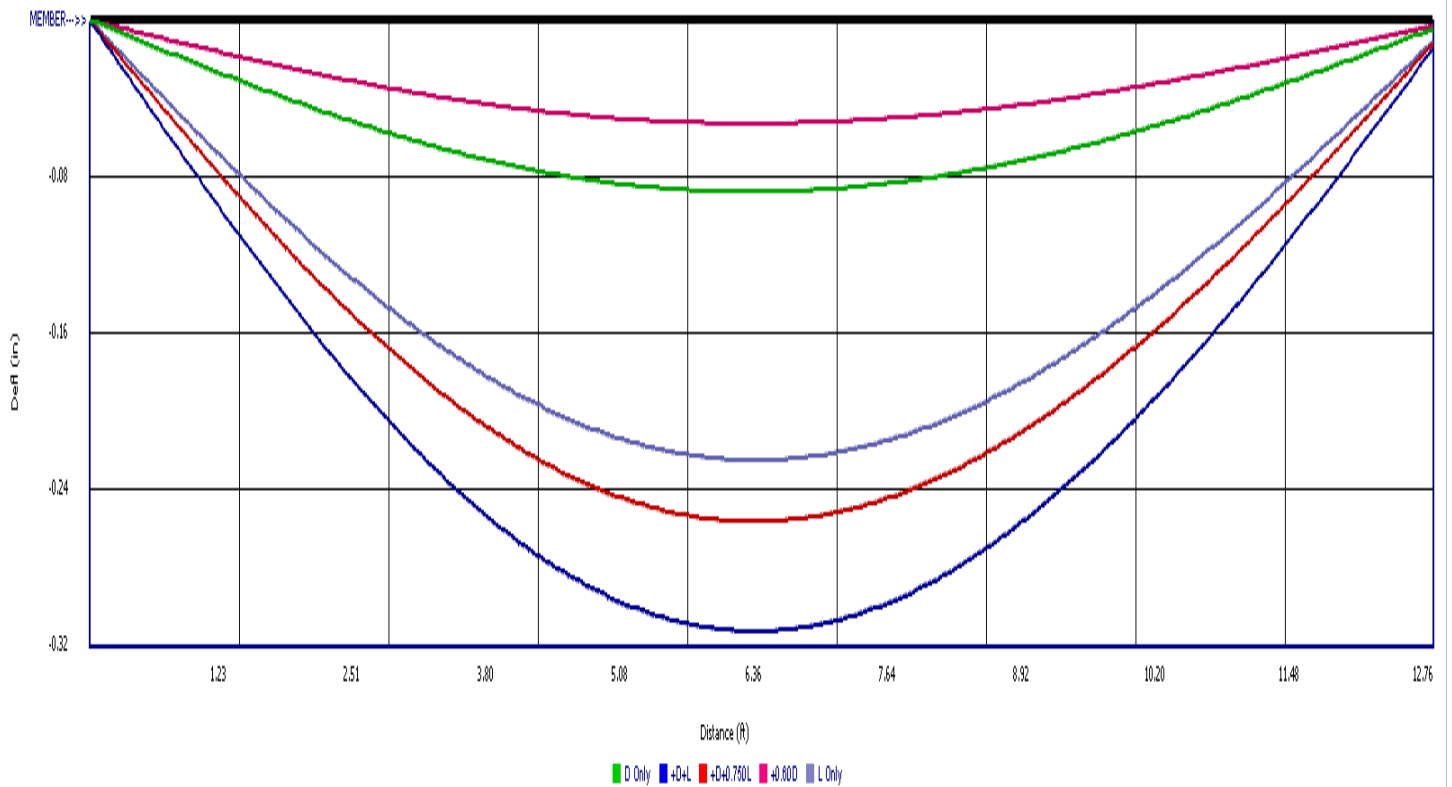
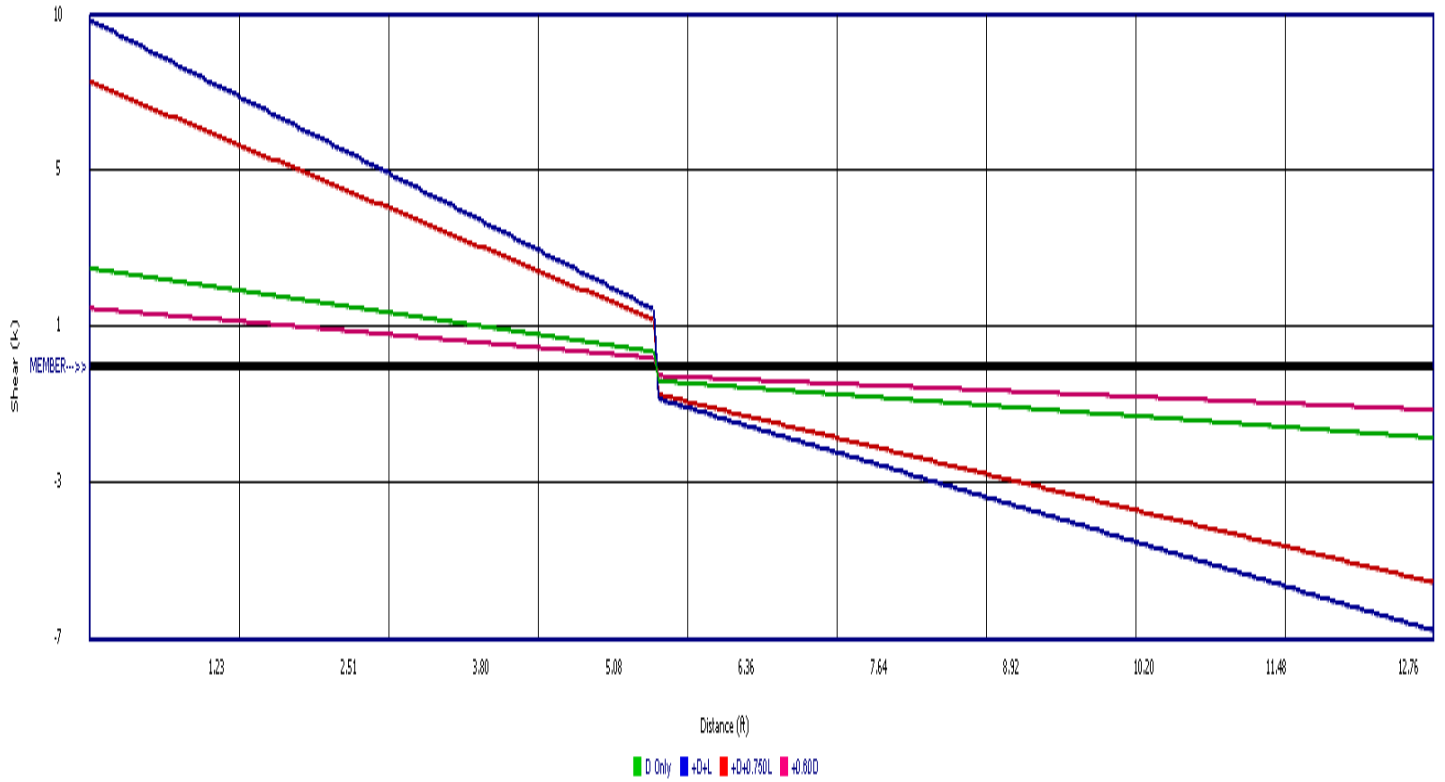
Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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DESCRIPTION: BM #6



**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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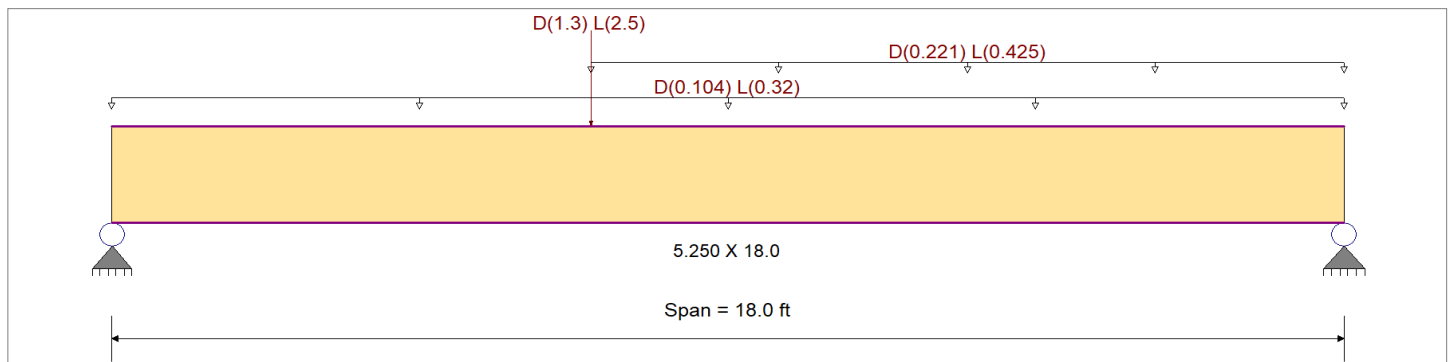
**DESCRIPTION: BM #7**

**CODE REFERENCES**

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

**Material Properties**

Analysis Method : Allowable Stress Design	Fb +	2,900.0 psi	E : Modulus of Elasticity
Load Combination : ASCE 7-16	Fb -	2,900.0 psi	Ebend- xx
	Fc - Prll	2,900.0 psi	Eminbend - xx
Wood Species : iLevel Truss Joist	Fc - Perp	750.0 psi	
Wood Grade : Parallam PSL 2.0E	Fv	290.0 psi	
	Ft	2,025.0 psi	Density
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling			45.070pcf



**Applied Loads**

Service loads entered. Load Factors will be applied for calculations.

Uniform Load : D = 0.0130, L = 0.040 ksf, Tributary Width = 8.0 ft  
 Uniform Load : D = 0.0130, L = 0.0250 ksf, Extent = 7.0 --> 18.0 ft, Tributary Width = 17.0 ft  
 Point Load : D = 1.30, L = 2.50 k @ 7.0 ft

**DESIGN SUMMARY**

**Design OK**

<b>Maximum Bending Stress Ratio</b>	=	<b>0.714</b> : 1	<b>Maximum Shear Stress Ratio</b>	=	<b>0.475</b> : 1
Section used for this span		<b>5.250 X 18.0</b>	Section used for this span		<b>5.250 X 18.0</b>
fb: Actual	=	2,069.35 psi	fv: Actual	=	137.81 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	290.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	8.409ft	Location of maximum on span	=	16.555ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
<b>Maximum Deflection</b>					
Max Downward Transient Deflection		0.379 in	Ratio =	<b>570</b> >=360	Span: 1 : L Only
Max Upward Transient Deflection		0 in	Ratio =	<b>0</b> <360	n/a
Max Downward Total Deflection		0.546 in	Ratio =	<b>395</b> >=240	Span: 1 : +D+L
Max Upward Total Deflection		0 in	Ratio =	<b>0</b> <240	n/a

**Maximum Forces & Stresses for Load Combinations**

Load Combination	Segment Length	Span #	Max Stress Ratios								Moment Values			Shear Values					
			M	V	C <sub>d</sub>	C <sub>F/V</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	F'b	V	fv	F'v		
D Only	Length = 18.0 ft	1	0.244	0.162	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	15.07	637.87	2610.00	0.00	0.00	0.00
+D+L	Length = 18.0 ft	1	0.714	0.475	1.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	48.89	2,069.35	2900.00	8.68	137.81	290.00
+D+0.750L	Length = 18.0 ft	1	0.472	0.314	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	40.43	1,711.48	3625.00	7.18	113.91	362.50
+0.60D	Length = 18.0 ft	1	0.082	0.055	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	9.04	382.72	4640.00	1.60	25.33	464.00

**Overall Maximum Deflections**

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.5464	9.066		0.0000	0.000

**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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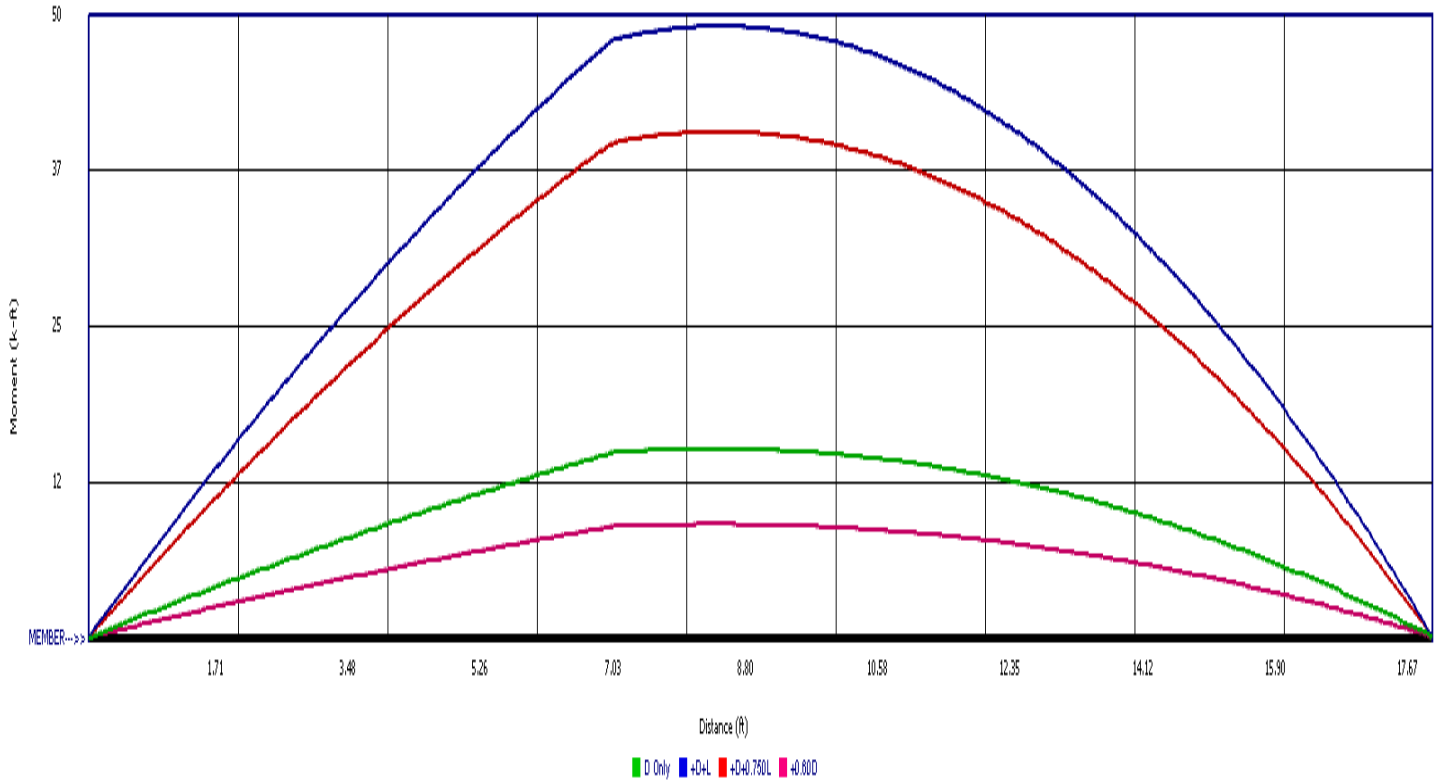
**DESCRIPTION: BM #7**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	8.310	10.229
Overall MINimum	5.836	7.099
D Only	2.473	3.130
+D+L	8.310	10.229
+D+0.750L	6.850	8.454
+0.60D	1.484	1.878
L Only	5.836	7.099





Wood Beam

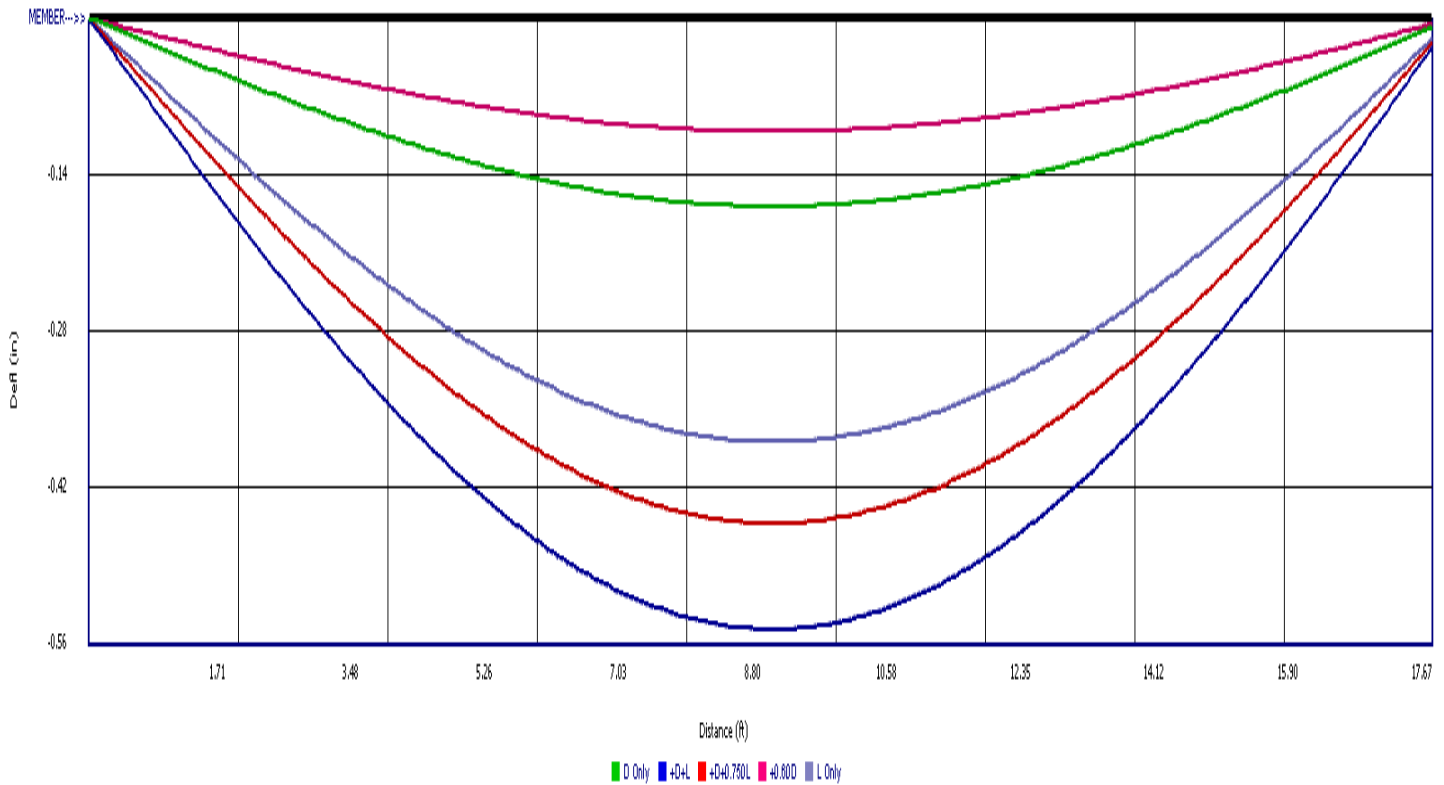
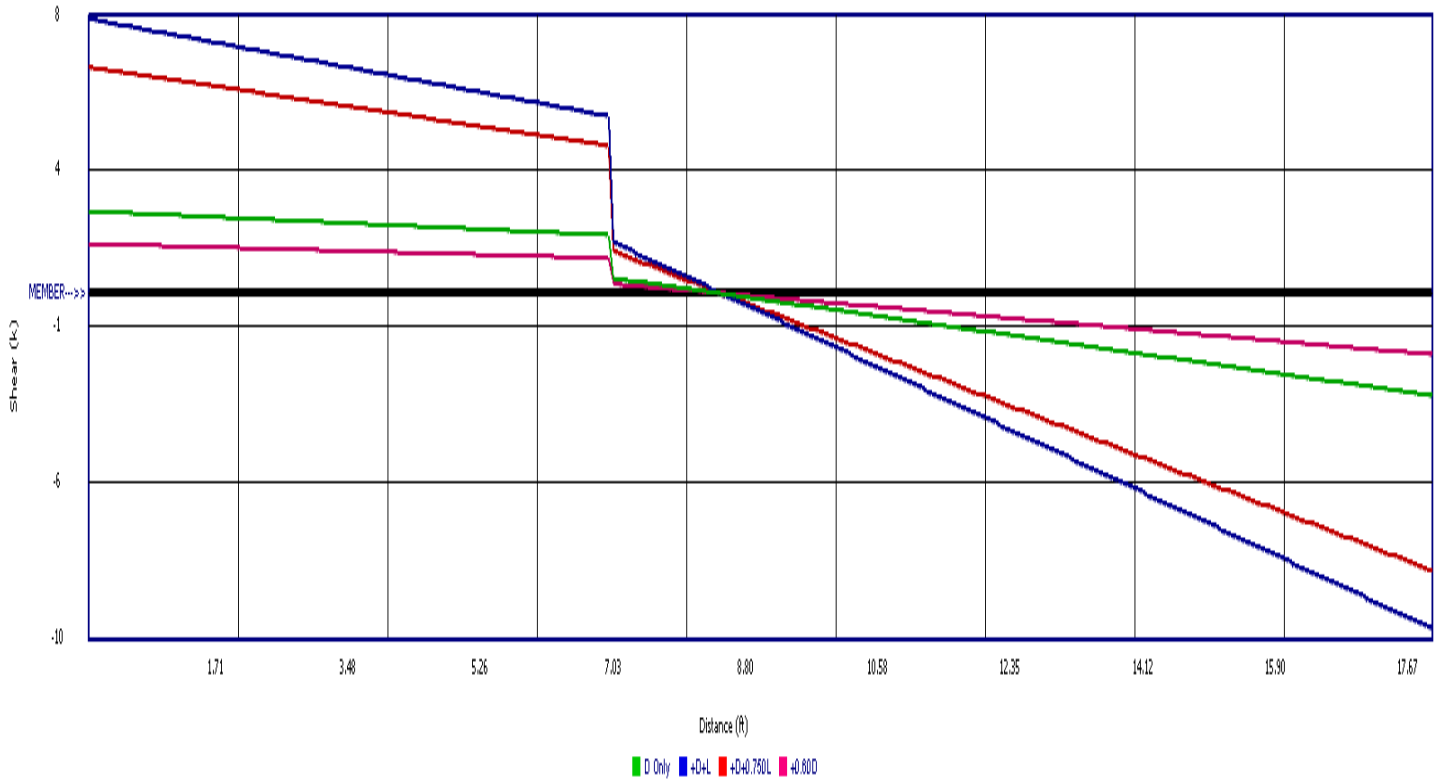
Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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DESCRIPTION: BM #7



**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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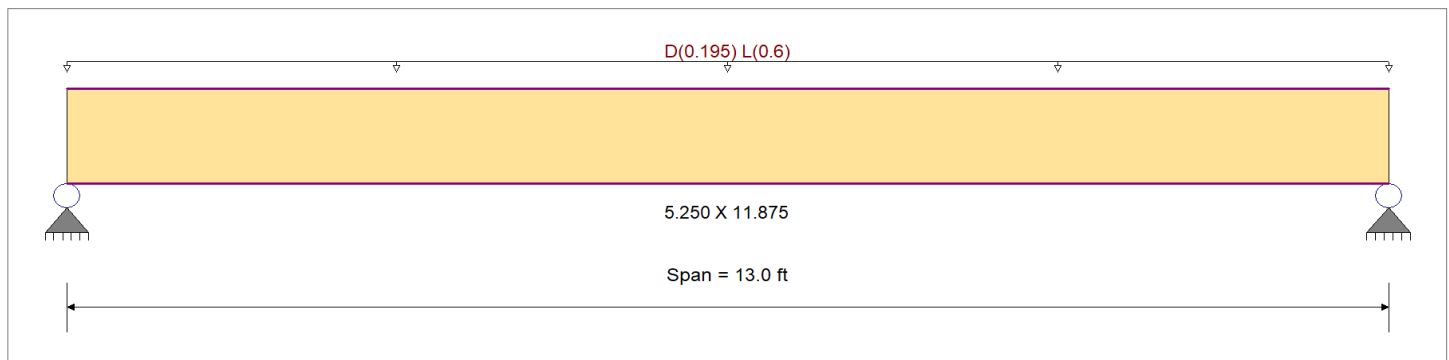
**DESCRIPTION: BM #8**

**CODE REFERENCES**

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

**Material Properties**

Analysis Method : Allowable Stress Design	Fb +	2,900.0 psi	E : Modulus of Elasticity
Load Combination : ASCE 7-16	Fb -	2,900.0 psi	Ebend- xx
	Fc - Prll	2,900.0 psi	Eminbend - xx
Wood Species : iLevel Truss Joist	Fc - Perp	750.0 psi	
Wood Grade : Parallam PSL 2.0E	Fv	290.0 psi	
	Ft	2,025.0 psi	Density
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling			45.070pcf



**Applied Loads**

Service loads entered. Load Factors will be applied for calculations.

Uniform Load : D = 0.0130, L = 0.040 ksf, Tributary Width = 15.0 ft

**DESIGN SUMMARY**

**Design OK**

<b>Maximum Bending Stress Ratio</b>	=	<b>0.563</b> : 1	<b>Maximum Shear Stress Ratio</b>	=	<b>0.366</b> : 1
Section used for this span		<b>5.250 X 11.875</b>	Section used for this span		<b>5.250 X 11.875</b>
fb: Actual	=	1,633.31 psi	fv: Actual	=	106.18 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	290.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	6.500ft	Location of maximum on span	=	12.051ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
<b>Maximum Deflection</b>					
Max Downward Transient Deflection	0.265 in	Ratio =	589	>=360	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0	<360	n/a
Max Downward Total Deflection	0.351 in	Ratio =	444	>=240	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0	<240	n/a

**Maximum Forces & Stresses for Load Combinations**

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values							
			M	V	C <sub>d</sub>	C <sub>F/V</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	F'b	V	fv	F'v					
D Only	Length = 13.0 ft	1	0.153	0.100	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	4.12	400.62	2610.00	0.00	0.00	0.00	1.08	26.04	261.00
+D+L	Length = 13.0 ft	1	0.563	0.366	1.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	16.79	1,633.31	2900.00	0.00	0.00	0.00	4.41	106.18	290.00
+D+0.750L	Length = 13.0 ft	1	0.366	0.238	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	13.63	1,325.14	3625.00	0.00	0.00	0.00	3.58	86.15	362.50
+0.60D	Length = 13.0 ft	1	0.052	0.034	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.47	240.37	4640.00	0.00	0.00	0.00	0.65	15.63	464.00

**Overall Maximum Deflections**

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.3507	6.547		0.0000	0.000

**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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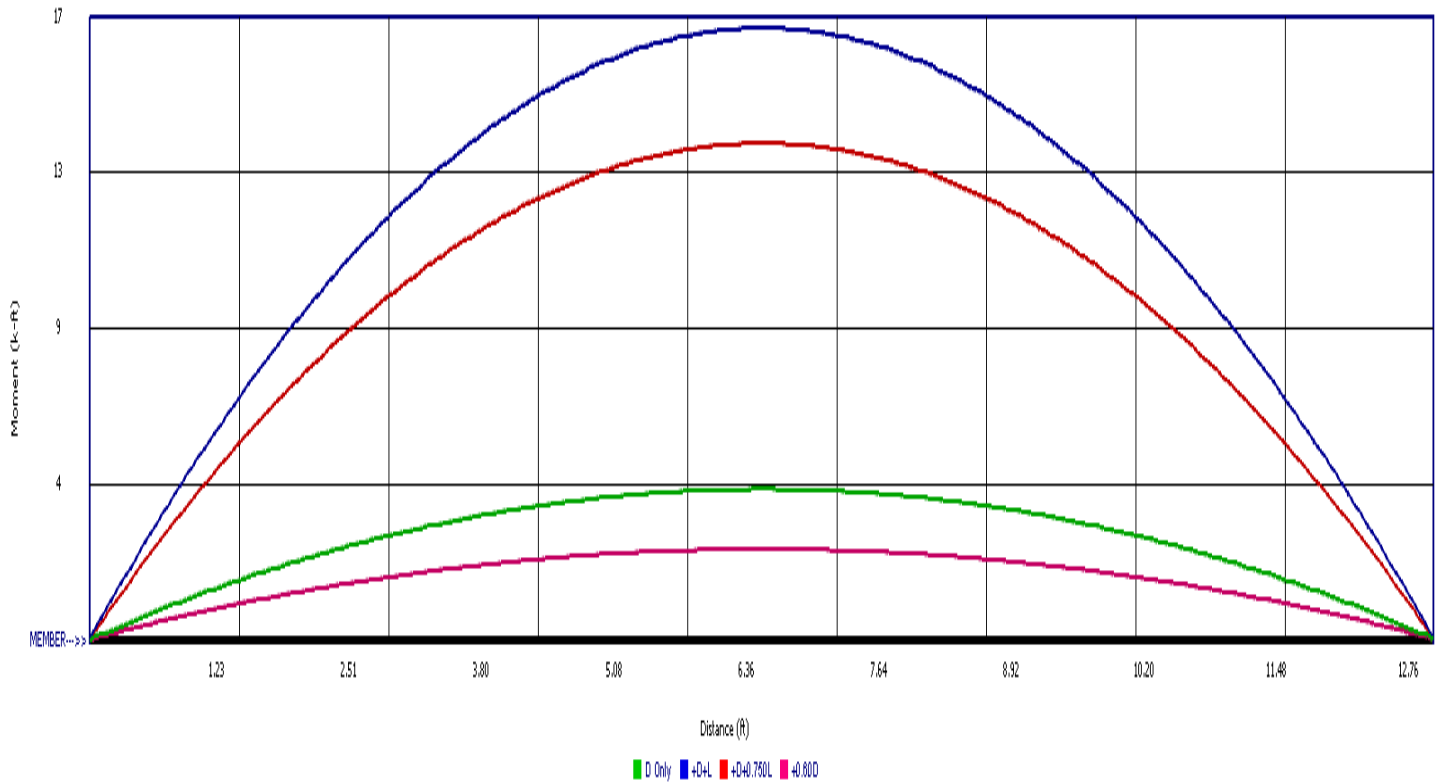
**DESCRIPTION: BM #8**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	5.168	5.168
Overall MINimum	3.900	3.900
D Only	1.268	1.268
+D+L	5.168	5.168
+D+0.750L	4.193	4.193
+0.60D	0.761	0.761
L Only	3.900	3.900



**Wood Beam**

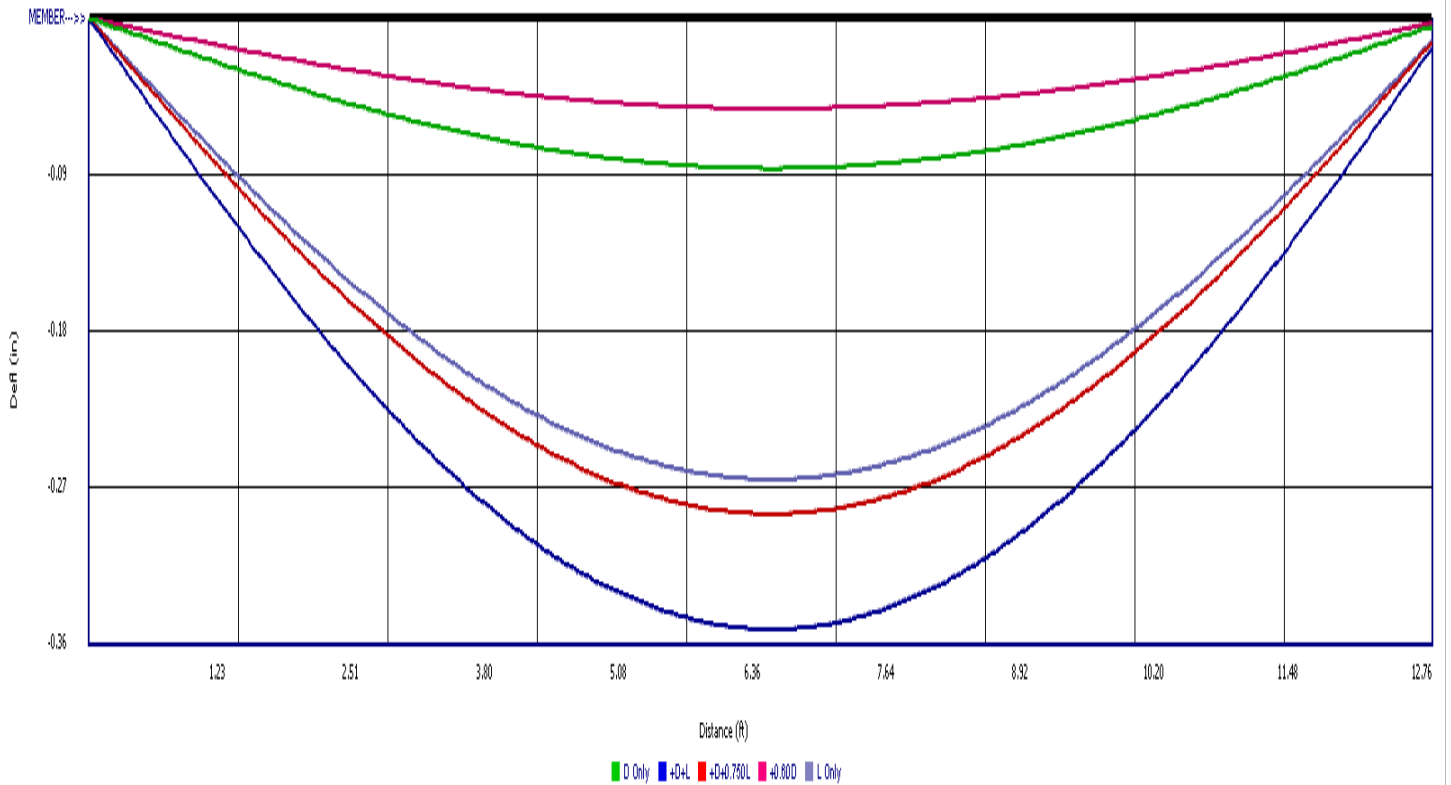
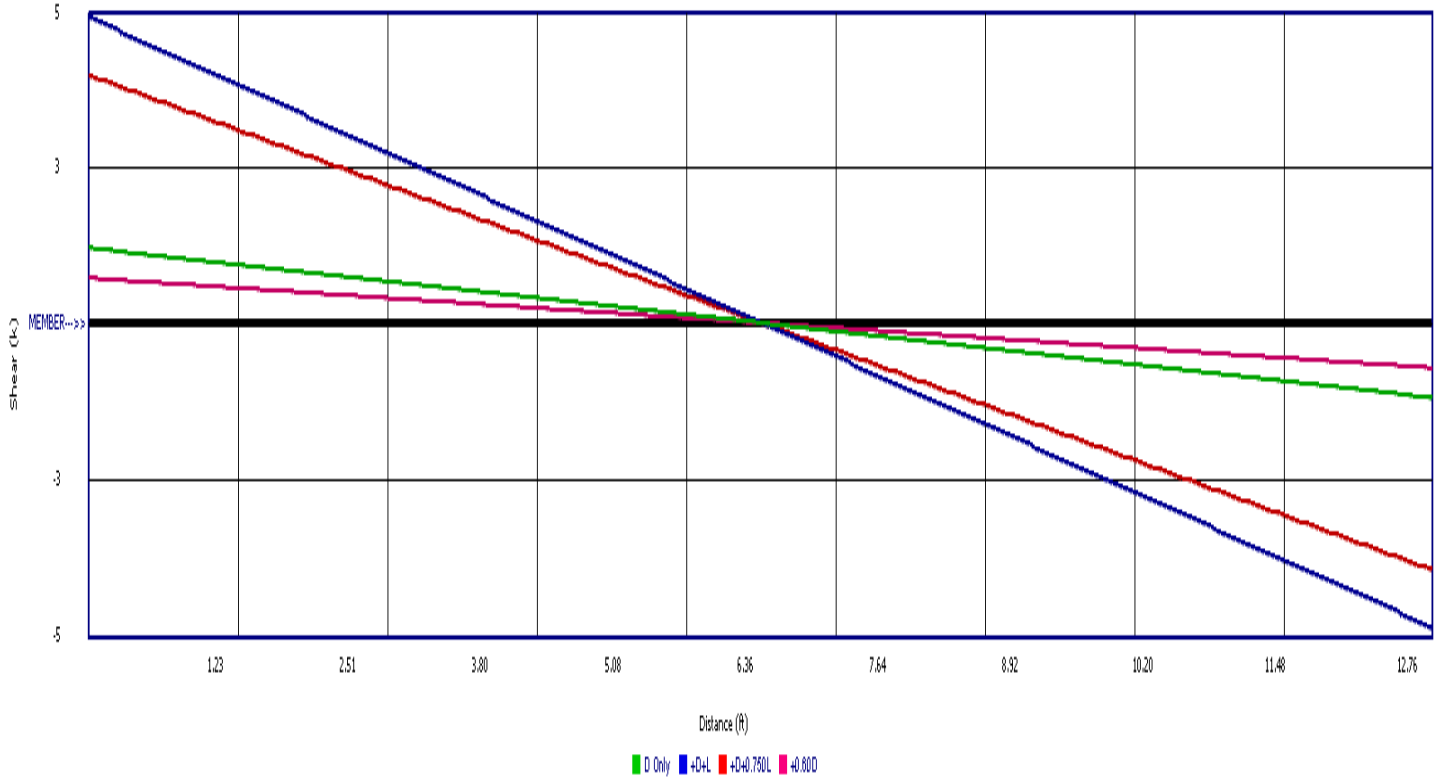
Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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**DESCRIPTION: BM #8**



**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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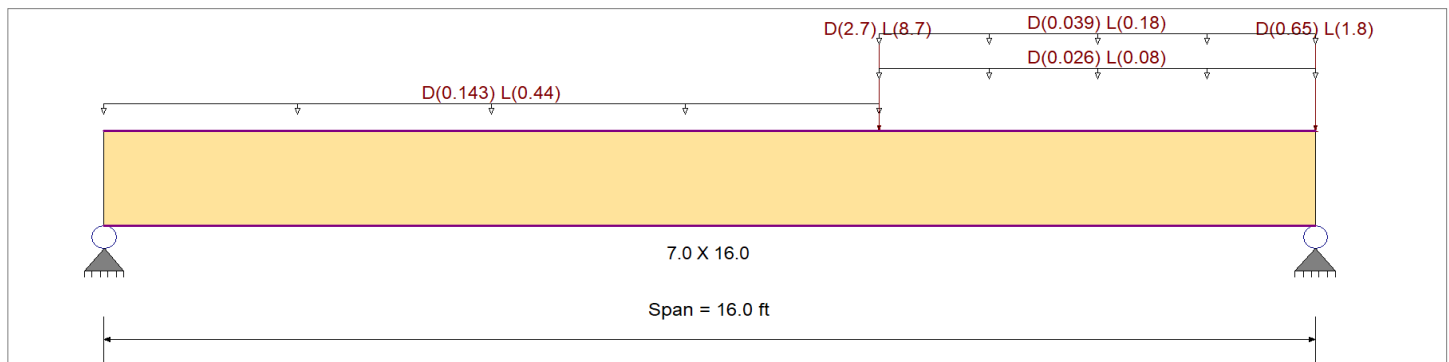
**DESCRIPTION: BM #9**

**CODE REFERENCES**

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

**Material Properties**

Analysis Method : Allowable Stress Design	Fb +	2,900.0 psi	E : Modulus of Elasticity
Load Combination : ASCE 7-16	Fb -	2,900.0 psi	Ebend- xx
	Fc - Prll	2,900.0 psi	Eminbend - xx
Wood Species : iLevel Truss Joist	Fc - Perp	750.0 psi	
Wood Grade : Parallam PSL 2.0E	Fv	290.0 psi	
	Ft	2,025.0 psi	Density
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling			45.070pcf



**Applied Loads**

Service loads entered. Load Factors will be applied for calculations.

Load for Span Number 1

- Uniform Load : D = 0.0130, L = 0.040 ksf, Extent = 0.0 --> 10.250 ft, Tributary Width = 11.0 ft
- Point Load : D = 0.650, L = 1.80 k @ 16.0 ft
- Point Load : D = 2.70, L = 8.70 k @ 10.250 ft
- Uniform Load : D = 0.0130, L = 0.040 ksf, Extent = 10.250 --> 16.0 ft, Tributary Width = 2.0 ft
- Uniform Load : D = 0.0130, L = 0.060 ksf, Extent = 10.250 --> 16.0 ft, Tributary Width = 3.0 ft

**DESIGN SUMMARY**

**Design OK**

<b>Maximum Bending Stress Ratio</b>	=	<b>0.781</b> : 1	<b>Maximum Shear Stress Ratio</b>	=	<b>0.477</b> : 1
Section used for this span		<b>7.0 X 16.0</b>	Section used for this span		<b>7.0 X 16.0</b>
fb: Actual	=	2,264.57 psi	fv: Actual	=	138.38 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	290.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	10.219ft	Location of maximum on span	=	14.715ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
<b>Maximum Deflection</b>					
Max Downward Transient Deflection	0.363 in	Ratio = 529 >=360	Span: 1 : L Only		
Max Upward Transient Deflection	0 in	Ratio = 0 <360	n/a		
Max Downward Total Deflection	0.475 in	Ratio = 404 >=240	Span: 1 : +D+L		
Max Upward Total Deflection	0 in	Ratio = 0 <240	n/a		

**Maximum Forces & Stresses for Load Combinations**

Load Combination	Segment Length	Span #	Max Stress Ratios								Moment Values			Shear Values						
			M	V	C <sub>d</sub>	C <sub>F/V</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	F'b	V	fv	F'v			
D Only	Length = 16.0 ft	1	0.205	0.124	0.90	1.000	1.00	1.00	1.00	1.00	1.00	13.32	535.02	2610.00	0.00	0.00	0.00	0.00	0.00	0.00
+D+L	Length = 16.0 ft	1	0.781	0.477	1.00	1.000	1.00	1.00	1.00	1.00	1.00	56.36	2,264.57	2900.00	10.33	138.38	290.00	0.00	0.00	0.00
+D+0.750L	Length = 16.0 ft	1	0.505	0.309	1.25	1.000	1.00	1.00	1.00	1.00	1.00	45.60	1,832.18	3625.00	8.36	111.90	362.50	0.00	0.00	0.00
+0.60D	Length = 16.0 ft	1	0.069	0.042	1.60	1.000	1.00	1.00	1.00	1.00	1.00	7.99	321.01	4640.00	1.45	19.46	464.00	0.00	0.00	0.00

**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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**DESCRIPTION: BM #9**

**Overall Maximum Deflections**

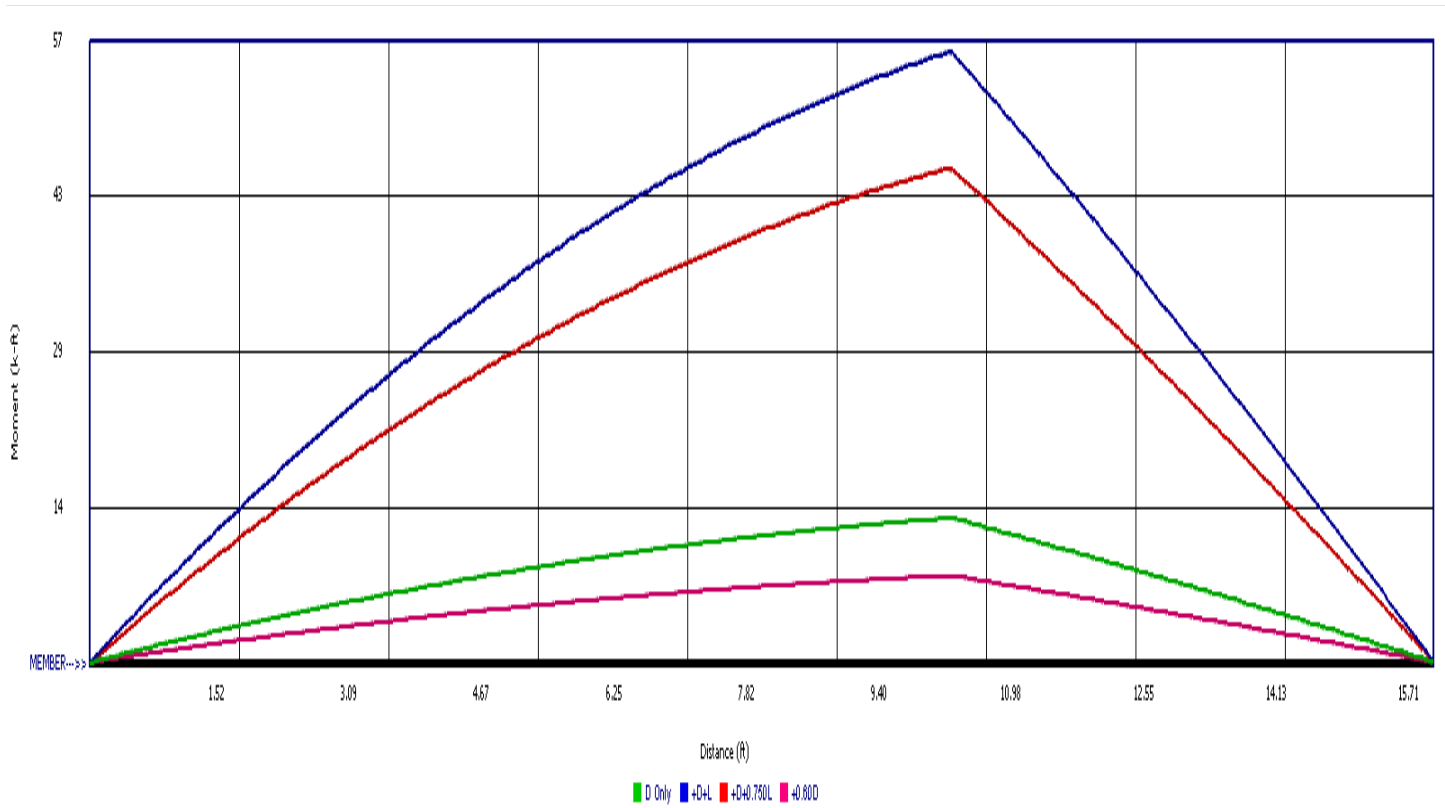
Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.4752	8.409		0.0000	0.000

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	8.494	13.200
Overall MINimum	6.461	10.044
D Only	2.034	3.156
+D+L	8.494	13.200
+D+0.750L	6.879	10.689
+0.60D	1.220	1.893
L Only	6.461	10.044



Wood Beam

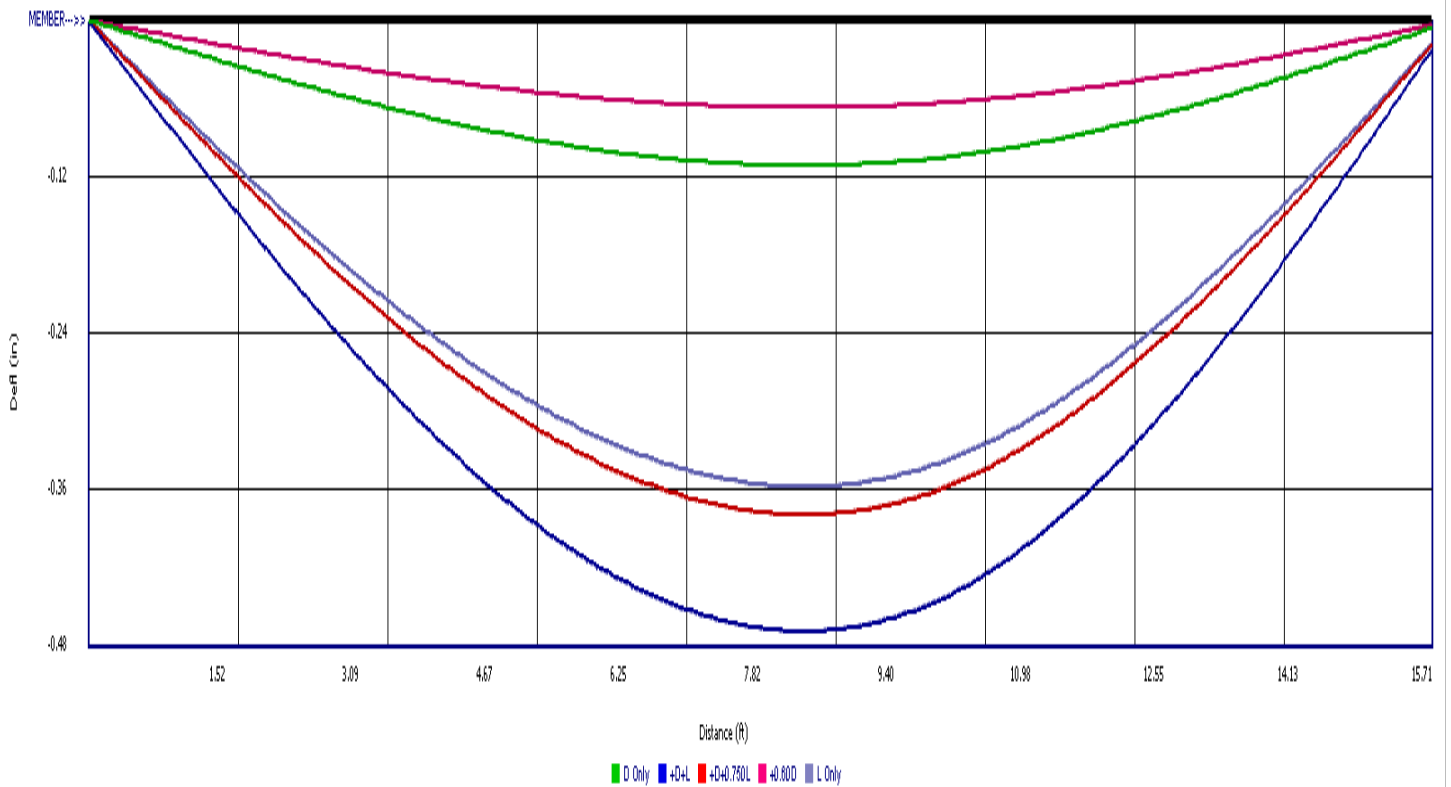
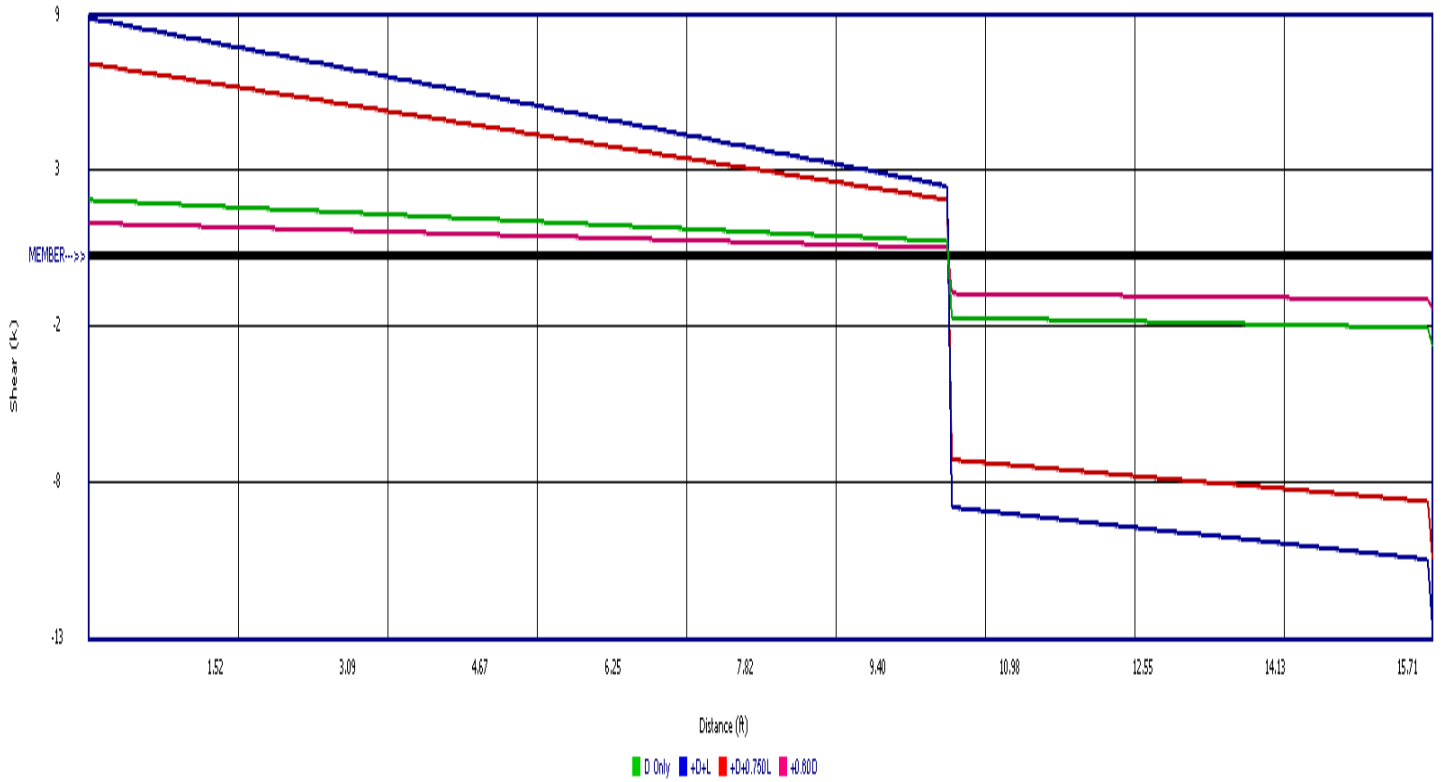
Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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DESCRIPTION: BM #9



**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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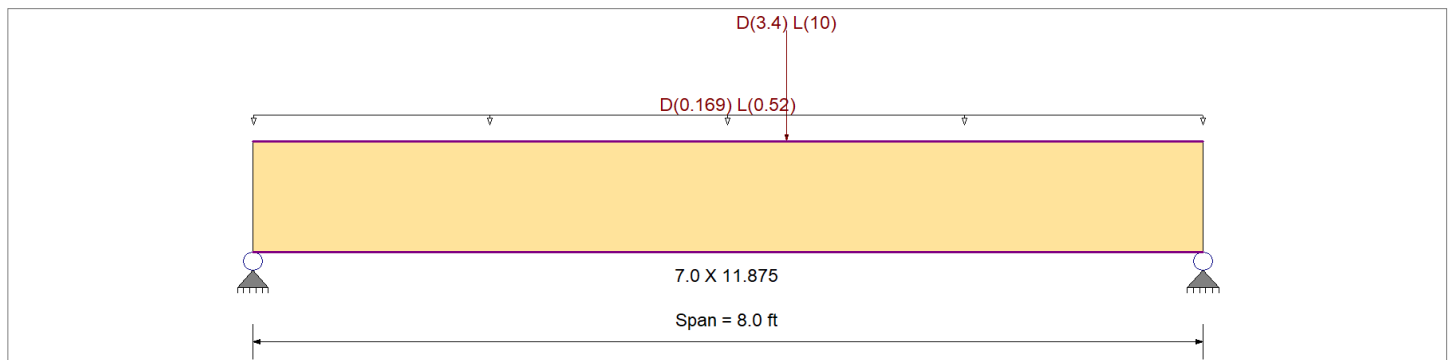
**DESCRIPTION: BM #10**

**CODE REFERENCES**

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

**Material Properties**

Analysis Method : Allowable Stress Design	Fb +	2,900.0 psi	E : Modulus of Elasticity
Load Combination : ASCE 7-16	Fb -	2,900.0 psi	Ebend- xx
	Fc - Prll	2,900.0 psi	Eminbend - xx
Wood Species : iLevel Truss Joist	Fc - Perp	750.0 psi	
Wood Grade : Parallam PSL 2.0E	Fv	290.0 psi	Density
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling	Ft	2,025.0 psi	45.070pcf



**Applied Loads**

Service loads entered. Load Factors will be applied for calculations.

Uniform Load : D = 0.0130, L = 0.040 ksf, Tributary Width = 13.0 ft  
 Point Load : D = 3.40, L = 10.0 k @ 4.50 ft

**DESIGN SUMMARY**

**Design OK**

<b>Maximum Bending Stress Ratio</b>	=	<b>0.800</b> : 1	<b>Maximum Shear Stress Ratio</b>	=	<b>0.599</b> : 1
Section used for this span	=	<b>7.0 X 11.875</b>	Section used for this span	=	<b>7.0 X 11.875</b>
fb: Actual	=	2,318.55 psi	fv: Actual	=	173.77 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	290.00 psi
Load Combination	=	+D+L	Load Combination	=	+D+L
Location of maximum on span	=	4.496ft	Location of maximum on span	=	7.036ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
<b>Maximum Deflection</b>					
Max Downward Transient Deflection		0.118 in Ratio =	816	>=360	Span: 1 : L Only
Max Upward Transient Deflection		0 in Ratio =	0	<360	n/a
Max Downward Total Deflection		0.157 in Ratio =	610	>=240	Span: 1 : +D+L
Max Upward Total Deflection		0 in Ratio =	0	<240	n/a

**Maximum Forces & Stresses for Load Combinations**

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values								
			M	V	C <sub>d</sub>	C <sub>F/V</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	F'b	V	fv	F'v						
D Only	Length = 8.0 ft	1	0.224	0.168	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
+D+L	Length = 8.0 ft	1	0.800	0.599	1.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
+D+0.750L	Length = 8.0 ft	1	0.520	0.390	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
+0.60D	Length = 8.0 ft	1	0.076	0.057	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00

**Overall Maximum Deflections**

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.1571	4.146		0.0000	0.000



**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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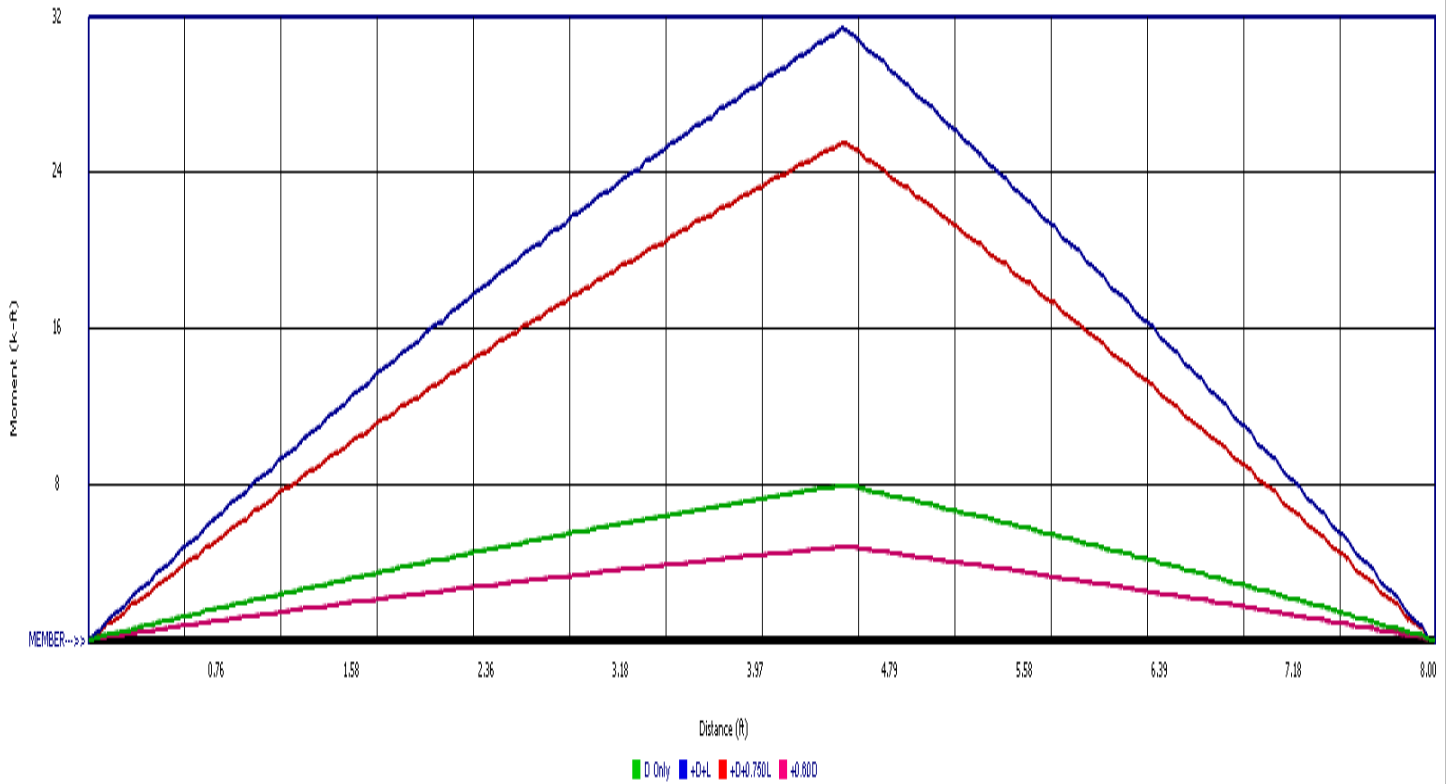
**DESCRIPTION: BM #10**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	8.619	10.294
Overall MINimum	6.455	7.705
D Only	2.164	2.589
+D+L	8.619	10.294
+D+0.750L	7.005	8.367
+0.60D	1.298	1.553
L Only	6.455	7.705



Wood Beam

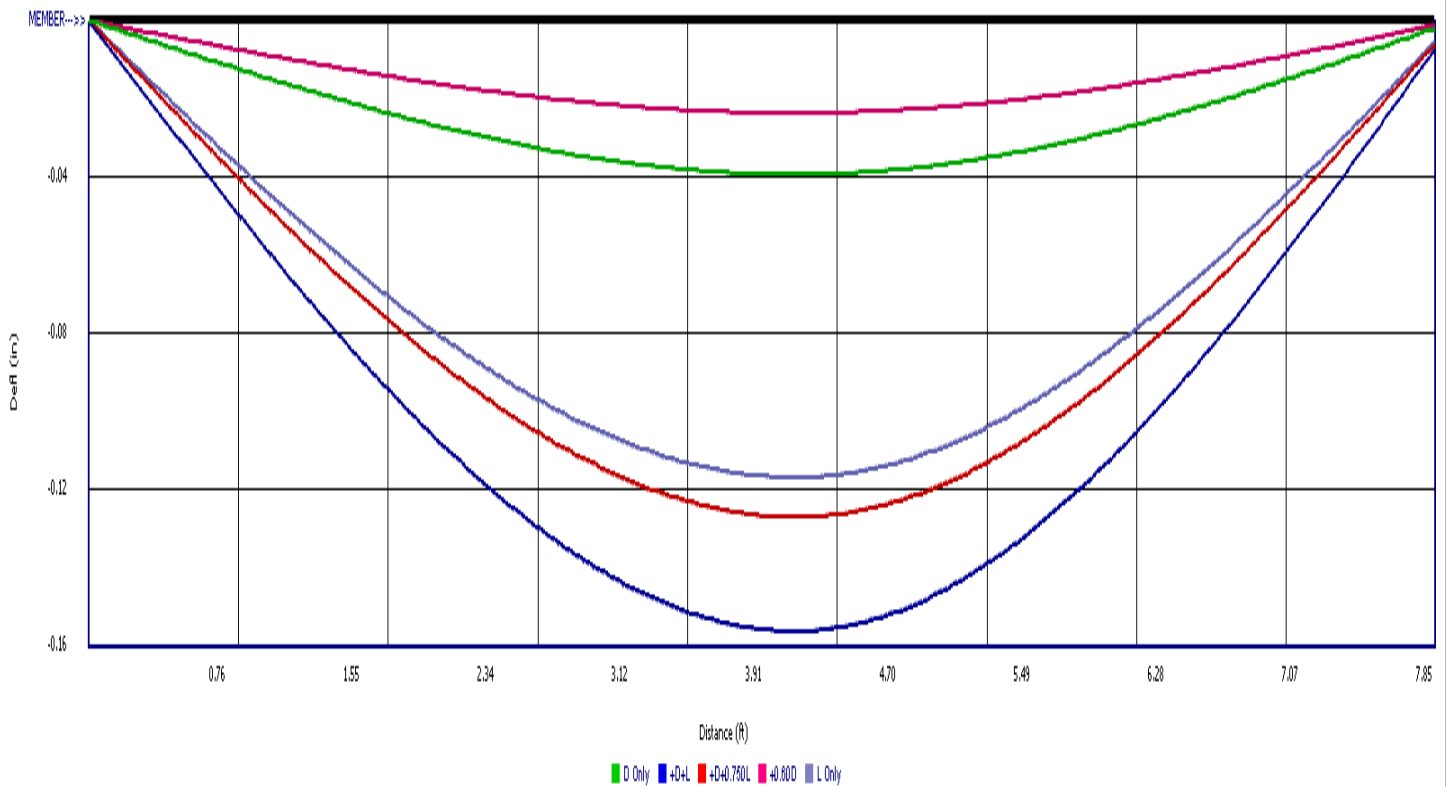
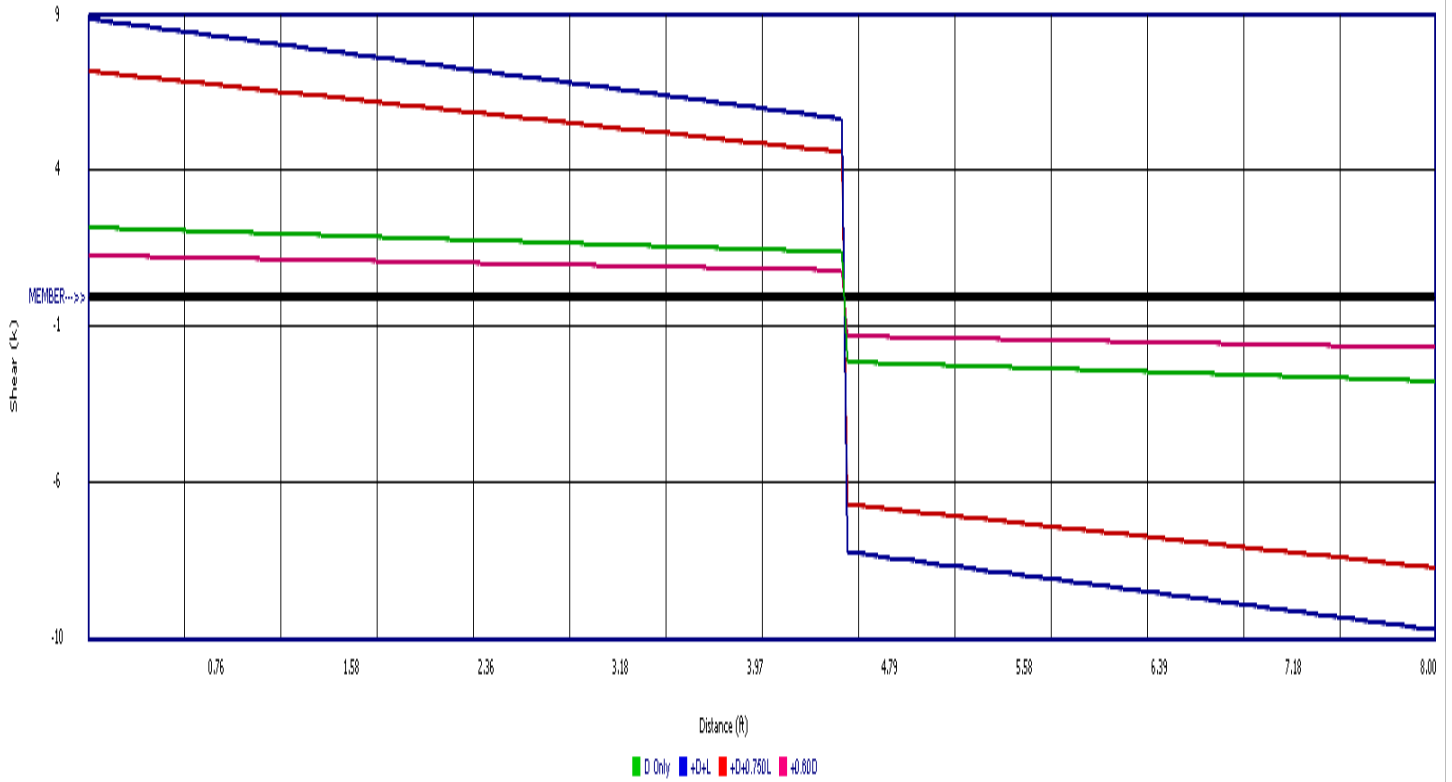
Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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DESCRIPTION: BM #10



**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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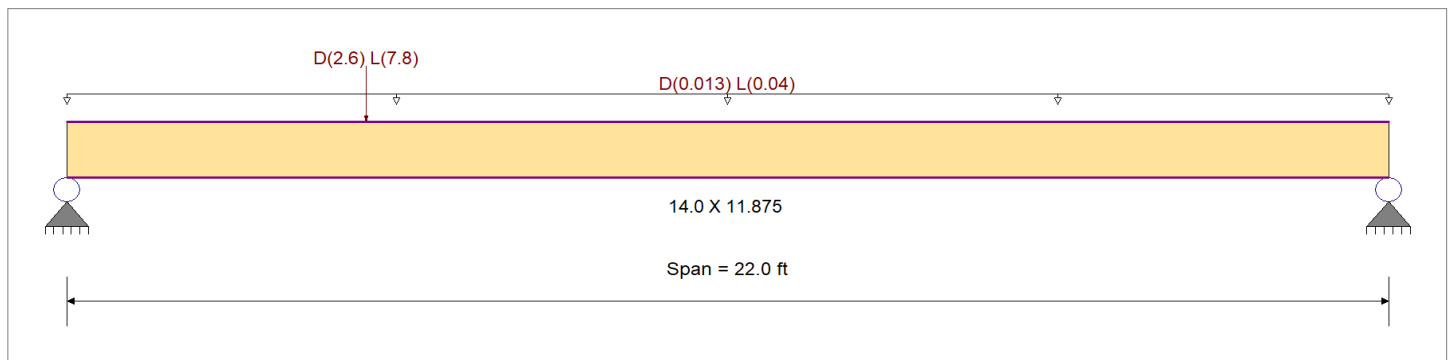
**DESCRIPTION: BM #11**

**CODE REFERENCES**

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

**Material Properties**

Analysis Method : Allowable Stress Design	Fb +	2,900.0 psi	E : Modulus of Elasticity
Load Combination : ASCE 7-16	Fb -	2,900.0 psi	Ebend- xx
	Fc - Prll	2,900.0 psi	Eminbend - xx
Wood Species : iLevel Truss Joist	Fc - Perp	750.0 psi	
Wood Grade : Parallam PSL 2.0E	Fv	290.0 psi	
	Ft	2,025.0 psi	Density
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling			45.070pcf



**Applied Loads**

Service loads entered. Load Factors will be applied for calculations.

Uniform Load : D = 0.0130, L = 0.040 ksf, Tributary Width = 1.0 ft  
 Point Load : D = 2.60, L = 7.80 k @ 5.0 ft

**DESIGN SUMMARY**

**Design OK**

<b>Maximum Bending Stress Ratio</b>	=	<b>0.532</b>	1	<b>Maximum Shear Stress Ratio</b>	=	<b>0.267</b>	: 1
Section used for this span		<b>14.0 X 11.875</b>		Section used for this span		<b>14.0 X 11.875</b>	
fb: Actual	=	1,543.23 psi		fv: Actual	=	77.31 psi	
Fb: Allowable	=	2,900.00 psi		Fv: Allowable	=	290.00 psi	
Load Combination		+D+L		Load Combination		+D+L	
Location of maximum on span	=	5.058ft		Location of maximum on span	=	0.000ft	
Span # where maximum occurs	=	Span # 1		Span # where maximum occurs	=	Span # 1	
<b>Maximum Deflection</b>							
Max Downward Transient Deflection		0.551 in	Ratio =	478	>=	360	Span: 1 : L Only
Max Upward Transient Deflection		0 in	Ratio =	0	<	360	n/a
Max Downward Total Deflection		0.735 in	Ratio =	359	>=	240	Span: 1 : +D+L
Max Upward Total Deflection		0 in	Ratio =	0	<	240	n/a

**Maximum Forces & Stresses for Load Combinations**

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values					
			M	V	C <sub>d</sub>	C <sub>F/V</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	F'b	V	fv	F'v			
D Only	Length = 22.0 ft	1	0.148	0.074	0.90	1.000	1.00	1.00	1.00	1.00	1.00	10.57	385.42	2610.00	0.00	0.00	0.00	0.00	19.30	261.00
+D+L	Length = 22.0 ft	1	0.532	0.267	1.00	1.000	1.00	1.00	1.00	1.00	1.00	42.31	1,543.23	2900.00	0.00	0.00	0.00	0.00	77.31	290.00
+D+0.750L	Length = 22.0 ft	1	0.346	0.173	1.25	1.000	1.00	1.00	1.00	1.00	1.00	34.38	1,253.77	3625.00	0.00	0.00	0.00	0.00	62.81	362.50
+0.60D	Length = 22.0 ft	1	0.050	0.025	1.60	1.000	1.00	1.00	1.00	1.00	1.00	6.34	231.25	4640.00	0.00	0.00	0.00	0.00	11.58	464.00

**Overall Maximum Deflections**

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.7348	9.796		0.0000	0.000

**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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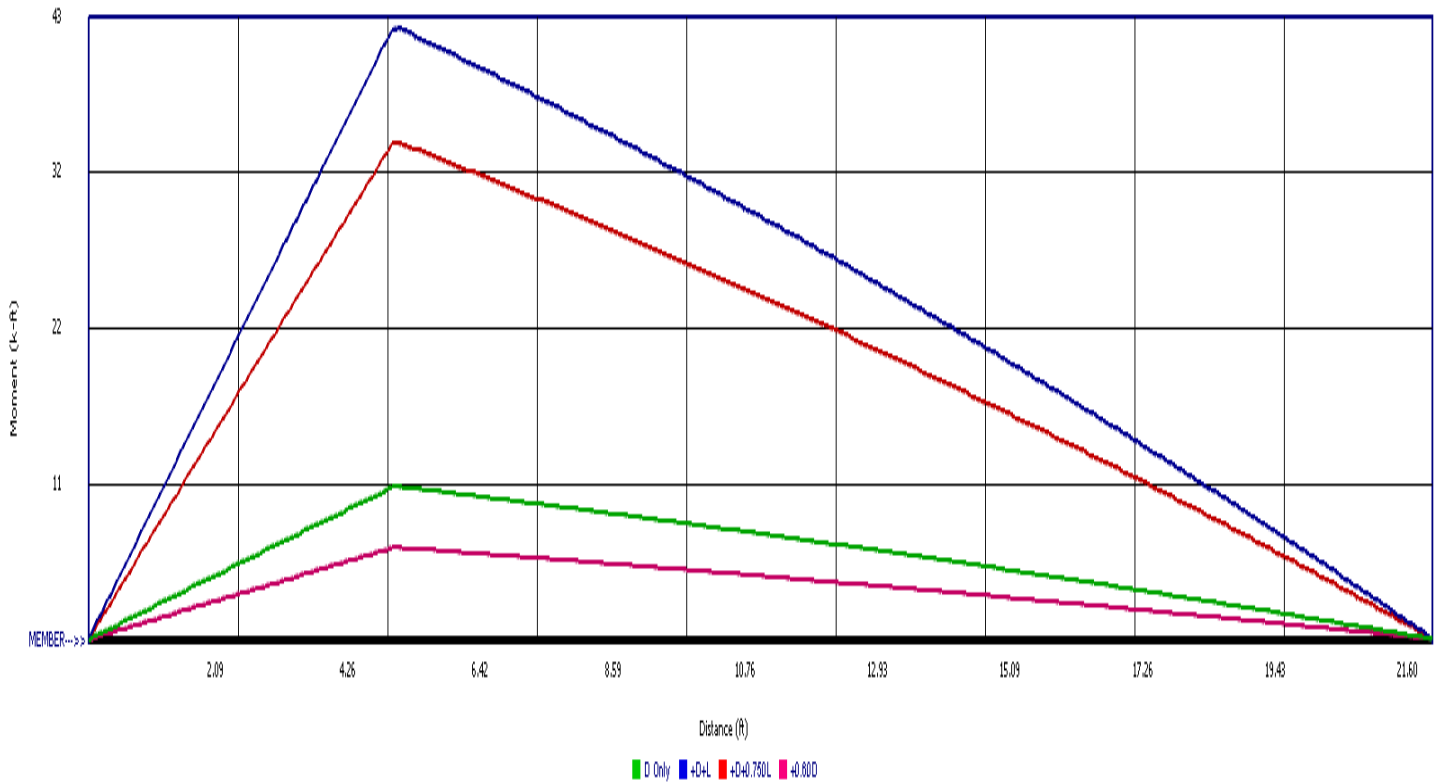
**DESCRIPTION: BM #11**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	8.619	2.947
Overall MINimum	6.467	2.213
D Only	2.152	0.734
+D+L	8.619	2.947
+D+0.750L	7.003	2.393
+0.60D	1.291	0.440
L Only	6.467	2.213



### Wood Beam

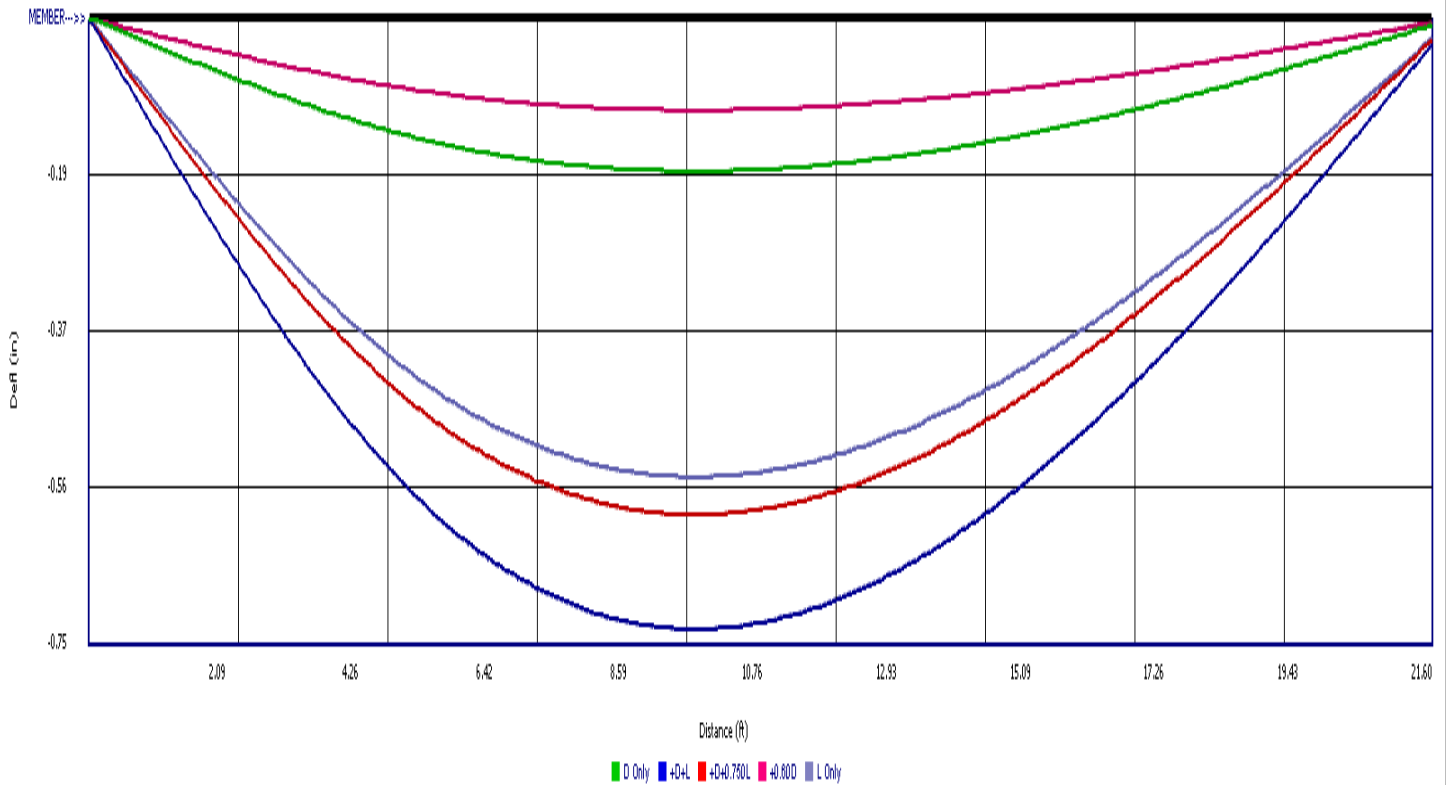
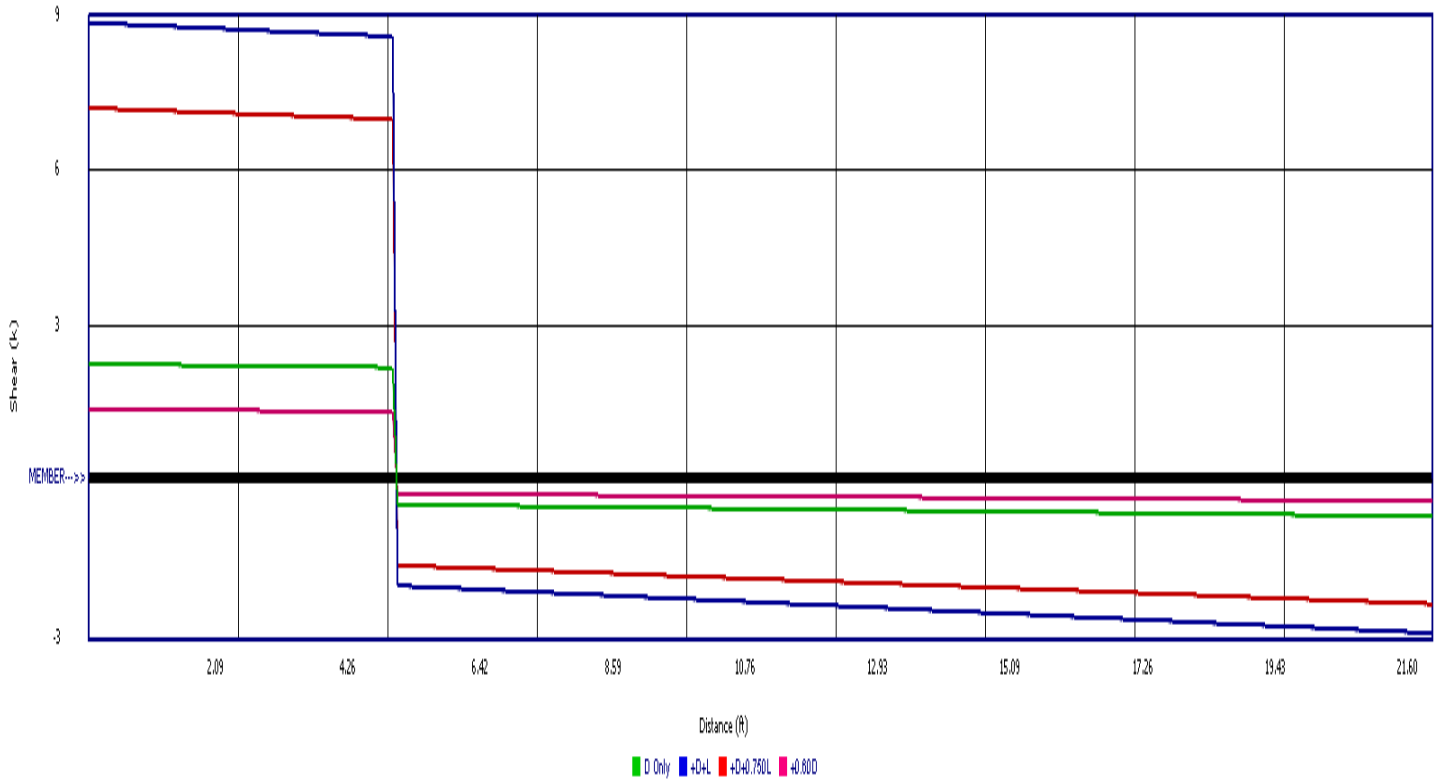
Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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DESCRIPTION: BM #11



**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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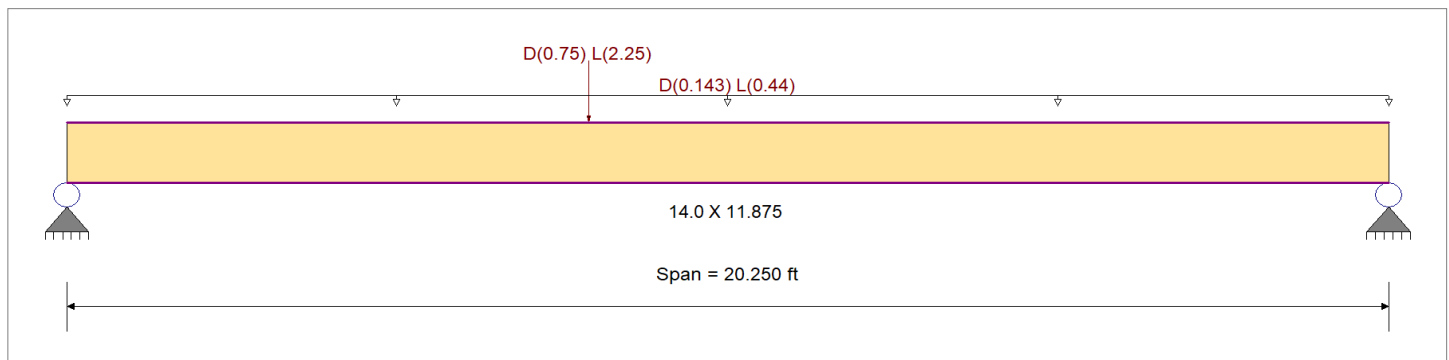
**DESCRIPTION: BM #12**

**CODE REFERENCES**

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

**Material Properties**

Analysis Method : Allowable Stress Design	Fb +	2,900.0 psi	E : Modulus of Elasticity
Load Combination : ASCE 7-16	Fb -	2,900.0 psi	Ebend- xx
	Fc - Prll	2,900.0 psi	Eminbend - xx
Wood Species : iLevel Truss Joist	Fc - Perp	750.0 psi	
Wood Grade : Parallam PSL 2.0E	Fv	290.0 psi	
	Ft	2,025.0 psi	Density
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling			45.070pcf



**Applied Loads**

Service loads entered. Load Factors will be applied for calculations.

Uniform Load : D = 0.0130, L = 0.040 ksf, Tributary Width = 11.0 ft  
 Point Load : D = 0.750, L = 2.250 k @ 8.0 ft

**DESIGN SUMMARY**

**Design OK**

<b>Maximum Bending Stress Ratio</b>	=	<b>0.542</b> : 1	<b>Maximum Shear Stress Ratio</b>	=	<b>0.223</b> : 1
Section used for this span	=	<b>14.0 X 11.875</b>	Section used for this span	=	<b>14.0 X 11.875</b>
fb: Actual	=	1,571.41 psi	fv: Actual	=	64.58 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	290.00 psi
Load Combination	=	+D+L	Load Combination	=	+D+L
Location of maximum on span	=	8.056ft	Location of maximum on span	=	0.000ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
<b>Maximum Deflection</b>					
Max Downward Transient Deflection	0.591 in	Ratio = 410 >=360	Span: 1 : L Only		
Max Upward Transient Deflection	0 in	Ratio = 0 <360	n/a		
Max Downward Total Deflection	0.785 in	Ratio = 309 >=240	Span: 1 : +D+L		
Max Upward Total Deflection	0 in	Ratio = 0 <240	n/a		

**Maximum Forces & Stresses for Load Combinations**

Load Combination	Segment Length	Span #	Max Stress Ratios								Moment Values			Shear Values						
			M	V	C <sub>d</sub>	C <sub>F/V</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	F'b	V	fv	F'v			
D Only	Length = 20.250 ft	1	0.149	0.061	0.90	1.000	1.00	1.00	1.00	1.00	1.00	10.64	387.93	2610.00	0.00	0.00	0.00	1.76	15.92	261.00
+D+L	Length = 20.250 ft	1	0.542	0.223	1.00	1.000	1.00	1.00	1.00	1.00	1.00	43.09	1,571.41	2900.00	0.00	0.00	0.00	7.16	64.58	290.00
+D+0.750L	Length = 20.250 ft	1	0.352	0.145	1.25	1.000	1.00	1.00	1.00	1.00	1.00	34.97	1,275.54	3625.00	0.00	0.00	0.00	5.81	52.41	362.50
+0.60D	Length = 20.250 ft	1	0.050	0.021	1.60	1.000	1.00	1.00	1.00	1.00	1.00	6.38	232.76	4640.00	0.00	0.00	0.00	1.06	9.55	464.00

**Overall Maximum Deflections**

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.7848	9.977		0.0000	0.000

**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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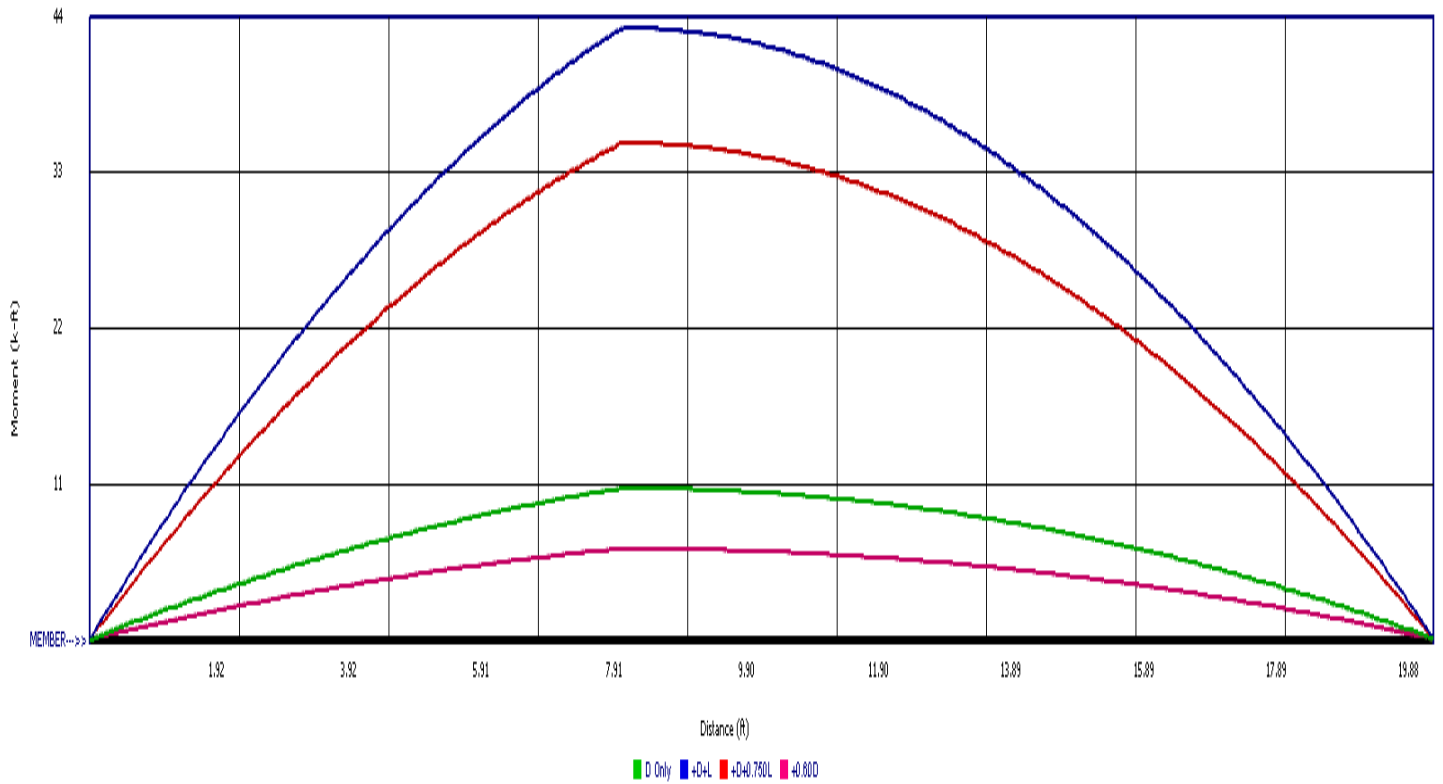
**DESCRIPTION: BM #12**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	7.718	7.088
Overall MINimum	5.816	5.344
D Only	1.902	1.744
+D+L	7.718	7.088
+D+0.750L	6.264	5.752
+0.60D	1.141	1.047
L Only	5.816	5.344



**Wood Beam**

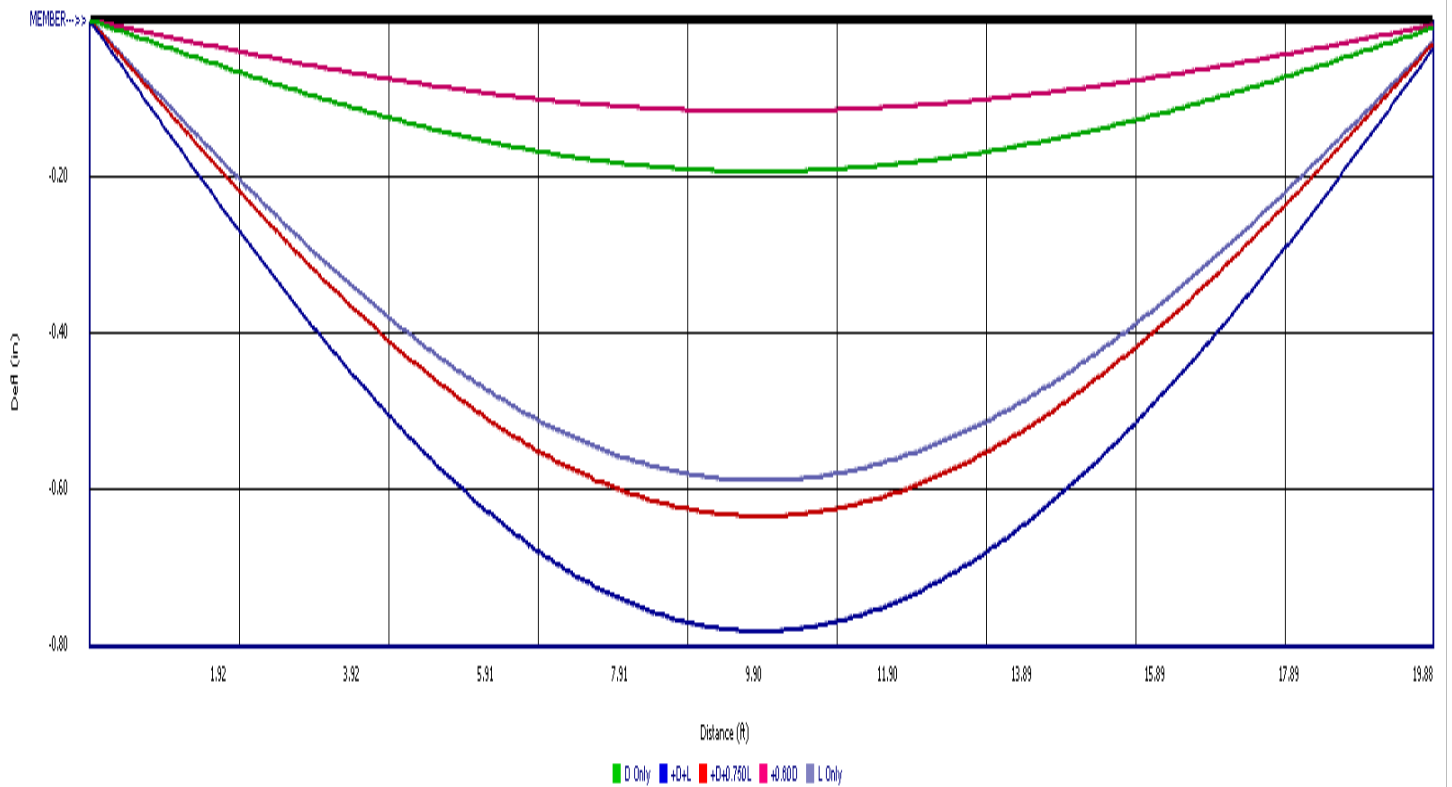
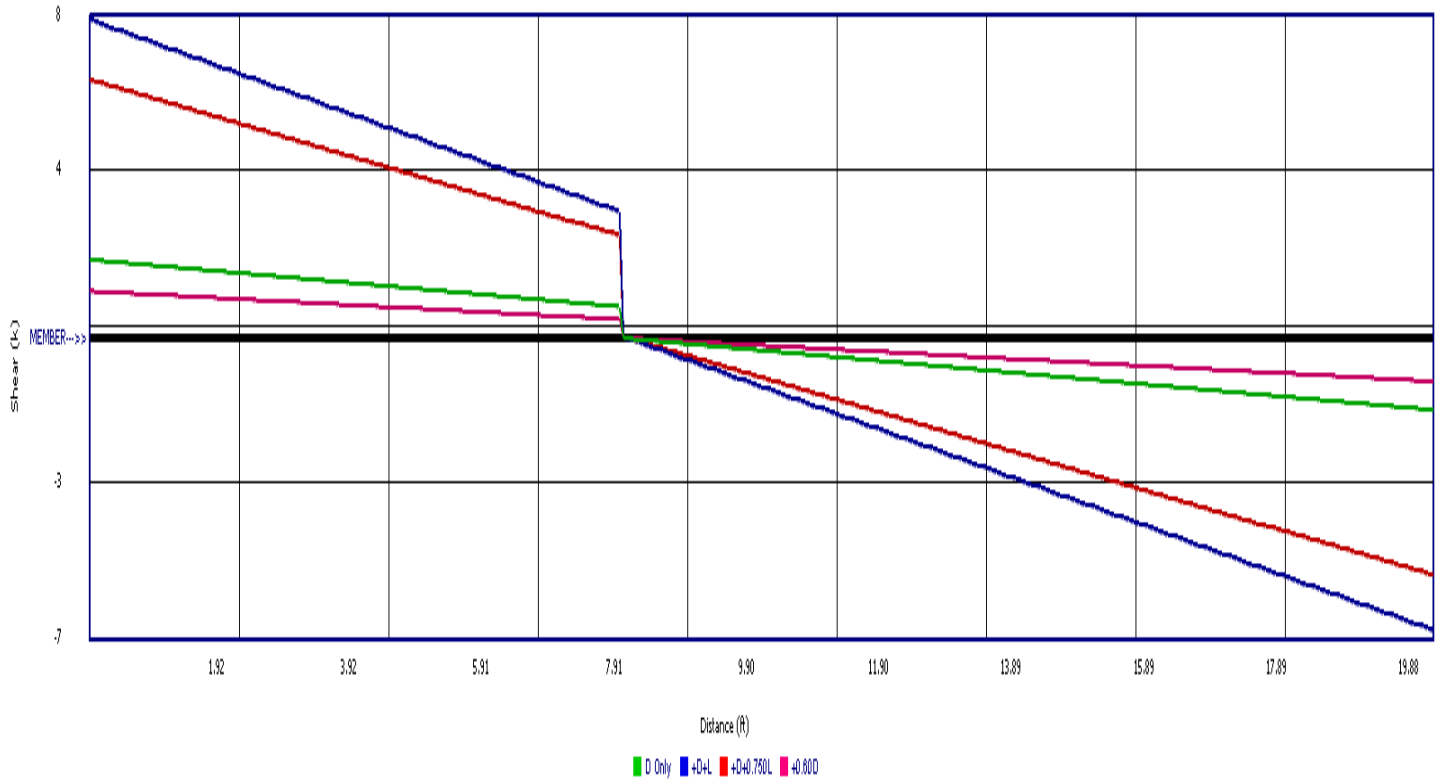
Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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**DESCRIPTION: BM #12**





**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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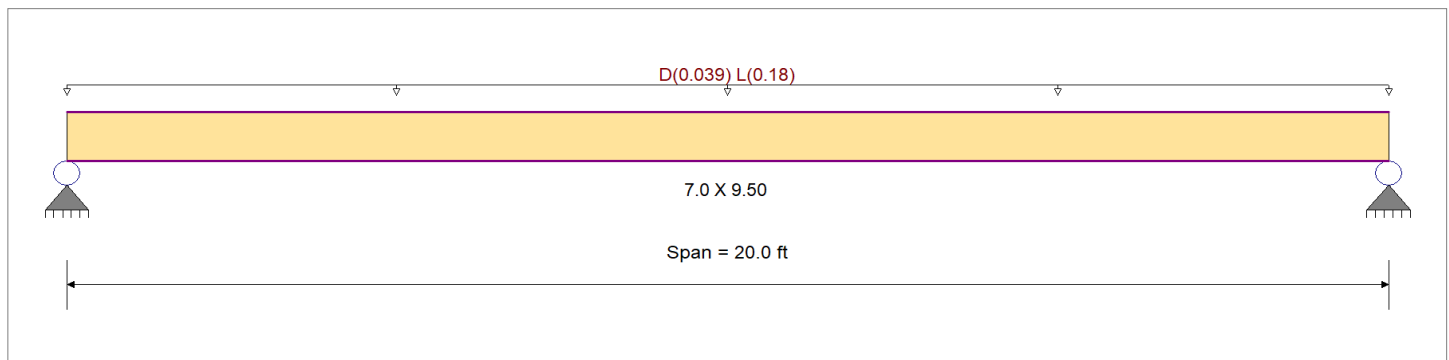
**DESCRIPTION: BM #13**

**CODE REFERENCES**

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

**Material Properties**

Analysis Method : Allowable Stress Design	Fb +	2,900.0 psi	E : Modulus of Elasticity
Load Combination : ASCE 7-16	Fb -	2,900.0 psi	Ebend- xx
	Fc - Prll	2,900.0 psi	Eminbend - xx
Wood Species : iLevel Truss Joist	Fc - Perp	750.0 psi	
Wood Grade : Parallam PSL 2.0E	Fv	290.0 psi	
	Ft	2,025.0 psi	Density
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling			45.070pcf



**Applied Loads**

Service loads entered. Load Factors will be applied for calculations.

Uniform Load : D = 0.0130, L = 0.060 ksf, Tributary Width = 3.0 ft

**DESIGN SUMMARY**

**Design OK**

<b>Maximum Bending Stress Ratio</b>	=	<b>0.430</b> : 1	<b>Maximum Shear Stress Ratio</b>	=	<b>0.158</b> : 1
Section used for this span		<b>7.0 X 9.50</b>	Section used for this span		<b>7.0 X 9.50</b>
fb: Actual	=	1,247.96 psi	fv: Actual	=	45.79 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	290.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	10.000ft	Location of maximum on span	=	0.000ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
<b>Maximum Deflection</b>					
Max Downward Transient Deflection		0.652 in	Ratio =	<b>368</b> >=360	Span: 1 : L Only
Max Upward Transient Deflection		0 in	Ratio =	<b>0</b> <360	n/a
Max Downward Total Deflection		0.793 in	Ratio =	<b>302</b> >=240	Span: 1 : +D+L
Max Upward Total Deflection		0 in	Ratio =	<b>0</b> <240	n/a

**Maximum Forces & Stresses for Load Combinations**

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values						
			M	V	C <sub>d</sub>	C <sub>F/V</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	F'b	V	fv	F'v				
D Only	Length = 20.0 ft	1	0.085	0.031	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.95	222.24	2610.00	0.00	0.00	0.00	0.00	8.15	261.00
+D+L	Length = 20.0 ft	1	0.430	0.158	1.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	10.95	1,247.96	2900.00	0.00	0.00	0.00	0.00	45.79	290.00
+D+0.750L	Length = 20.0 ft	1	0.274	0.100	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	8.70	991.53	3625.00	0.00	0.00	0.00	0.00	36.38	362.50
+0.60D	Length = 20.0 ft	1	0.029	0.011	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.17	133.34	4640.00	0.00	0.00	0.00	0.00	4.89	464.00

**Overall Maximum Deflections**

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.7928	10.073		0.0000	0.000

**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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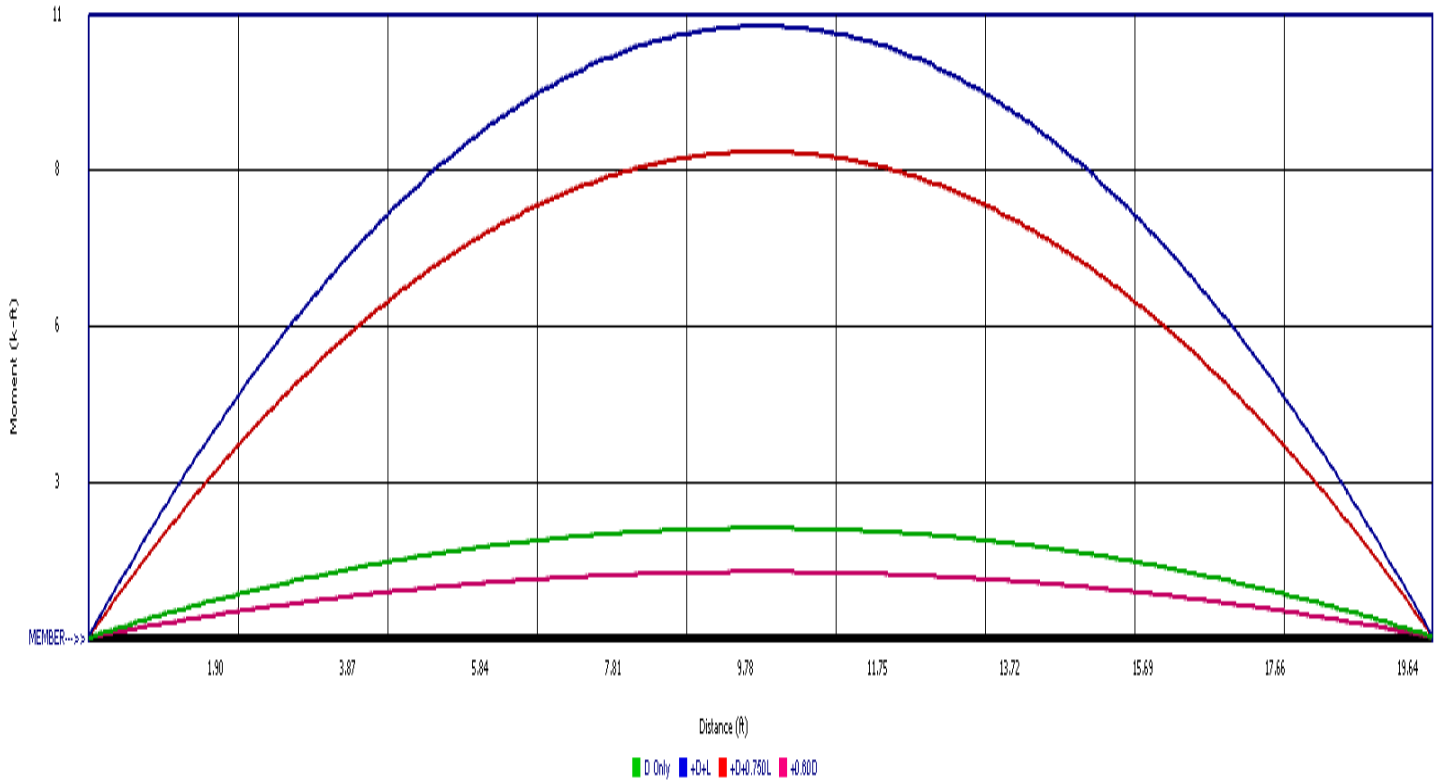
**DESCRIPTION: BM #13**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	2.190	2.190
Overall MINimum	1.800	1.800
D Only	0.390	0.390
+D+L	2.190	2.190
+D+0.750L	1.740	1.740
+0.60D	0.234	0.234
L Only	1.800	1.800



Wood Beam

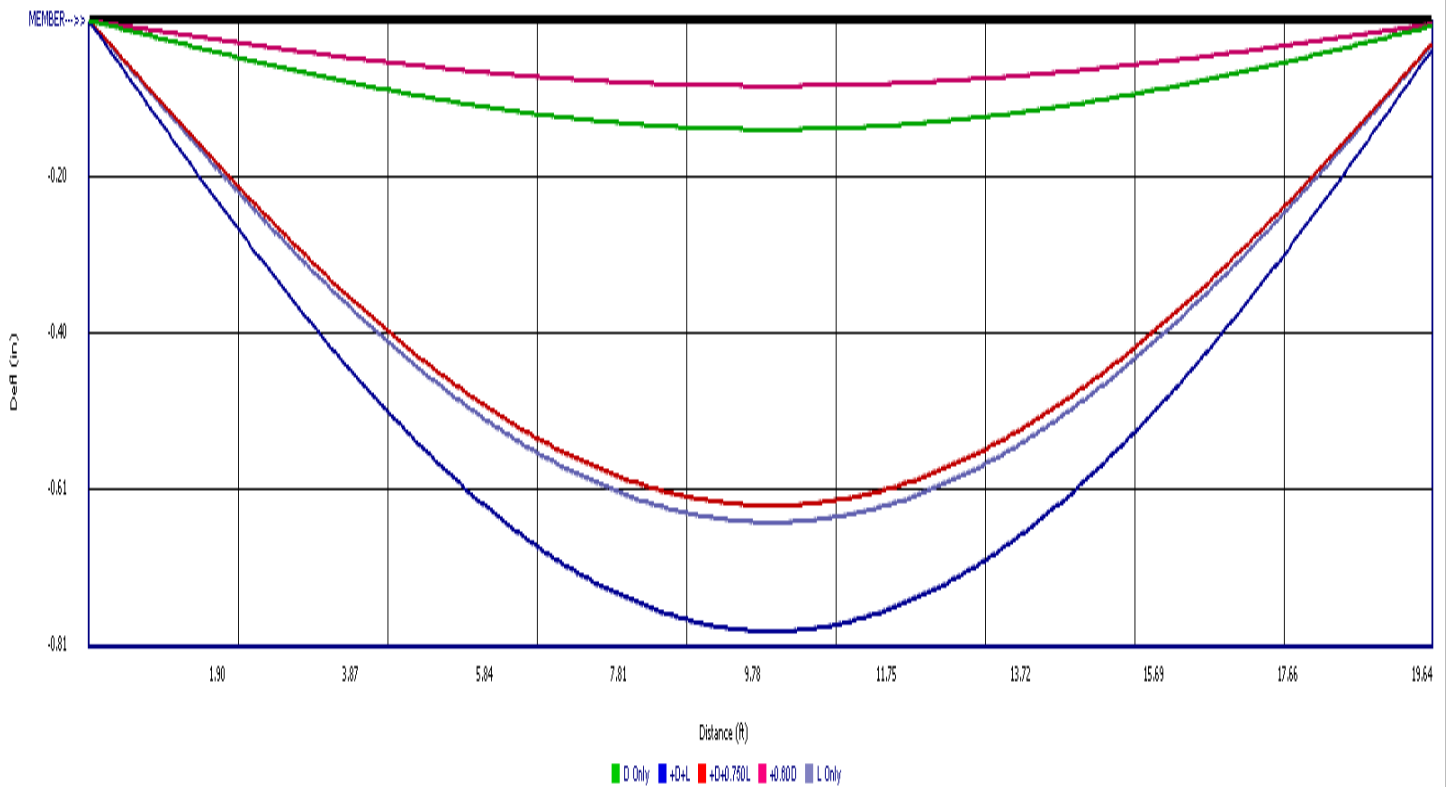
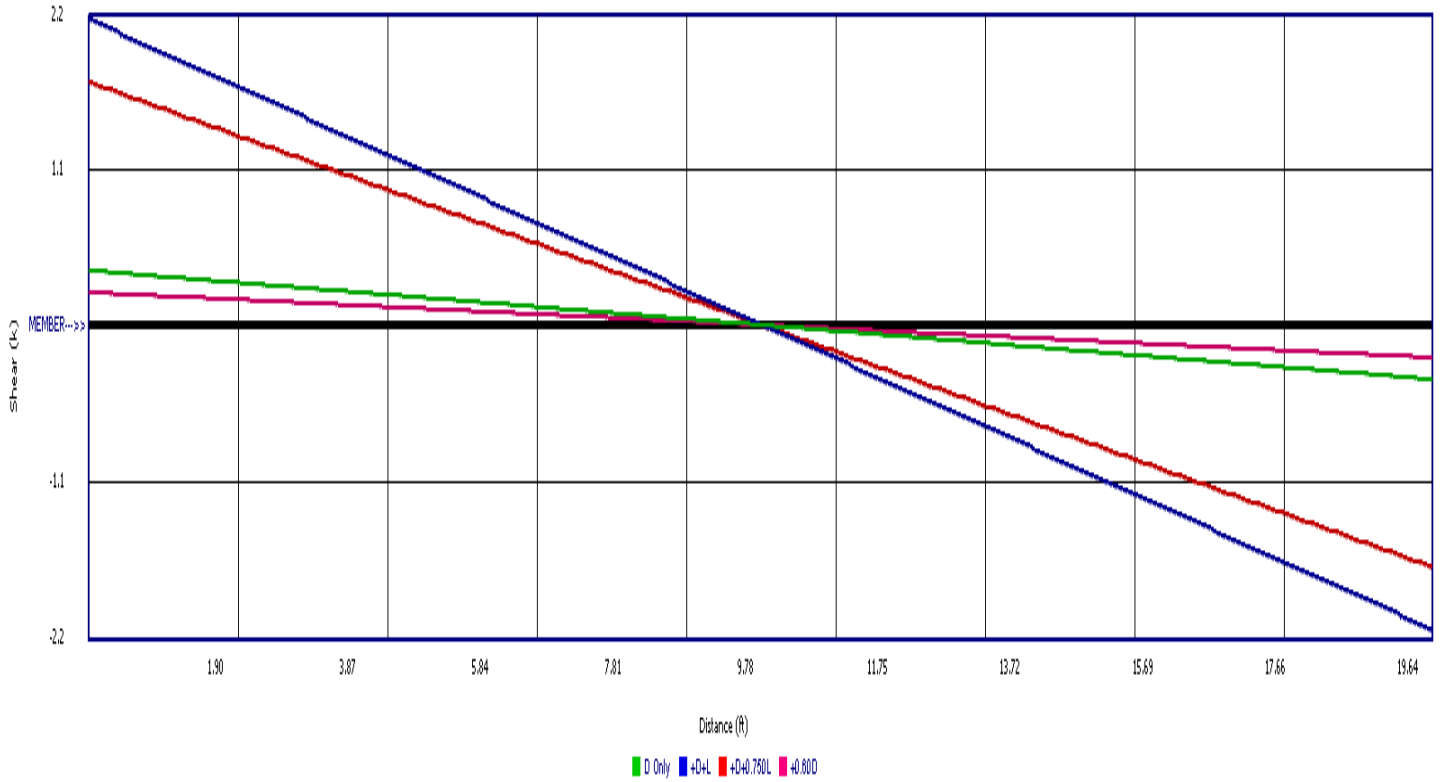
Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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DESCRIPTION: BM #13



**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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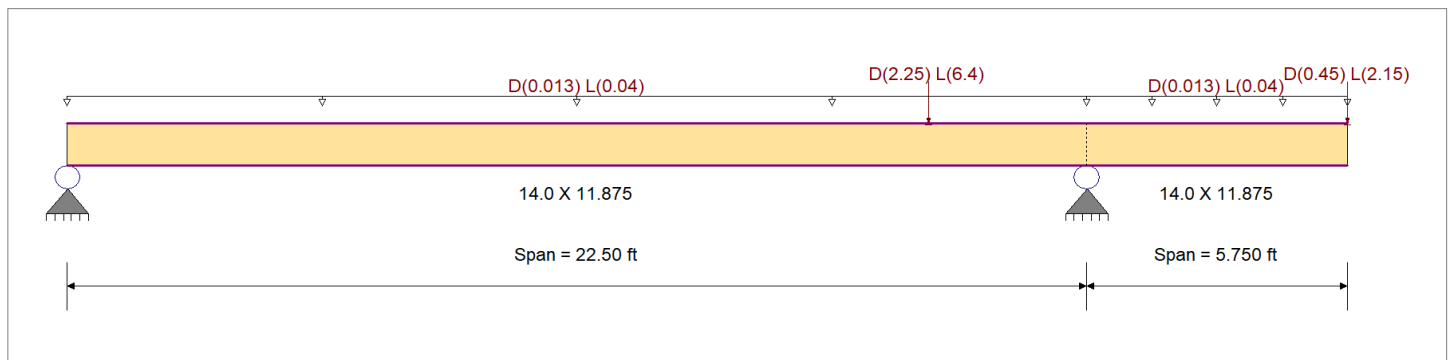
**DESCRIPTION: BM #14**

**CODE REFERENCES**

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

**Material Properties**

Analysis Method : Allowable Stress Design	Fb +	2,900.0 psi	E : Modulus of Elasticity
Load Combination : ASCE 7-16	Fb -	2,900.0 psi	Ebend- xx
	Fc - Prll	2,900.0 psi	Eminbend - xx
Wood Species : iLevel Truss Joist	Fc - Perp	750.0 psi	
Wood Grade : Parallam PSL 2.0E	Fv	290.0 psi	Density
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling	Ft	2,025.0 psi	45.070pcf



**Applied Loads**

Service loads entered. Load Factors will be applied for calculations.

Load for Span Number 1  
 Uniform Load : D = 0.0130, L = 0.040 ksf, Tributary Width = 1.0 ft  
 Point Load : D = 2.250, L = 6.40 k @ 19.0 ft  
 Load for Span Number 2  
 Uniform Load : D = 0.0130, L = 0.040 ksf, Tributary Width = 1.0 ft  
 Point Load : D = 0.450, L = 2.150 k @ 5.750 ft

**DESIGN SUMMARY**

**Design OK**

<b>Maximum Bending Stress Ratio</b>	=	<b>0.199</b> : 1	<b>Maximum Shear Stress Ratio</b>	=	<b>0.266</b> : 1
Section used for this span		<b>14.0 X 11.875</b>	Section used for this span		<b>14.0 X 11.875</b>
fb: Actual	=	577.18 psi	fv: Actual	=	77.21 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	290.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	0.000ft	Location of maximum on span	=	0.880ft
Span # where maximum occurs	=	Span # 2	Span # where maximum occurs	=	Span # 2
<b>Maximum Deflection</b>					
Max Downward Transient Deflection		0.183 in Ratio =	<b>1475</b> >=360	Span: 1 : L Only	
Max Upward Transient Deflection		-0.070 in Ratio =	<b>1966</b> >=360	Span: 2 : L Only	
Max Downward Total Deflection		0.271 in Ratio =	<b>995</b> >=240	Span: 1 : +D+L	
Max Upward Total Deflection		-0.136 in Ratio =	<b>1014</b> >=240	Span: 2 : +D+L	

**Maximum Forces & Stresses for Load Combinations**

Load Combination	Segment Length	Span #	Max Stress Ratios								Moment Values			Shear Values						
			M	V	C <sub>d</sub>	C <sub>F/V</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	F'b	V	fv	F'v			
D Only	Length = 22.50 ft	2	0.066	0.075	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	4.71	171.90	2610.00	0.00	0.00	0.00
	Length = 5.750 ft	2	0.039	0.075	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.80	102.20	2610.00	0.51	19.48	261.00
+D+L	Length = 22.50 ft	2	0.199	0.266	1.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	15.83	577.18	2900.00	0.00	0.00	0.00
	Length = 5.750 ft	2	0.199	0.266	1.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	15.83	577.18	2900.00	2.85	77.21	290.00
+D+0.750L	Length = 22.50 ft	2	0.126	0.173	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	12.57	458.44	3625.00	0.00	0.00	0.00
	Length = 5.750 ft	2	0.126	0.173	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	12.57	458.44	3625.00	2.27	62.78	362.50

**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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**DESCRIPTION: BM #14**

**Maximum Forces & Stresses for Load Combinations**

Load Combination	Segment Length	Span #	Max Stress Ratios								Moment Values			Shear Values				
			M	V	C <sub>d</sub>	C <sub>F/V</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	F'b	V	f <sub>v</sub>	F'v	
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00	0.00
Length = 22.50 ft	2		0.022	0.025	1.60	1.000	1.00	1.00	1.00	1.00	1.00	2.83	103.14	4640.00	1.30	11.69	464.00	
Length = 5.750 ft	2		0.013	0.025	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.68	61.32	4640.00	0.31	11.69	464.00	

**Overall Maximum Deflections**

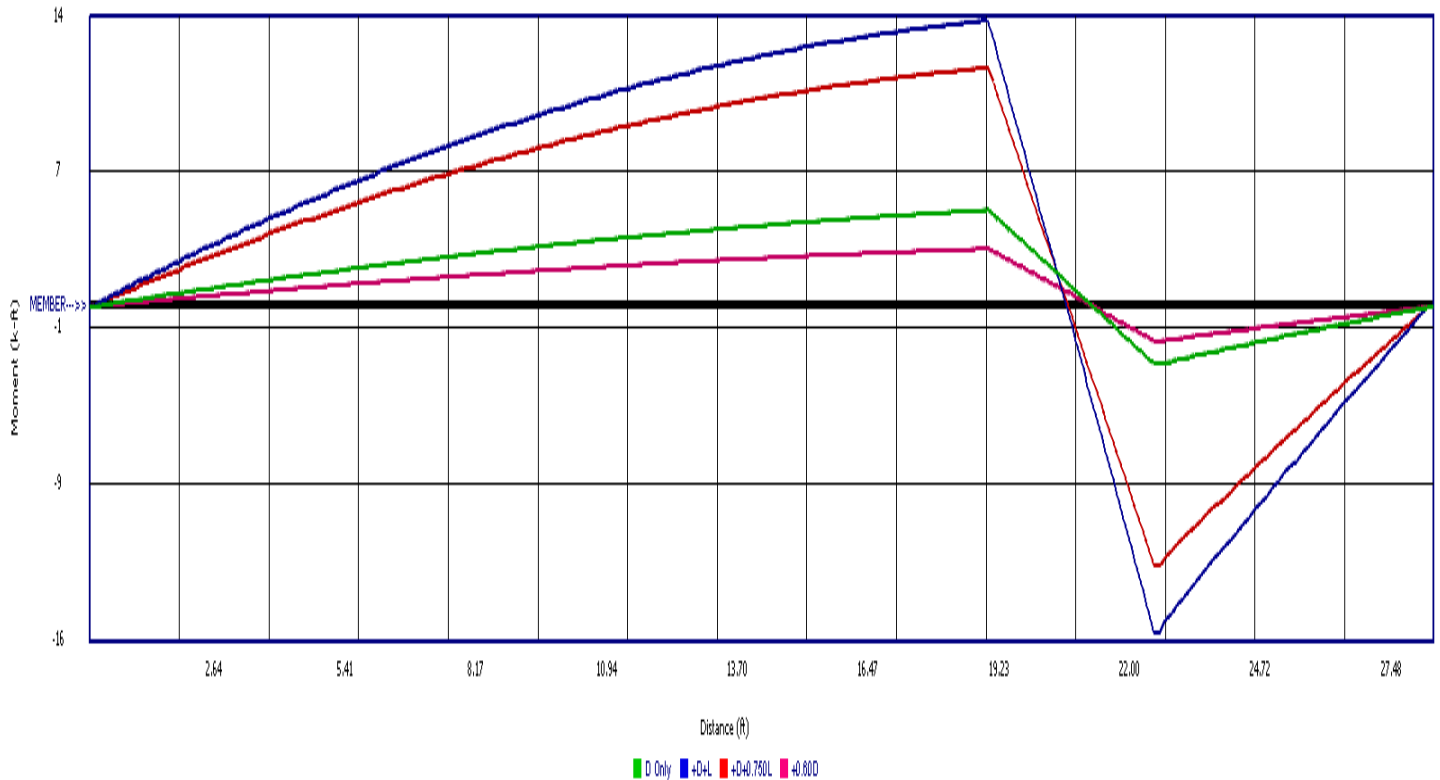
Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.2713	12.318		0.0000	0.000
	2	0.0000	12.318	+D+L	-0.1360	5.750

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum	1.238	11.509	
Overall MINimum	0.867	8.813	
D Only	0.372	2.696	
+D+L	1.238	11.509	
+D+0.750L	1.022	9.306	
+0.60D	0.223	1.617	
L Only	0.867	8.813	



**Wood Beam**

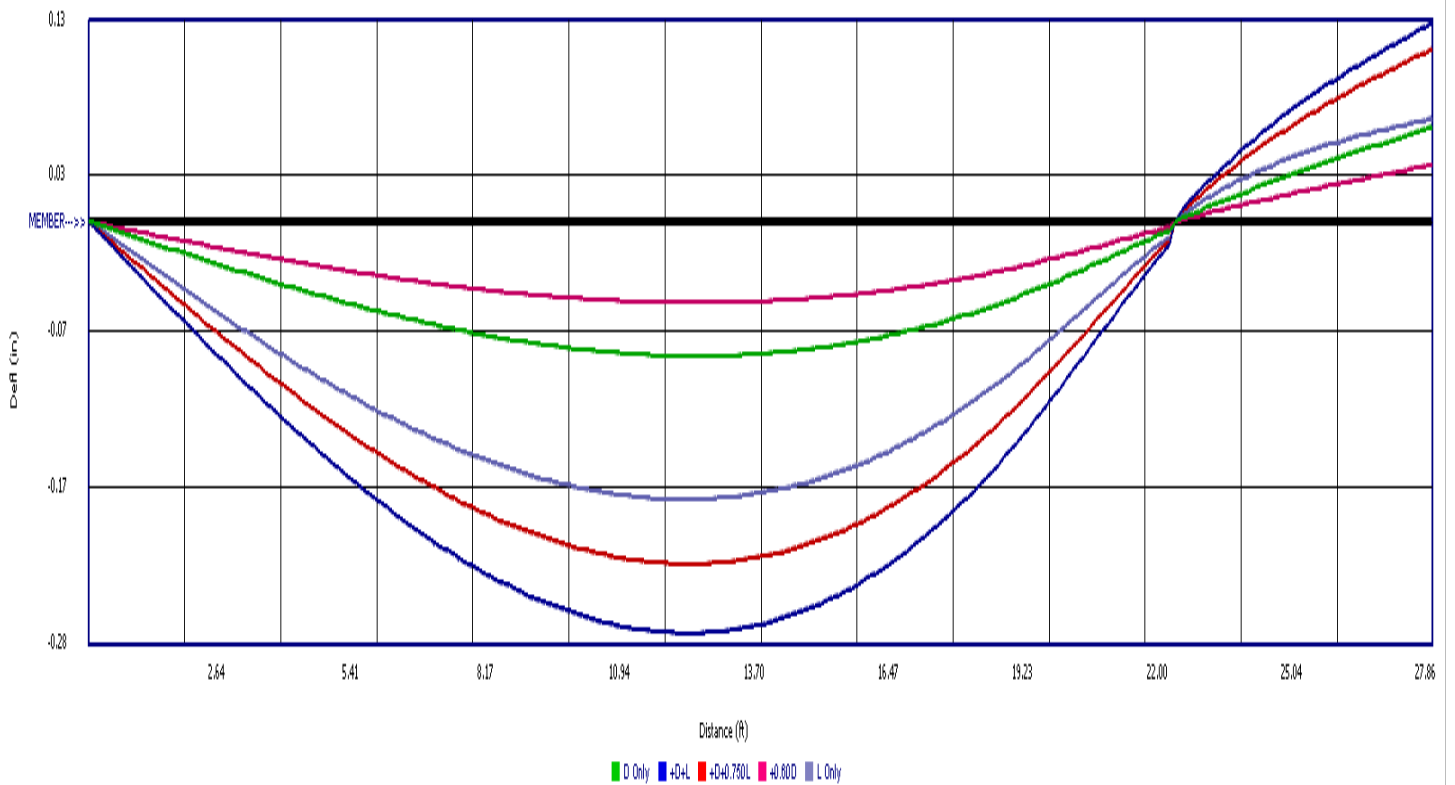
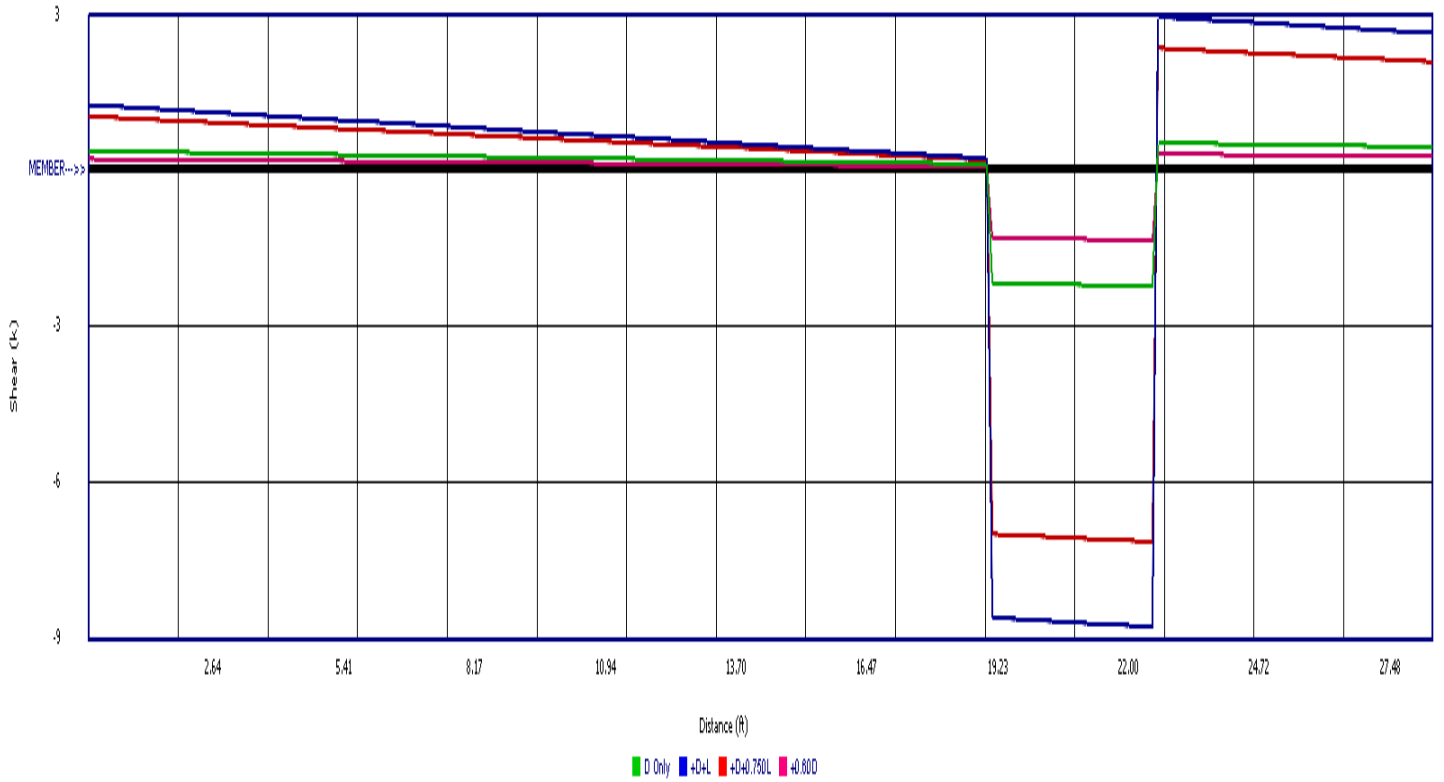
Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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**DESCRIPTION: BM #14**



**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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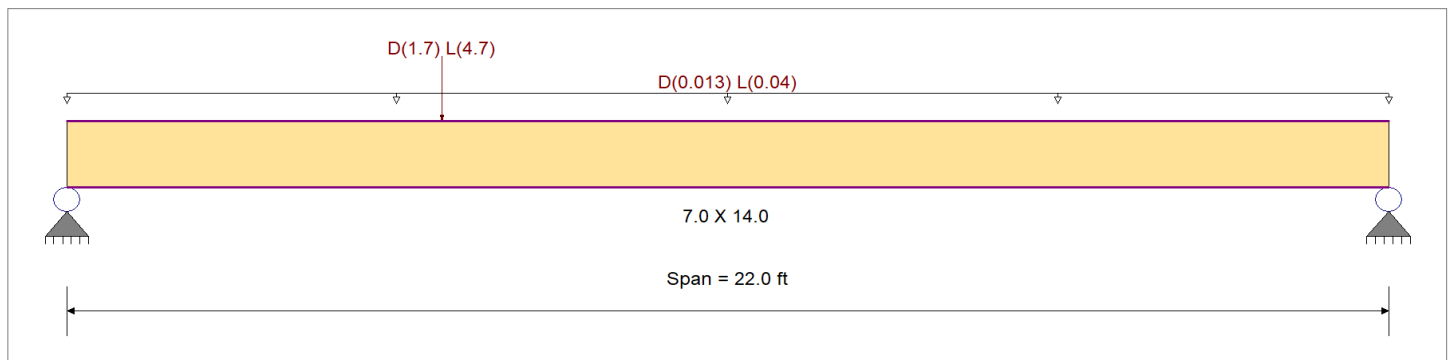
**DESCRIPTION: BM #15**

**CODE REFERENCES**

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combination Set : ASCE 7-16

**Material Properties**

Analysis Method : Allowable Stress Design	Fb +	2,900.0 psi	E : Modulus of Elasticity	
Load Combination : ASCE 7-16	Fb -	2,900.0 psi	Ebend- xx	2,000.0ksi
	Fc - Prll	2,900.0 psi	Eminbend - xx	1,016.54ksi
Wood Species : iLevel Truss Joist	Fc - Perp	750.0 psi		
Wood Grade : Parallam PSL 2.0E	Fv	290.0 psi		
	Ft	2,025.0 psi	Density	45.070pcf
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling				



**Applied Loads**

Service loads entered. Load Factors will be applied for calculations.

Uniform Load : D = 0.0130, L = 0.040 ksf, Tributary Width = 1.0 ft  
 Point Load : D = 1.70, L = 4.70 k @ 6.250 ft

**DESIGN SUMMARY**

**Design OK**

<b>Maximum Bending Stress Ratio</b>	=	<b>0.565</b> : 1	<b>Maximum Shear Stress Ratio</b>	=	<b>0.269</b> : 1
Section used for this span	=	<b>7.0 X 14.0</b>	Section used for this span	=	<b>7.0 X 14.0</b>
fb: Actual	=	1,638.63 psi	fv: Actual	=	78.14 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	290.00 psi
Load Combination	=	+D+L	Load Combination	=	+D+L
Location of maximum on span	=	6.263ft	Location of maximum on span	=	0.000ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
<b>Maximum Deflection</b>					
Max Downward Transient Deflection		0.502 in Ratio =	525	>=360	Span: 1 : L Only
Max Upward Transient Deflection		0 in Ratio =	0	<360	n/a
Max Downward Total Deflection		0.682 in Ratio =	387	>=240	Span: 1 : +D+L
Max Upward Total Deflection		0 in Ratio =	0	<240	n/a

**Maximum Forces & Stresses for Load Combinations**

Load Combination	Segment Length	Span #	Max Stress Ratios								Moment Values			Shear Values										
			M	V	C <sub>d</sub>	C <sub>F/V</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	F'b	V	fv	F'v							
D Only	Length = 22.0 ft	1	0.166	0.079	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	8.24	432.47	2610.00	0.00	0.00	0.00	1.35	20.59	261.00
+D+L	Length = 22.0 ft	1	0.565	0.269	1.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	31.22	1,638.63	2900.00	0.00	0.00	0.00	5.11	78.14	290.00
+D+0.750L	Length = 22.0 ft	1	0.369	0.176	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	25.48	1,337.09	3625.00	0.00	0.00	0.00	4.17	63.75	362.50
+0.60D	Length = 22.0 ft	1	0.056	0.027	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	4.94	259.48	4640.00	0.00	0.00	0.00	0.81	12.36	464.00

**Overall Maximum Deflections**

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.6815	10.036		0.0000	0.000

**Wood Beam**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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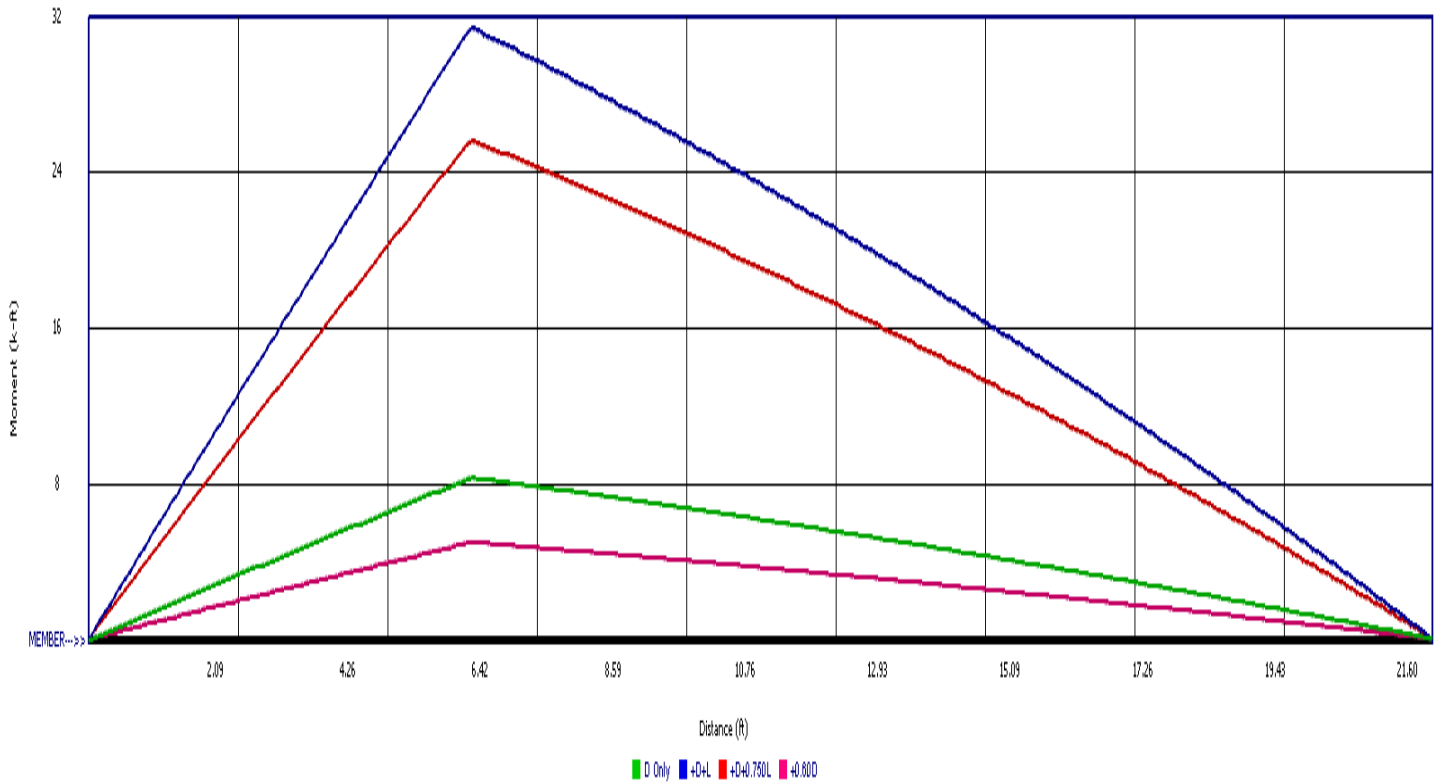
**DESCRIPTION: BM #15**

**Vertical Reactions**

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	5.165	2.401
Overall MINimum	3.805	1.775
D Only	1.360	0.626
+D+L	5.165	2.401
+D+0.750L	4.214	1.957
+0.60D	0.816	0.376
L Only	3.805	1.775





**Wood Beam**

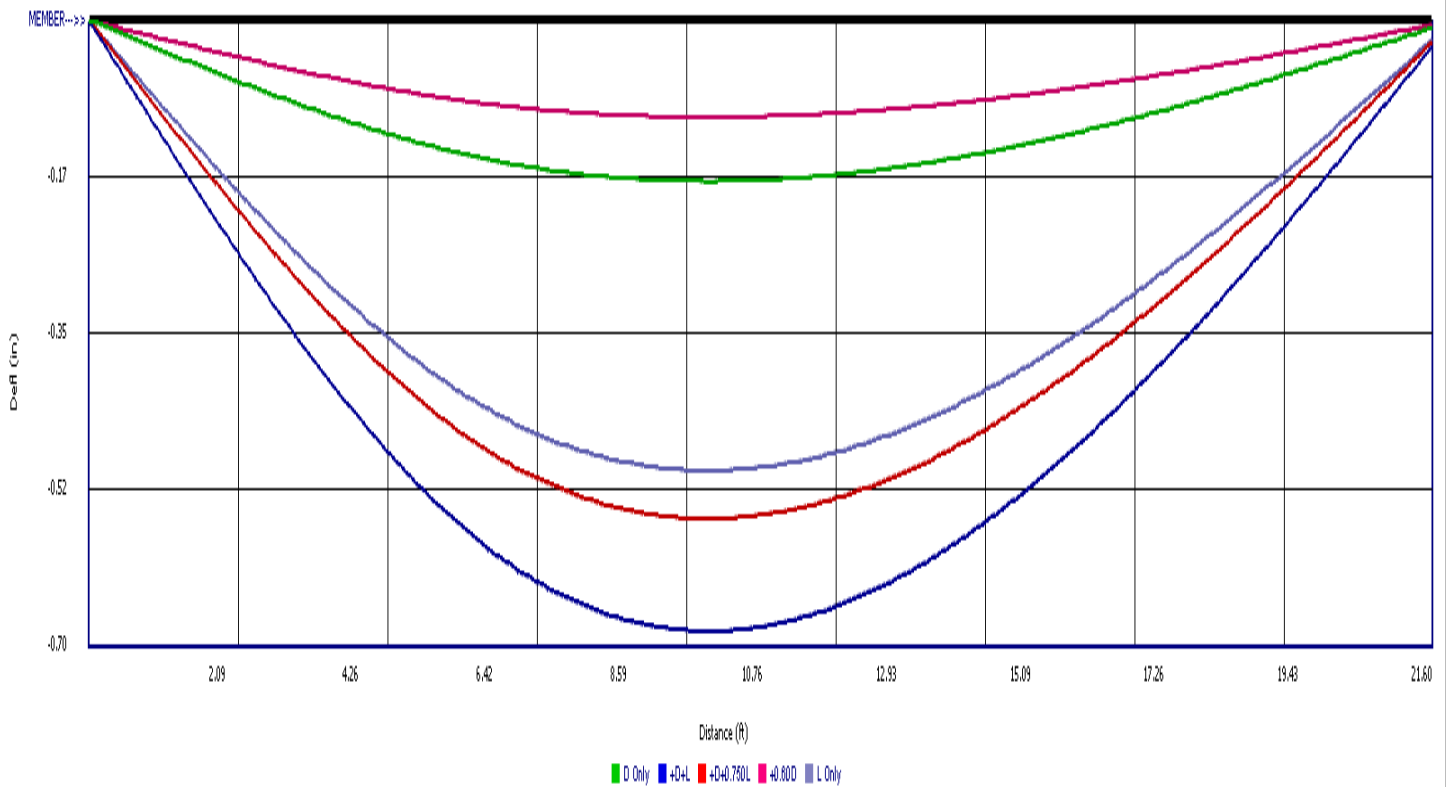
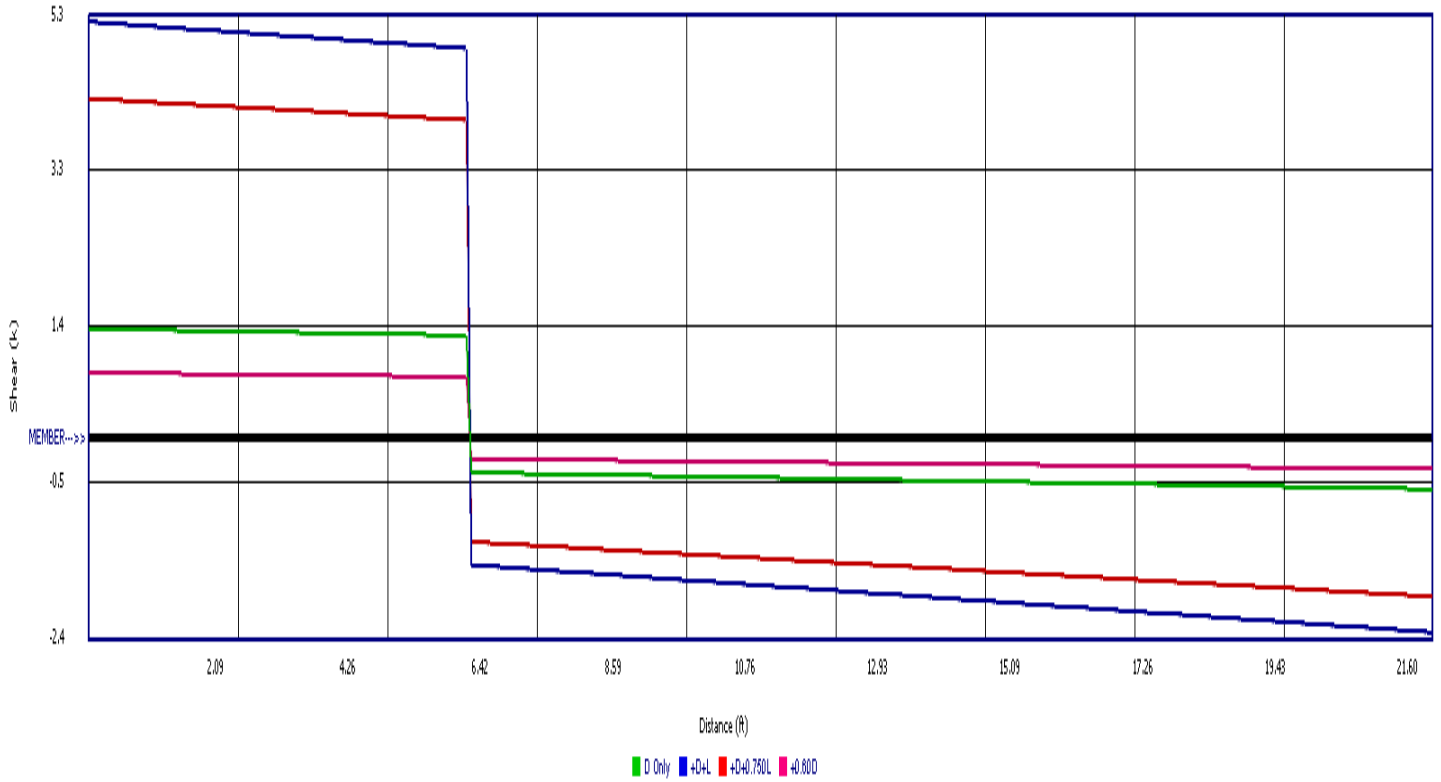
Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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**DESCRIPTION: BM #15**





**General Footing**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

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**DESCRIPTION: F #1**

**Code References**

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combinations Used : ASCE 7-16

**General Information**

**Material Properties**

f'c : Concrete 28 day strength	=	2.50 ksi
fy : Rebar Yield	=	40.0 ksi
Ec : Concrete Elastic Modulus	=	3,122.0 ksi
Concrete Density	=	145.0 pcf
φ Values Flexure	=	0.90
Shear	=	0.750

**Soil Design Values**

Allowable Soil Bearing	=	2.50 ksf
Soil Density	=	110.0 pcf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	250.0 pcf
Soil/Concrete Friction Coeff.	=	0.30

**Analysis Settings**

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	No
Use Pedestal wt for stability, mom & shear	:	No

**Increases based on footing depth**

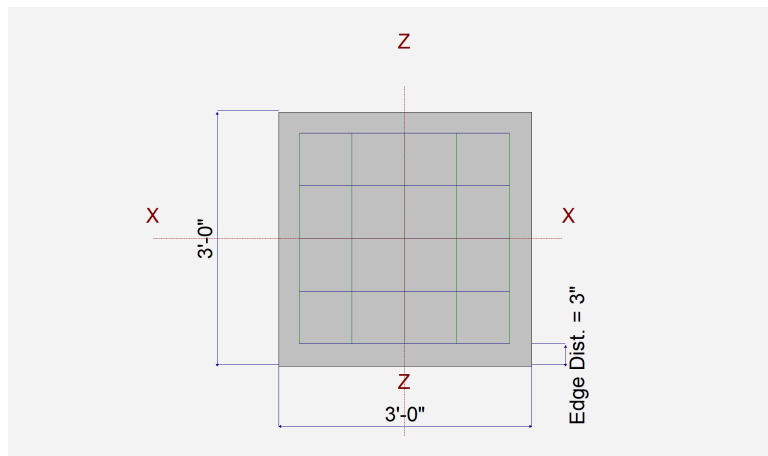
Footing base depth below soil surface	=	ft
Allow press. increase per foot of depth when footing base is below	=	ksf ft

**Increases based on footing plan dimension**

Allowable pressure increase per foot of depth when max. length or width is greater than	=	ksf ft
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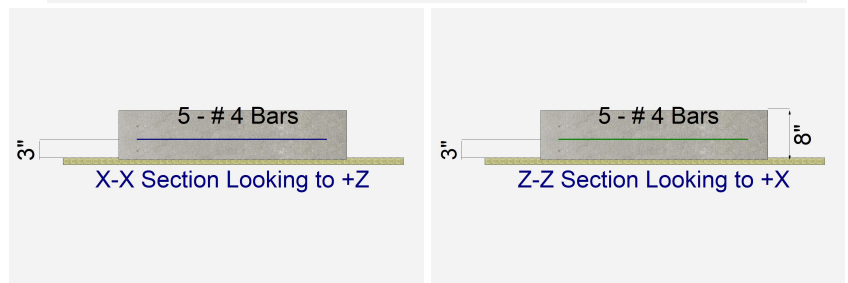
**Dimensions**

Width parallel to X-X Axis	=	3.0 ft
Length parallel to Z-Z Axis	=	3.0 ft
Footing Thickness	=	8.0 in
Pedestal dimensions...		
px : parallel to X-X Axis	=	6.0 in
pz : parallel to Z-Z Axis	=	6.0 in
Height	=	in
Rebar Centerline to Edge of Concrete... at Bottom of footing	=	3.0 in



**Reinforcing**

Bars parallel to X-X Axis	=	
Number of Bars	=	5.0
Reinforcing Bar Size	=	# 4
Bars parallel to Z-Z Axis	=	
Number of Bars	=	5.0
Reinforcing Bar Size	=	# 4
<b>Bandwidth Distribution Check (ACI 15.4.4.2)</b>		
Direction Requiring Closer Separation	=	n/a
# Bars required within zone	=	n/a
# Bars required on each side of zone	=	n/a



**Applied Loads**

	D	Lr	L	S	W	E	H
P : Column Load	=	3.20		10.10			k
OB : Overburden	=						ksf
M-xx	=						k-ft
M-zz	=						k-ft
V-x	=						k
V-z	=						k

**General Footing**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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**DESCRIPTION: F #1**

**DESIGN SUMMARY**

**Design OK**

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.6296	Soil Bearing	1.574 ksf	2.50 ksf	+D+L about Z-Z axis
PASS	n/a	Overturing - X-X	0.0 k-ft	0.0 k-ft	No Overturing
PASS	n/a	Overturing - Z-Z	0.0 k-ft	0.0 k-ft	No Overturing
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.3664	Z Flexure (+X)	1.736 k-ft/ft	4.739 k-ft/ft	+1.20D+1.60L
PASS	0.3664	Z Flexure (-X)	1.736 k-ft/ft	4.739 k-ft/ft	+1.20D+1.60L
PASS	0.3664	X Flexure (+Z)	1.736 k-ft/ft	4.739 k-ft/ft	+1.20D+1.60L
PASS	0.3664	X Flexure (-Z)	1.736 k-ft/ft	4.739 k-ft/ft	+1.20D+1.60L
PASS	0.4148	1-way Shear (+X)	31.111 psi	75.0 psi	+1.20D+1.60L
PASS	0.4148	1-way Shear (-X)	31.111 psi	75.0 psi	+1.20D+1.60L
PASS	0.4148	1-way Shear (+Z)	31.111 psi	75.0 psi	+1.20D+1.60L
PASS	0.4148	1-way Shear (-Z)	31.111 psi	75.0 psi	+1.20D+1.60L
PASS	0.5515	2-way Punching	82.727 psi	150.0 psi	+1.20D+1.60L

**Detailed Results**

**Soil Bearing**

Rotation Axis & Load Combination...	Gross Allowable	Xecc		Actual Soil Bearing Stress @ Location				Actual / Allow Ratio
		Zecc (in)		Bottom, -Z	Top, +Z	Left, -X	Right, +X	
X-X, D Only	2.50	n/a	0.0	0.4522	0.4522	n/a	n/a	0.181
X-X, +D+L	2.50	n/a	0.0	1.574	1.574	n/a	n/a	0.630
X-X, +D+0.750L	2.50	n/a	0.0	1.294	1.294	n/a	n/a	0.518
X-X, +0.60D	2.50	n/a	0.0	0.2713	0.2713	n/a	n/a	0.109
Z-Z, D Only	2.50	0.0	n/a	n/a	n/a	0.4522	0.4522	0.181
Z-Z, +D+L	2.50	0.0	n/a	n/a	n/a	1.574	1.574	0.630
Z-Z, +D+0.750L	2.50	0.0	n/a	n/a	n/a	1.294	1.294	0.518
Z-Z, +0.60D	2.50	0.0	n/a	n/a	n/a	0.2713	0.2713	0.109

**Overturing Stability**

Rotation Axis & Load Combination...	Overturing Moment	Resisting Moment	Stability Ratio	Status
Footing Has NO Overturing				

All units k

**Sliding Stability**

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
Footing Has NO Sliding				

**Footing Flexure**

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	0.3889	+Z	Bottom	0.1728	AsMin	0.3333	4.739	OK
X-X, +1.40D	0.3889	-Z	Bottom	0.1728	AsMin	0.3333	4.739	OK
X-X, +1.20D+1.60L	1.736	+Z	Bottom	0.1728	AsMin	0.3333	4.739	OK
X-X, +1.20D+1.60L	1.736	-Z	Bottom	0.1728	AsMin	0.3333	4.739	OK
X-X, +1.20D+L	1.210	+Z	Bottom	0.1728	AsMin	0.3333	4.739	OK
X-X, +1.20D+L	1.210	-Z	Bottom	0.1728	AsMin	0.3333	4.739	OK
X-X, +1.20D	0.3333	+Z	Bottom	0.1728	AsMin	0.3333	4.739	OK
X-X, +1.20D	0.3333	-Z	Bottom	0.1728	AsMin	0.3333	4.739	OK
X-X, +0.90D	0.250	+Z	Bottom	0.1728	AsMin	0.3333	4.739	OK
X-X, +0.90D	0.250	-Z	Bottom	0.1728	AsMin	0.3333	4.739	OK
Z-Z, +1.40D	0.3889	-X	Bottom	0.1728	AsMin	0.3333	4.739	OK
Z-Z, +1.40D	0.3889	+X	Bottom	0.1728	AsMin	0.3333	4.739	OK
Z-Z, +1.20D+1.60L	1.736	-X	Bottom	0.1728	AsMin	0.3333	4.739	OK
Z-Z, +1.20D+1.60L	1.736	+X	Bottom	0.1728	AsMin	0.3333	4.739	OK
Z-Z, +1.20D+L	1.210	-X	Bottom	0.1728	AsMin	0.3333	4.739	OK
Z-Z, +1.20D+L	1.210	+X	Bottom	0.1728	AsMin	0.3333	4.739	OK
Z-Z, +1.20D	0.3333	-X	Bottom	0.1728	AsMin	0.3333	4.739	OK

Project Title:  
 Engineer:  
 Project ID:  
 Project Descr:

F4/7

**General Footing**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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**DESCRIPTION: F #1**

**Footing Flexure**

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
Z-Z, +1.20D	0.3333	+X	Bottom	0.1728	AsMin	0.3333	4.739	OK
Z-Z, +0.90D	0.250	-X	Bottom	0.1728	AsMin	0.3333	4.739	OK
Z-Z, +0.90D	0.250	+X	Bottom	0.1728	AsMin	0.3333	4.739	OK

**One Way Shear**

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	6.97 psi	6.97 psi	6.97 psi	6.97 psi	6.97 psi	75.00 psi	0.09	OK
+1.20D+1.60L	31.11 psi	31.11 psi	31.11 psi	31.11 psi	31.11 psi	75.00 psi	0.41	OK
+1.20D+L	21.68 psi	21.68 psi	21.68 psi	21.68 psi	21.68 psi	75.00 psi	0.29	OK
+1.20D	5.97 psi	5.97 psi	5.97 psi	5.97 psi	5.97 psi	75.00 psi	0.08	OK
+0.90D	4.48 psi	4.48 psi	4.48 psi	4.48 psi	4.48 psi	75.00 psi	0.06	OK

All units k

**Two-Way "Punching" Shear**

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	18.53 psi	150.00psi	0.1235	OK
+1.20D+1.60L	82.73 psi	150.00psi	0.5515	OK
+1.20D+L	57.66 psi	150.00psi	0.3844	OK
+1.20D	15.88 psi	150.00psi	0.1059	OK
+0.90D	11.91 psi	150.00psi	0.07942	OK

**General Footing**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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**DESCRIPTION: F #2**

**Code References**

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16  
 Load Combinations Used : ASCE 7-16

**General Information**

**Material Properties**

f'c : Concrete 28 day strength	=	2.50 ksi
fy : Rebar Yield	=	40.0 ksi
Ec : Concrete Elastic Modulus	=	3,122.0 ksi
Concrete Density	=	145.0 pcf
φ Values Flexure	=	0.90
Shear	=	0.750

**Soil Design Values**

Allowable Soil Bearing	=	2.50 ksf
Soil Density	=	110.0 pcf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	250.0 pcf
Soil/Concrete Friction Coeff.	=	0.30

**Analysis Settings**

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	No
Use Pedestal wt for stability, mom & shear	:	No

**Increases based on footing depth**

Footing base depth below soil surface	=	ft
Allow press. increase per foot of depth when footing base is below	=	ksf ft

**Increases based on footing plan dimension**

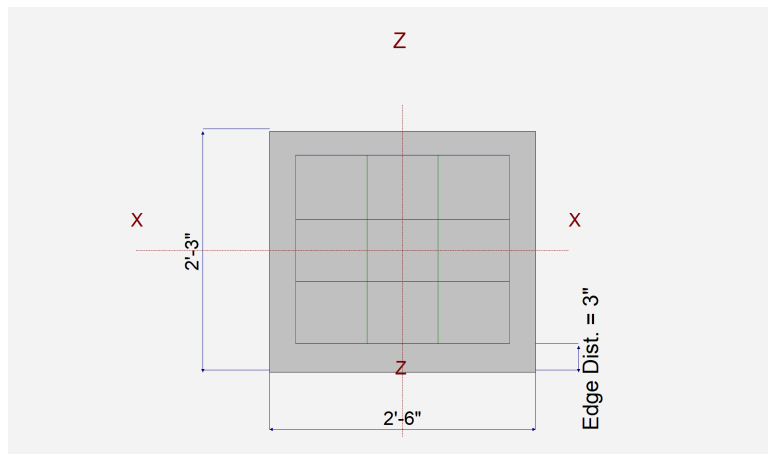
Allowable pressure increase per foot of depth when max. length or width is greater than	=	ksf ft
---	---	-----------

**Dimensions**

Width parallel to X-X Axis	=	2.50 ft
Length parallel to Z-Z Axis	=	2.250 ft
Footing Thickness	=	8.0 in

**Pedestal dimensions...**

px : parallel to X-X Axis	=	6.0 in
pz : parallel to Z-Z Axis	=	6.0 in
Height	=	in
Rebar Centerline to Edge of Concrete... at Bottom of footing	=	3.0 in

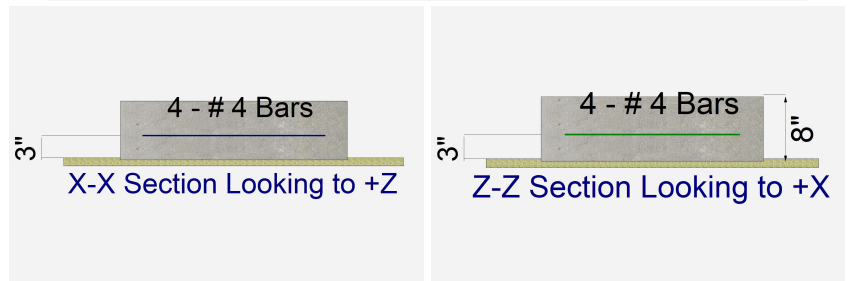


**Reinforcing**

<b>Bars parallel to X-X Axis</b>		
Number of Bars	=	4
Reinforcing Bar Size	=	# 4
<b>Bars parallel to Z-Z Axis</b>		
Number of Bars	=	4
Reinforcing Bar Size	=	# 4

**Bandwidth Distribution Check (ACI 15.4.4.2)**

Direction Requiring Closer Separation		
	Bars along Z-Z Axis	
# Bars required within zone		94.7 %
# Bars required on each side of zone		5.3 %



**Applied Loads**

	D	Lr	L	S	W	E	H
P : Column Load	=	3.30		10.0			k
OB : Overburden	=						ksf
M-xx	=						k-ft
M-zz	=						k-ft
V-x	=						k
V-z	=						k

**General Footing**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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**DESCRIPTION: F #2**

**DESIGN SUMMARY**

**Design OK**

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.9844	Soil Bearing	2.461 ksf	2.50 ksf	+D+L about Z-Z axis
PASS	n/a	Overturing - X-X	0.0 k-ft	0.0 k-ft	No Overturing
PASS	n/a	Overturing - Z-Z	0.0 k-ft	0.0 k-ft	No Overturing
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.3523	Z Flexure (+X)	1.774 k-ft/ft	5.036 k-ft/ft	+1.20D+1.60L
PASS	0.3523	Z Flexure (-X)	1.774 k-ft/ft	5.036 k-ft/ft	+1.20D+1.60L
PASS	0.2980	X Flexure (+Z)	1.358 k-ft/ft	4.559 k-ft/ft	+1.20D+1.60L
PASS	0.2980	X Flexure (-Z)	1.358 k-ft/ft	4.559 k-ft/ft	+1.20D+1.60L
PASS	0.4534	1-way Shear (+X)	34.006 psi	75.0 psi	+1.20D+1.60L
PASS	0.4534	1-way Shear (-X)	34.006 psi	75.0 psi	+1.20D+1.60L
PASS	0.3548	1-way Shear (+Z)	26.613 psi	75.0 psi	+1.20D+1.60L
PASS	0.3548	1-way Shear (-Z)	26.613 psi	75.0 psi	+1.20D+1.60L
PASS	0.5178	2-way Punching	77.663 psi	150.0 psi	+1.20D+1.60L

**Detailed Results**

**Soil Bearing**

Rotation Axis & Load Combination...	Gross Allowable	Xecc		Actual Soil Bearing Stress @ Location				Actual / Allow Ratio
		Zecc (in)		Bottom, -Z	Top, +Z	Left, -X	Right, +X	
X-X, D Only	2.50	n/a	0.0	0.6833	0.6833	n/a	n/a	0.273
X-X, +D+L	2.50	n/a	0.0	2.461	2.461	n/a	n/a	0.984
X-X, +D+0.750L	2.50	n/a	0.0	2.017	2.017	n/a	n/a	0.807
X-X, +0.60D	2.50	n/a	0.0	0.410	0.410	n/a	n/a	0.164
Z-Z, D Only	2.50	0.0	n/a	n/a	n/a	0.6833	0.6833	0.273
Z-Z, +D+L	2.50	0.0	n/a	n/a	n/a	2.461	2.461	0.984
Z-Z, +D+0.750L	2.50	0.0	n/a	n/a	n/a	2.017	2.017	0.807
Z-Z, +0.60D	2.50	0.0	n/a	n/a	n/a	0.410	0.410	0.164

**Overturing Stability**

Rotation Axis & Load Combination...	Overturing Moment	Resisting Moment	Stability Ratio	Status
Footing Has NO Overturing				

All units k

**Sliding Stability**

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
Footing Has NO Sliding				

**Footing Flexure**

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	0.3144	+Z	Bottom	0.1728	AsMin	0.320	4.559	OK
X-X, +1.40D	0.3144	-Z	Bottom	0.1728	AsMin	0.320	4.559	OK
X-X, +1.20D+1.60L	1.358	+Z	Bottom	0.1728	AsMin	0.320	4.559	OK
X-X, +1.20D+1.60L	1.358	-Z	Bottom	0.1728	AsMin	0.320	4.559	OK
X-X, +1.20D+L	0.950	+Z	Bottom	0.1728	AsMin	0.320	4.559	OK
X-X, +1.20D+L	0.950	-Z	Bottom	0.1728	AsMin	0.320	4.559	OK
X-X, +1.20D	0.2695	+Z	Bottom	0.1728	AsMin	0.320	4.559	OK
X-X, +1.20D	0.2695	-Z	Bottom	0.1728	AsMin	0.320	4.559	OK
X-X, +0.90D	0.2021	+Z	Bottom	0.1728	AsMin	0.320	4.559	OK
X-X, +0.90D	0.2021	-Z	Bottom	0.1728	AsMin	0.320	4.559	OK
Z-Z, +1.40D	0.4107	-X	Bottom	0.1728	AsMin	0.3556	5.036	OK
Z-Z, +1.40D	0.4107	+X	Bottom	0.1728	AsMin	0.3556	5.036	OK
Z-Z, +1.20D+1.60L	1.774	-X	Bottom	0.1728	AsMin	0.3556	5.036	OK
Z-Z, +1.20D+1.60L	1.774	+X	Bottom	0.1728	AsMin	0.3556	5.036	OK
Z-Z, +1.20D+L	1.241	-X	Bottom	0.1728	AsMin	0.3556	5.036	OK
Z-Z, +1.20D+L	1.241	+X	Bottom	0.1728	AsMin	0.3556	5.036	OK
Z-Z, +1.20D	0.3520	-X	Bottom	0.1728	AsMin	0.3556	5.036	OK

Project Title:  
 Engineer:  
 Project ID:  
 Project Descr:

F7/7

**General Footing**

Project File: Mercer Island.ec6

LIC# : KW-06015928, Build:20.21.12.16

RB Engineers, Inc.

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**DESCRIPTION: F #2**

**Footing Flexure**

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
Z-Z, +1.20D	0.3520	+X	Bottom	0.1728	AsMin	0.3556	5.036	OK
Z-Z, +0.90D	0.2640	-X	Bottom	0.1728	AsMin	0.3556	5.036	OK
Z-Z, +0.90D	0.2640	+X	Bottom	0.1728	AsMin	0.3556	5.036	OK

**One Way Shear**

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	7.87 psi	7.87 psi	6.16 psi	6.16 psi	7.87 psi	75.00 psi	0.10	OK
+1.20D+1.60L	34.01 psi	34.01 psi	26.61 psi	26.61 psi	34.01 psi	75.00 psi	0.45	OK
+1.20D+L	23.78 psi	23.78 psi	18.61 psi	18.61 psi	23.78 psi	75.00 psi	0.32	OK
+1.20D	6.75 psi	6.75 psi	5.28 psi	5.28 psi	6.75 psi	75.00 psi	0.09	OK
+0.90D	5.06 psi	5.06 psi	3.96 psi	3.96 psi	5.06 psi	75.00 psi	0.07	OK

All units k

**Two-Way "Punching" Shear**

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	17.98 psi	150.00psi	0.1198	OK
+1.20D+1.60L	77.66 psi	150.00psi	0.5178	OK
+1.20D+L	54.32 psi	150.00psi	0.3621	OK
+1.20D	15.41 psi	150.00psi	0.1027	OK
+0.90D	11.56 psi	150.00psi	0.07704	OK



RI

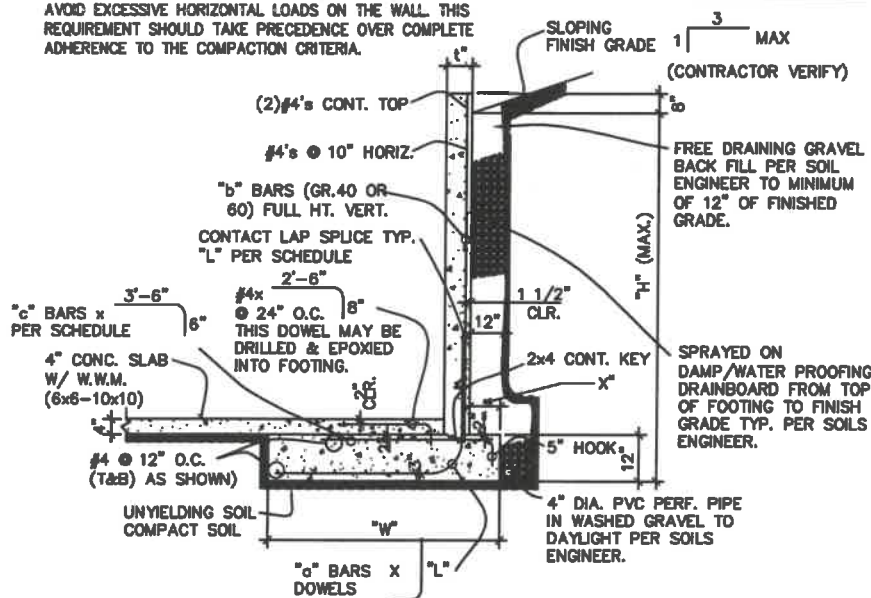
**RETAINING WALL NOTES:**

1. 2,000 PSF SOIL BEARING, 0.4 CO. OF FRICTION
2. 35 PCF EQUIV. FLUID PRESSURE, 250 PCF PASSIVE PRESSURE.
3. 2,500 PSI CONCRETE.
4. GRADE 40 OR 60 REINF.
5. CONTRACTOR SHALL VERIFY ALL EXISTING & FINISH GRADES PRIOR TO CONSTRUCTION.
6. REINFORCING SHALL BE INSPECTED POURING CONCRETE.
7. BUILDING INSPECTOR/SOILS ENGINEER TO INSPECT & APPROVE SOILS BELOW FOOTING PRIOR TO CONSTRUCTION OF FOOTINGS.
8. THIS DESIGN SHALL NOT BE CONSTRUCTED ON SILT OR CLAY BEARING SOILS, OR WITH SILT OR CLAY BACKFILL BEHIND WALLS.
9. CONTRACTOR SHALL COMPLY WITH ALL O.S.H.A. & W.I.S.H.A. HEALTH & SAFETY STANDARDS.
10. BACKFILL SHOULD BE PLACED WITH EXTREME CARE TO AVOID EXCESSIVE HORIZONTAL LOADS ON THE WALL. THIS REQUIREMENT SHOULD TAKE PRECEDENCE OVER COMPLETE ADHERENCE TO THE COMPACTION CRITERIA.

**IMPORTANT NOTES:**

1. INFO NOT NOTED PER CITY APPROVED PLAN.
2. CONTRACTOR MAY BACKFILL "H"/3 MAX. BEHIND WALLS PRIOR TO PLACEMENT OF SLAB ON GRADE.
3. CONTRACTOR MAY NOT FULLY BACKFILL BEHIND WALL UNTIL REINF. SLAB IS IN PLACE & CURED.

RETAINING WALL SCHEDULE							
"H" HEIGHT	"W" WIDTH	"a" #5@6'	"b" #5@12'	"c" #5@12'	"L" 5'-0"	"t" 8"	"X" 10"
11'	5'-6"	#5@6'	#5@12'	#5@12'	5'-0"	8"	10"
9'	4'-0"	#5@8'	#5@16'	#5@16'	4'-6"	8"	10"
7'	3'-0"	#4@9'	#4@18'	#4@18'	4'-0"	8"	10"
5'	2'-4"	#4@16'	#4@16'	#4@16'	3'-6"	8"	8"



C1 "L" SHAPED RETAINING WALL

L SHAPE RET. WALL.

Project Title:  
Engineer:  
Project ID:  
Project Descr:

RZ

Printed: 3 NOV 2021, 1:33PM

### Cantilevered Retaining Wall

File: L shape Retaining wall w slab Nov 12,2020.ec6  
Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.17  
RB Engineers, Inc.

Lic. #: KW-06010288

DESCRIPTION: L Shape Ret Wall 5.00' to Bottom of Ftg W/ Slab

Calculations per ACI 318-11, ACI 530-11, IBC 2012, CBC 2013, ASCE 7-10

#### Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft
Vertical component of active Lateral soil pressure options:		
NOT USED for Soil Pressure.		
NOT USED for Sliding Resistance.		
NOT USED for Overturning Resistance.		

#### Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	35.0 psf/ft
Toe Active Pressure	=	0.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Friction Coeff btwn Ftg & Soil	=	0.400
Soil height to ignore for passive pressure	=	0.00 in

#### Design Summary

##### Wall Stability Ratios

Overturning	=	2.26 OK
Sliding	=	1.31 OK
<i>Slab Resists All Sliding !</i>		
Total Bearing Load	=	1,120 lbs
...resultant ecc.	=	4.15 in
Soil Pressure @ Toe	=	907 psf OK
Soil Pressure @ Heel	=	53 psf OK
Allowable	=	2,000 psf
<i>Soil Pressure Less Than Allowable</i>		
ACI Factored @ Toe	=	1,089 psf
ACI Factored @ Heel	=	63 psf
Footing Shear @ Toe	=	2.4 psi OK
Footing Shear @ Heel	=	4.4 psi OK
Allowable	=	75.0 psi
<b>Sliding Calcs</b> Slab Resists All Sliding !		
Lateral Sliding Force	=	437.5 lbs
less 100% Passive Force	= -	125.0 lbs
less 100% Friction Force	= -	440.0 lbs
Added Force Req'd	=	0.0 lbs OK
...for 1.5 : 1 Stability	=	83.3 lbs NG

#### Stem Construction

##### Design Height Above Ftg

Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Thickness	in =	8.00
Rebar Size	=	# 4
Rebar Spacing	in =	16.00
Rebar Placed at	=	Edge
<b>Design Data</b>		
fb/FB + fa/Fa	=	0.216
Total Force @ Section	lbs =	448.0
Moment....Actual	ft-l =	597.3
Moment....Allowable	ft-l =	2,759.4
Shear....Actual	psi =	6.0
Shear....Allowable	psi =	75.0
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.25
Lap splice if above	in =	12.48
Lap splice if below	in =	6.00
Hook embed into footing	in =	6.00

##### Concrete Data

f'c	psi =	2,500.0
Fy	psi =	

#### Load Factors

Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

SLAB IS RESISTING SLIDING OVER  $H/3$  ∴ OK.

### Cantilevered Retaining Wall

Lic. #: KW-06010288

File: L shape Retaining wall w slab Nov 12,2020.ec6  
 Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.17  
 RB Engineers, Inc.

DESCRIPTION: L Shape Ret Wall 5.00' to Bottom of Ftg W/ Slab

#### Footing Dimensions & Strengths

Toe Width	=	1.00	ft
Heel Width	=	1.33	
Total Footing Width	=	2.33	
Footing Thickness	=	12.00	in
Key Width	=	0.00	in
Key Depth	=	0.00	in
Key Distance from Toe	=	0.00	ft
f'c =	2,500	psi	Fy = 40,000 psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0018	
Cover @ Top	2.00		@ Btm. = 3.00 in

#### Footing Design Results

	Toe	Heel
Factored Pressure	= 1,089	63 psf
Mu' : Upward	= 471	0 ft-lb
Mu' : Downward	= 90	168 ft-lb
Mu: Design	= 381	168 ft-lb
Actual 1-Way Shear	= 2.41	4.42 psi
Allow 1-Way Shear	= 75.00	75.00 psi
Toe Reinforcing	= # 4 @ 16.00 in	
Heel Reinforcing	= # 4 @ 16.00 in	
Key Reinforcing	= None Spec'd	

#### Other Acceptable Sizes & Spacings

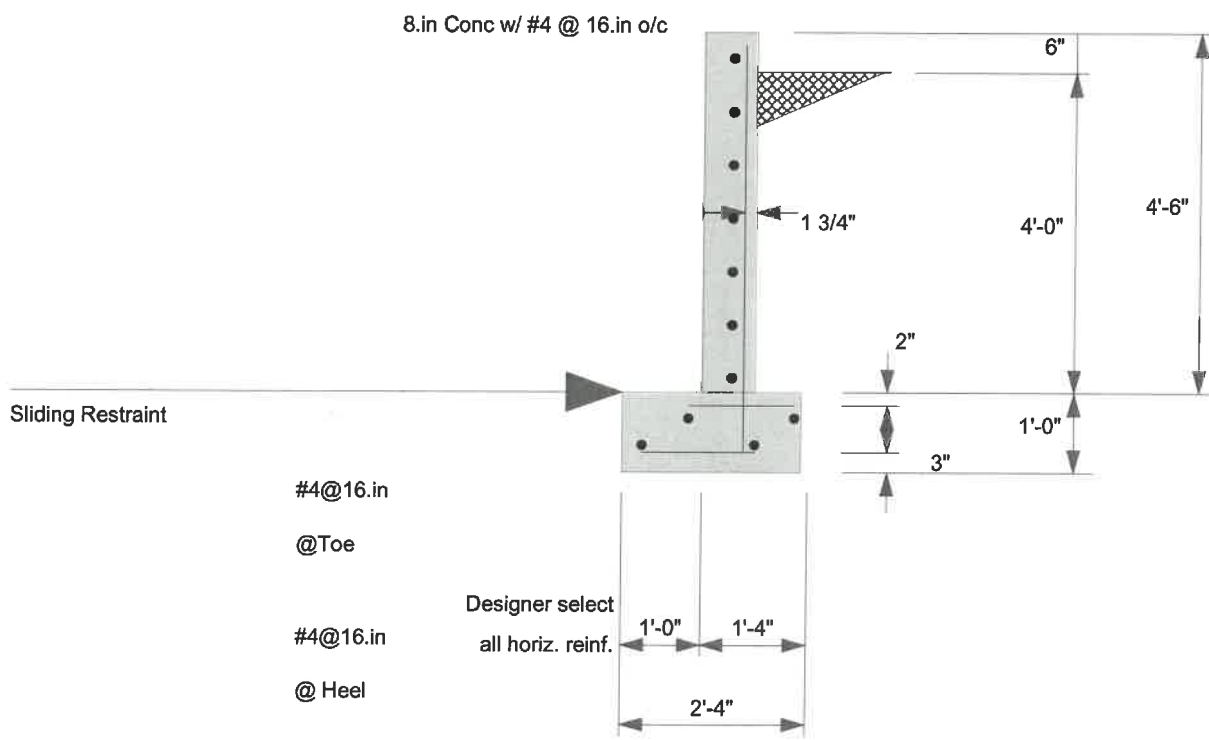
Toe: Not req'd, Mu < S \* Fr  
 Heel: Not req'd, Mu < S \* Fr  
 Key: No key defined

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-lb	Force lbs	Distance ft	Moment ft-lb	
Heel Active Pressure	= 437.5	1.67	729.2	Soil Over Heel	= 319.8	2.00	639.6
Surcharge over Heel	=			Sloped Soil Over Heel	=		
Toe Active Pressure	=	0.33		Surcharge Over Heel	=		
Surcharge Over Toe	=			Adjacent Footing Load	=		
Adjacent Footing Load	=			Axial Dead Load on Stem	=		
Added Lateral Load	=			* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=			Soil Over Toe	=		
				Surcharge Over Toe	=		
				Stem Weight(s)	= 450.0	1.33	600.0
				Earth @ Stem Transitions	=		
				Footing Weight	= 350.0	1.17	408.2
				Key Weight	=		
				Vert. Component	=		
<b>Total</b>	<b>= 437.5</b>	<b>O.T.M. =</b>	<b>729.2</b>	<b>Total =</b>	<b>1,119.8 lbs</b>	<b>R.M. =</b>	<b>1,647.8</b>
<b>Resisting/Overturning Ratio</b>		<b>=</b>	<b>2.26</b>				
Vertical Loads used for Soil Pressure =		1,119.8	lbs				

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

R4



**Cantilevered Retaining Wall**

File: L shape Retaining wall w slab Nov 12,2020.ec6  
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 RB Engineers, Inc.

Lic. #: KW-06010288

**DESCRIPTION:** L Shape Ret Wall 7' to Bottom of Ftg w/ Slab

Calculations per ACI 318-11, ACI 530-11, IBC 2012, CBC 2013, ASCE 7-10

**Criteria**

Retained Height	=	6.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft
Vertical component of active Lateral soil pressure options:		
NOT USED for Soil Pressure.		
NOT USED for Sliding Resistance.		
NOT USED for Overturning Resistance.		

**Soil Data**

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	35.0 psf/ft
Toe Active Pressure	=	0.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Friction Coeff btwn Ftg & Soil	=	0.400
Soil height to ignore for passive pressure	=	12.00 in

**Design Summary**

<b>Wall Stability Ratios</b>		
Overturning	=	1.71 OK
Sliding	=	0.79 OK
<i>Slab Resists All Sliding!</i>		
Total Bearing Load	=	1,700 lbs
...resultant ecc.	=	8.01 in
Soil Pressure @ Toe	=	1,361 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,633 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	9.3 psi OK
Footing Shear @ Heel	=	7.6 psi OK
Allowable	=	75.0 psi
<b>Sliding Calcs</b> Slab Resists All Sliding!		
Lateral Sliding Force	=	857.5 lbs
less 100% Passive Force	= -	0.0 lbs
less 100% Friction Force	= -	680.0 lbs
Added Force Req'd	=	177.5 lbs
....for 1.5 : 1 Stability	=	606.3 lbs NG
<b>Load Factors</b>		
Dead Load		1.200
Live Load		1.600
Earth, H		1.600
Wind, W		1.600
Seismic, E		1.000

**Stem Construction**

<b>Design Height Above Ftg</b>	
ft =	Stem OK 0.00
Wall Material Above "Ht"	= Concrete
Thickness	in = 8.00
Rebar Size	= # 4
Rebar Spacing	in = 9.00
Rebar Placed at	= Edge

**Top Stem**

<b>Design Data</b>	
fb/FB + fa/Fa	= 0.417
Total Force @ Section	lbs = 1,008.0
Moment....Actual	ft-l = 2,016.0
Moment....Allowable	ft-l = 4,832.2
Shear....Actual	psi = 13.4
Shear....Allowable	psi = 75.0
Wall Weight	psf = 100.0
Rebar Depth 'd'	in = 6.25
Lap splice if above	in = 12.48
Lap splice if below	in = 6.00
Hook embed into footing	in = 6.00

**Concrete Data**

f'c	psi = 2,500.0
Fy	psi =

SLAB IS RESISTING SLIDING OVER  $H/3$  ∴ OK.

**Cantilevered Retaining Wall**

File: L shape Retaining wall w slab Nov 12,2020.ec6  
 Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.17

Lic. #: KW-06010288

RB Engineers, Inc.

**DESCRIPTION:** L Shape Ret Wall 7' to Bottom of Ftg w/ Slab

**Footing Dimensions & Strengths**

Toe Width	=	1.50	ft
Heel Width	=	1.50	
Total Footing Width	=	3.00	
Footing Thickness	=	12.00	in
Key Width	=	0.00	in
Key Depth	=	0.00	in
Key Distance from Toe	=	0.00	ft
$f_c$	=	2,500	psi
$F_y$	=	40,000	psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0018	
Cover @ Top	=	2.00	
	@ Btm.	=	3.00 in

**Footing Design Results**

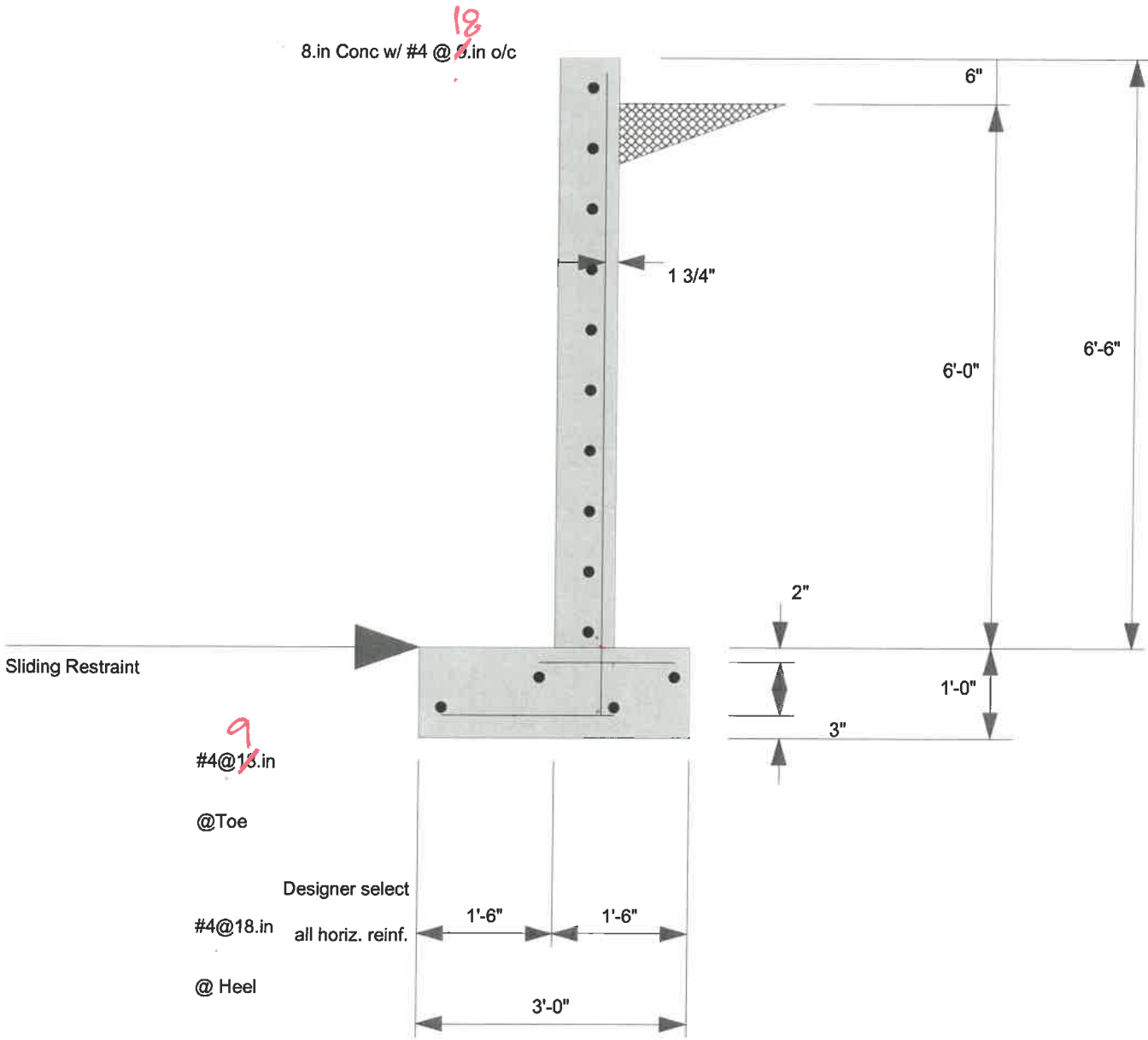
		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	1,633	0 psf
$\mu_u$ : Upward	=	1,469	0 ft-lb
$\mu_u$ : Downward	=	203	363 ft-lb
$\mu_u$ : Design	=	1,267	363 ft-lb
Actual 1-Way Shear	=	9.27	7.63 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 4 @ 18.00 in	
Heel Reinforcing	=	# 4 @ 18.00 in	
Key Reinforcing	=	None Spec'd	
<b>Other Acceptable Sizes &amp; Spacings</b>			
Toe:	Not req'd, $\mu_u < S * F_r$		
Heel:	Not req'd, $\mu_u < S * F_r$		
Key:	No key defined		

**Summary of Overturning & Resisting Forces & Moments**

Item	.....OVERTURNING.....			.....RESISTING.....		
	Force lbs	Distance ft	Moment ft-lb	Force lbs	Distance ft	Moment ft-lb
Heel Active Pressure	=	857.5	2.33	2,000.8		
Surcharge over Heel	=					
Toe Active Pressure	=		0.33			
Surcharge Over Toe	=					
Adjacent Footing Load	=					
Added Lateral Load	=					
Load @ Stem Above Soil	=					
<b>Total</b>	=	<b>857.5</b>	<b>O.T.M. =</b>	<b>2,000.8</b>		
<b>Resisting/Overturning Ratio</b>			=	<b>1.71</b>		
Vertical Loads used for Soil Pressure	=	1,700.0	lbs			
Soil Over Heel	=			600.0	2.58	1,550.0
Sloped Soil Over Heel	=					
Surcharge Over Heel	=					
Adjacent Footing Load	=					
Axial Dead Load on Stem	=					
* Axial Live Load on Stem	=					
Soil Over Toe	=					
Surcharge Over Toe	=					
Stem Weight(s)	=			650.0	1.83	1,191.7
Earth @ Stem Transitions	=					
Footing Weight	=			450.0	1.50	675.0
Key Weight	=					
Vert. Component	=					
<b>Total</b>				<b>1,700.0</b>	<b>lbs R.M. =</b>	<b>3,416.7</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

R7



**Cantilevered Retaining Wall**

File: L shape Retaining wall w slab Nov 12,2020.ec6  
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 RB Engineers, Inc.

Lic. #: KW-06010288

**DESCRIPTION:** L Shape Ret Wall 9' to Bottom of Ftg w/ Slab

Criteria		
Retained Height	=	8.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft
Vertical component of active Lateral soil pressure options:		
NOT USED for Soil Pressure.		
NOT USED for Sliding Resistance.		
NOT USED for Overturing Resistance.		

Soil Data		
Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	35.0 psf/ft
Toe Active Pressure	=	0.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Friction Coeff btwn Ftg & Soil	=	0.400
Soil height to ignore for passive pressure	=	12.00 in

Calculations per ACI 318-11, ACI 530-11, IBC 2012, CBC 2013, ASCE 7-10

Design Summary		
<b>Wall Stability Ratios</b>		
Overturing	=	1.52 OK
Sliding	=	0.63 OK
<i>Slab Resists All Sliding !</i>		
Total Bearing Load	=	2,250 lbs
...resultant ecc.	=	12.15 in
Soil Pressure @ Toe	=	1,519 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,822 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	19.2 psi OK
Footing Shear @ Heel	=	9.7 psi OK
Allowable	=	75.0 psi
<b>Sliding Calcs</b> Slab Resists All Sliding !		
Lateral Sliding Force	=	1,417.5 lbs
less 100% Passive Force	= -	0.0 lbs
less 100% Friction Force	= -	900.0 lbs
Added Force Req'd	=	517.5 lbs
....for 1.5 : 1 Stability	=	1,226.3 lbs XG

Stem Construction		Top Stem
<b>Design Height Above Ftg</b>	ft =	Stem OK 0.00
Wall Material Above "Ht"	=	Concrete
Thickness	in =	8.00
Rebar Size	=	# 5
Rebar Spacing	in =	8.00
Rebar Placed at	=	Edge
<b>Design Data</b>		
fb/FB + fa/Fa	=	0.588
Total Force @ Section	lbs =	1,792.0
Moment....Actual	ft-l =	4,778.7
Moment....Allowable	ft-l =	8,121.3
Shear.....Actual	psi =	24.1
Shear.....Allowable	psi =	75.0
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.19
Lap splice if above	in =	15.60
Lap splice if below	in =	7.00
Hook embed into footing	in =	7.00
<b>Concrete Data</b>		
f'c	psi =	2,500.0
Fy	psi =	

SLAB IS RESISTING SLIDING OVER  $H/3$  ∴ OK.

Load Factors	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000



**Cantilevered Retaining Wall**

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Lic. #: KW-06010288

RB Engineers, Inc.

**DESCRIPTION:** L Shape Ret Wall 9' to Bottom of Ftg w/ Slab

**Footing Dimensions & Strengths**

Toe Width	=	2.50 ft
Heel Width	=	1.50
Total Footing Width	=	4.00
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
$f_c$	=	2,500 psi
$F_y$	=	40,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm.= 3.00 in

**Footing Design Results**

	Toe	Heel
Factored Pressure	= 1,822	0 psf
$\mu_u$ : Upward	= 4,093	0 ft-lb
$\mu_u$ : Downward	= 563	463 ft-lb
$\mu_u$ : Design	= 3,531	463 ft-lb
Actual 1-Way Shear	= 19.17	9.74 psi
Allow 1-Way Shear	= 75.00	75.00 psi
Toe Reinforcing	= # 5 @ 16.00 in	
Heel Reinforcing	= # 5 @ 16.00 in	
Key Reinforcing	= None Spec'd	

**Other Acceptable Sizes & Spacings**

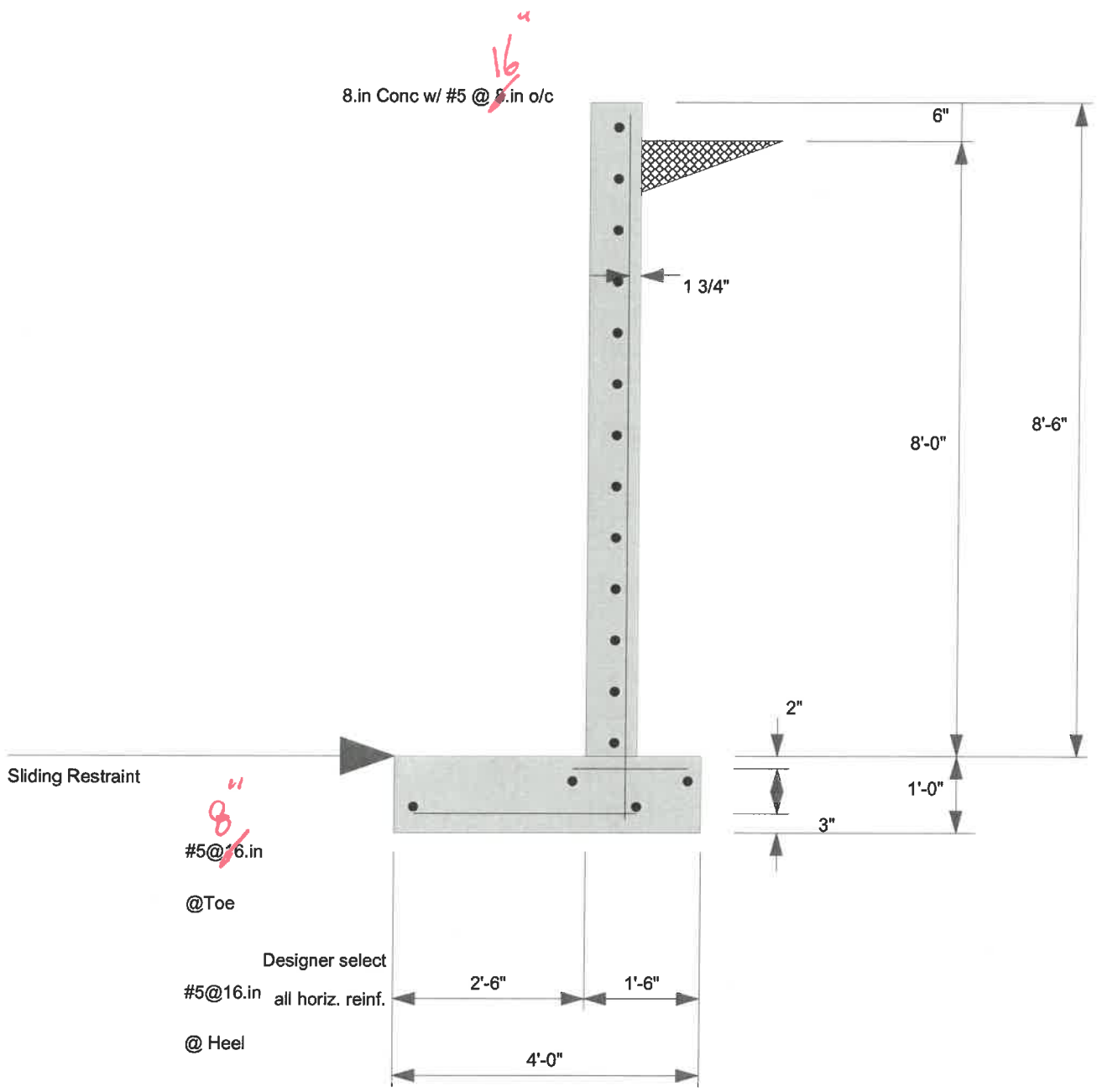
Toe: #4@ 13.00 in, #5@ 20.00 in, #6@ 28.50 in, #7@ 38.75 in, #8@ 48.25 in, #9@ 4  
 Heel: Not req'd,  $\mu_u < S * F_r$   
 Key: No key defined

**Summary of Overturning & Resisting Forces & Moments**

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-lb	Force lbs	Distance ft	Moment ft-lb	
Heel Active Pressure	= 1,417.5	3.00	4,252.5	Soil Over Heel	= 800.0	3.58	2,866.7
Surcharge over Heel	=			Sloped Soil Over Heel	=		
Toe Active Pressure	=	0.33		Surcharge Over Heel	=		
Surcharge Over Toe	=			Adjacent Footing Load	=		
Adjacent Footing Load	=			Axial Dead Load on Stem	=		
Added Lateral Load	=			* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=			Soil Over Toe	=		
				Surcharge Over Toe	=		
				Stem Weight(s)	= 850.0	2.83	2,408.3
				Earth @ Stem Transitions	=		
				Footing Weight	= 600.0	2.00	1,200.0
				Key Weight	=		
				Vert. Component	=		
<b>Total</b>	<b>= 1,417.5</b>	<b>O.T.M. =</b>	<b>4,252.5</b>	<b>Total =</b>	<b>2,250.0 lbs</b>	<b>R.M. =</b>	<b>6,475.0</b>
<b>Resisting/Overturning Ratio</b>		<b>=</b>	<b>1.52</b>				
Vertical Loads used for Soil Pressure =		2,250.0 lbs					

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

R10



**Cantilevered Retaining Wall**

Lic. # : KW-06010288

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 RB Engineers, Inc.

**DESCRIPTION:** L Shape Ret Wall 11' to Bottom of Ftg w/ Slab

Calculations per ACI 318-11, ACI 530-11, IBC 2012, CBC 2013, ASCE 7-10

**Criteria**

Retained Height	=	10.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft
Vertical component of active Lateral soil pressure options:		
NOT USED for Soil Pressure.		
NOT USED for Sliding Resistance.		
NOT USED for Overturning Resistance.		

**Soil Data**

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	35.0 psf/ft
Toe Active Pressure	=	0.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	120.00 pcf
Friction Coeff btwn Ftg & Soil	=	0.400
Soil height to ignore for passive pressure	=	12.00 in

**Design Summary**

<b>Wall Stability Ratios</b>		
Overturning	=	1.53 OK
Sliding	=	0.54 OK
<i>Slab Resists All Sliding !</i>		
Total Bearing Load	=	2,875 lbs
...resultant ecc.	=	15.73 in
Soil Pressure @ Toe	=	1,332 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	2,000 psf
<i>Soil Pressure Less Than Allowable</i>		
ACI Factored @ Toe	=	1,598 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	26.1 psi OK
Footing Shear @ Heel	=	11.8 psi OK
Allowable	=	75.0 psi
<b>Sliding Calcs</b> Slab Resists All Sliding !		
Lateral Sliding Force	=	2,117.5 lbs
less 100% Passive Force	= -	0.0 lbs
less 100% Friction Force	= -	1,150.0 lbs
Added Force Req'd	=	967.5 lbs
....for 1.5 : 1 Stability	=	2,026.3 lbs NG
<b>Load Factors</b>		
Dead Load		1.200
Live Load		1.600
Earth, H		1.600
Wind, W		1.600
Seismic, E		1.000

**Stem Construction**

<b>Design Height Above Ftg</b>	ft =	0.00
Wall Material Above "H"	=	Concrete
Thickness	in =	8.00
Rebar Size	=	# 5
Rebar Spacing	in =	6.00
Rebar Placed at	=	Edge

**Top Stem**

<b>Design Data</b>		
fb/FB + fa/Fa	=	0.880
Total Force @ Section	lbs =	2,800.0
Moment....Actual	ft-l =	9,333.3
Moment....Allowable	ft-l =	10,601.6
Shear.....Actual	psi =	37.7
Shear.....Allowable	psi =	75.0
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.19
Lap splice if above	in =	15.60
Lap splice if below	in =	7.00
Hook embed into footing	in =	7.00

**Concrete Data**

f'c	psi =	2,500.0
Fy	psi =	

← SLAB IS RESISTING SLIDING OVER 1/3 ∴ OK.

**Cantilevered Retaining Wall**

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 RB Engineers, Inc.

Lic. # : KW-06010288

DESCRIPTION: L Shape Ret Wall 11' to Bottom of Ftg w/ Slab

**Footing Dimensions & Strengths**

Toe Width	=	4.00 ft
Heel Width	=	1.50
Total Footing Width	=	5.50
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f'c =	2,500 psi	Fy = 40,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm.= 3.00 in

**Footing Design Results**

		<b>Toe</b>	<b>Heel</b>
Factored Pressure	=	1,598	0 psf
Mu' : Upward	=	8,836	0 ft-lb
Mu' : Downward	=	1,440	563 ft-lb
Mu: Design	=	7,396	563 ft-lb
Actual 1-Way Shear	=	26.10	11.84 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 5 @ 12.00 in	
Heel Reinforcing	=	# 5 @ 12.00 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: #4@ 6.25 in, #5@ 9.50 in, #6@ 13.50 in, #7@ 18.25 in, #8@ 24.00 in, #9@ 30.  
 Heel: Not req'd, Mu < S \* Fr  
 Key: No key defined

**Summary of Overturning & Resisting Forces & Moments**

Item	.....OVERTURNING.....				.....RESISTING.....				
	Force lbs	Distance ft	Moment ft-lb		Force lbs	Distance ft	Moment ft-lb		
Heel Active Pressure	=	2,117.5	3.67	7,764.2	Soil Over Heel	=	1,000.0	5.08	5,083.3
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Toe Active Pressure	=		0.33		Surcharge Over Heel	=			
Surcharge Over Toe	=				Adjacent Footing Load	=			
Adjacent Footing Load	=				Axial Dead Load on Stem	=			
Added Lateral Load	=				* Axial Live Load on Stem	=			
Load @ Stem Above Soil	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
					Stem Weight(s)	=	1,050.0	4.33	4,550.0
					Earth @ Stem Transitions	=			
<b>Total</b>	=	2,117.5	<b>O.T.M. =</b>	7,764.2	Footing Weight	=	825.0	2.75	2,268.8
<b>Resisting/Overturning Ratio</b>			=	<b>1.53</b>	Key Weight	=			
Vertical Loads used for Soil Pressure =				2,875.0 lbs	Vert. Component	=			
					<b>Total =</b>		<b>2,875.0 lbs</b>	<b>R.M. =</b>	<b>11,902.1</b>

\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

R13

12"  
8.in Conc w/ #5 @ 6.in o/c

