

4815 E MERCER WAY,
MERCER ISLAND, WA 98040

STRUCTURAL CALCULATIONS
FOR
EXISTING RESIDENCE BUILDING
ADDITION



Date Signed: 11-30-2023

2018 International Residential Code
2018 International Building Code

PROJECT NAME
ADDRESS 4815 E MERCER WAY
PROJECT #
DATE 11/22/2023

BUILDING CODE 2018 International Residential Code
2018 International Building Code

WIND DESIGN
Vult = 110 MPH
Vasd = 85 MPH
Exposure = B
Kzt = 1.00
Importance Factor = 1.0

SEISMIC DESIGN
Ss(g) = 1.435 Sms(g) = 1.722 Sds(g) = 1.148
Si(g) = 0.498
Seismic Design Category = D
Site Class = D
Importance Factor = 1.0

DESIGN LOADING
Roof Snow Load = 25 PSF
Floor Live Load = 40 PSF
Bedroom Live Load = 30 PSF
Deck & Balcony Live Load = 60 PSF
Roof Dead Load = 15 PSF
Floor Dead Load = 15 PSF (For framing gravity design)
Exterior Wall Dead Load = 10 PSF
Partition Wall Seismic Weight = 10 PSF
Floor Seismic Weight = 10 PSF
Allowable Soil Pressure = 1500 PSF
Lateral Earth (Restrained) Pressure = 50 PCF
Passive Pressure = 300 PCF
Coefficient of Friction = 0.4

SCOPE OF WORK Existing residence building addition

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
 USGS web services are now operational so this tool should work as expected.



OSHPD

4815 E Mercer Way, Mercer Island, WA 98040, USA

Latitude, Longitude: 47.5592643, -122.2151633



Date	11/28/2023, 5:53:36 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Type	Value	Description
S _S	1.435	MCE _R ground motion. (for 0.2 second period)
S ₁	0.498	MCE _R ground motion. (for 1.0s period)
S _{MS}	1.722	Site-modified spectral acceleration value
S _{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S _{DS}	1.148	Numeric seismic design value at 0.2 second SA
S _{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F _a	1.2	Site amplification factor at 0.2 second
F _v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.614	MCE _G peak ground acceleration
F _{PGA}	1.2	Site amplification factor at PGA
PGA _M	0.737	Site modified peak ground acceleration
T _L	6	Long-period transition period in seconds
S _{sRT}	1.435	Probabilistic risk-targeted ground motion. (0.2 second)
S _{sUH}	1.59	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
S _{sD}	4.021	Factored deterministic acceleration value. (0.2 second)
S _{1RT}	0.498	Probabilistic risk-targeted ground motion. (1.0 second)
S _{1UH}	0.555	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S _{1D}	1.569	Factored deterministic acceleration value. (1.0 second)

Type	Value	Description
PGAd	1.351	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA _{UH}	0.614	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
CRS	0.902	Mapped value of the risk coefficient at short periods
CR1	0.898	Mapped value of the risk coefficient at a period of 1 s
CV	1.387	Vertical coefficient

LATERAL DESIGN CHECK.

NEW BUILDING ADDITION IS SEISMIC CONTROL

BUILDING HT = 9'6" MAX.

SEISMIC WT = $358 \text{ ft}^3 \cdot (15 \text{ psf} + 10 \text{ psf}/2) = 7.1 \text{ kip}$

$V_s = 1.09 \text{ k}$ \rightarrow $\sim V_s = 500 \#$ @ EA WALL LINE.

\rightarrow PROVIDE WB @ 3-SIDES

DESCRIPTION: Seismic Base Shear Analysis

Specific Description: 4815 E MERCER WAY

Risk Category

Calculations per ASCE 7-16

Risk Category of Building or Other Structure : "II" : All Buildings and other structures except those listed as Category I, III, and IV *SCE 7-16, Page 4, Table 1.5-1*Seismic Importance Factor = 1 *ASCE 7-16, Page 5, Table 1.5-2***USER DEFINED Ground Motion***ASCE 7-16 11.4.2*

Max. Ground Motions, 5% Damping

 $S_S = 1.435$ g, 0.2 sec response $S_1 = 0.4980$ g, 1.0 sec response

For the closest datapoint grid location . . .

Latitude = 0.000 deg North

Longitude = 0.000 deg West

Conforms to ASCE 7 Section 12.8.1.3: Regular structure with period of 0.5 s or less, SDS limited to max of 0.7*SDS or 1.0 for calculation

Site Class, Site Coeff. and Design CategoryClassification: "D" : Shear Wave Velocity 600 to 1,200 ft/sec = **D** (By Default per 11.4.3) *ASCE 7-16 Table 20.3-1*Site Coefficients F_a & F_v $F_a = 1.20$ $F_v = 1.80$ *ASCE 7-16 Table 11.4-1 & 11.4-2*
(using straight-line interpolation from table values)Maximum Considered Earthquake Acceleration $S_{MS} = F_a * S_s = 1.722$ *ASCE 7-16 Eq. 11.4-1*
 $S_{M1} = F_v * S_1 = 0.897$ *ASCE 7-16 Eq. 11.4-2*Design Spectral Acceleration $S_{DS} = S_{MS} * 2/3 = 1.148$ *ASCE 7-16 Eq. 11.4-3*
 $S_{D1} = S_{M1} * 2/3 = 0.598$ *ASCE 7-16 Eq. 11.4-4*Seismic Design Category = **D** *ASCE 7-16 Table 11.6-1 & -2***Resisting System***ASCE 7-16 Table 12.2-1*

Basic Seismic Force Resisting System . . .

Bearing Wall Systems**15. Light-frame (wood) walls sheathed w/wood structural panels rated for shear resistance.**

Response Modification Coefficient "R" = 6.50

System Overstrength Factor "W_o" = 3.00Deflection Amplification Factor "C_d" = 4.00

NOTE! See ASCE 7-16 for all applicable footnotes

Building height Limits :

Category "A & B" Limit: No Limit

Category "C" Limit: No Limit

Category "D" Limit: Limit = 65

Category "E" Limit: Limit = 65

Category "F" Limit: Limit = 65

Lateral Force Procedure*ASCE 7-16 Section 12.8.2*

Equivalent Lateral Force Procedure

The "Equivalent Lateral Force Procedure" is being used according to the provisions of ASCE 7-16 12.8**Determine Building Period***Use ASCE 12.8-7*

Structure Type for Building Period Calculation: All Other Structural Systems

"C_t" value = 0.020 "h_n" : Height from base to highest level = 9.50 ft

"x" value = 0.75

"T_a" Approximate fundamental period using Eq. 12.8-7 : $T_a = C_t * (h_n^x) = 0.108$ sec"T_L" : Long-period transition period per ASCE 7-16 Maps 22-14 -> 22-17 = 6.000 secBuilding Period "T_a" Calculated from Approximate Method set= 0.108

DESCRIPTION: Seismic Base Shear Analysis

" Cs " Response Coefficient

ASCE 7-16 Section 12.8.1.1

S_{DS} : Short Period Design Spectral Response	=	1.148	From Eq. 12.8-2, Preliminary C_s	=	0.154
" R " : Response Modification Factor	=	6.50	From Eq. 12.8-3 & 12.8-4, C_s need not exceed	=	0.850
" I " : Seismic Importance Factor	=	1	From Eq. 12.8-5 & 12.8-6, C_s not be less than	=	0.044

User has selected ASCE 12.8.1.3 : Regular structure, **C_s : Seismic Response Coefficient = 0.1538**
 Less than 5 Stories and with $T \leq 0.5$ sec, SO $S_s \leq 1.5$ for C_s calcul

Seismic Base Shear

ASCE 7-16 Section 12.8.1

C_s = 0.1538 from 12.8.1.1		W (see Sum W_i below) =	7.10 k
		Seismic Base Shear $V = C_s * W =$	1.09 k

Vertical Distribution of Seismic Forces

ASCE 7-16 Section 12.8.3

" k " : h_x exponent based on $T_a = 1.00$

Table of building Weights by Floor Level...

Level #	W_i : Weight	H_i : Height	$(W_i * H_i^k)$	C_{vx}	$F_x = C_{vx} * V$	Sum Story Shear	Sum Story Moment
1	7.10	9.50	67.45	1.0000	1.09	1.09	0.00
Sum $W_i =$	7.10 k	Sum $W_i * H_i =$	67.45 k-ft		Total Base Shear =	1.09 k	Base Moment = 10.4 k-ft

Diaphragm Forces : Seismic Design Category "B" to "F"

ASCE 7-16 12.10.1.1

Level #	W_i	F_i	Sum F_i	Sum W_i	F_{px} : Calcd	F_{px} : Min	F_{px} : Max	F_{px}	Dsgn. Force
1	7.10	1.09	1.09	7.10	1.09	1.63	3.26	1.63	1.63

- W_{px} Weight at level of diaphragm and other structure elements attached to it.
- F_i Design Lateral Force applied at the level.
- Sum F_i Sum of "Lat. Force" of current level plus all levels above
- MIN Req'd Force @ Level ... $0.20 * S_{DS} * I * W_{px}$
- MAX Req'd Force @ Level .. $0.40 * S_{DS} * I * W_{px}$
- F_{px} : Design Force @ Level . $W_{px} * \text{SUM}(x \rightarrow n) F_i / \text{SUM}(x \rightarrow n) w_i$, $x =$ Current level, $n =$ Top Level

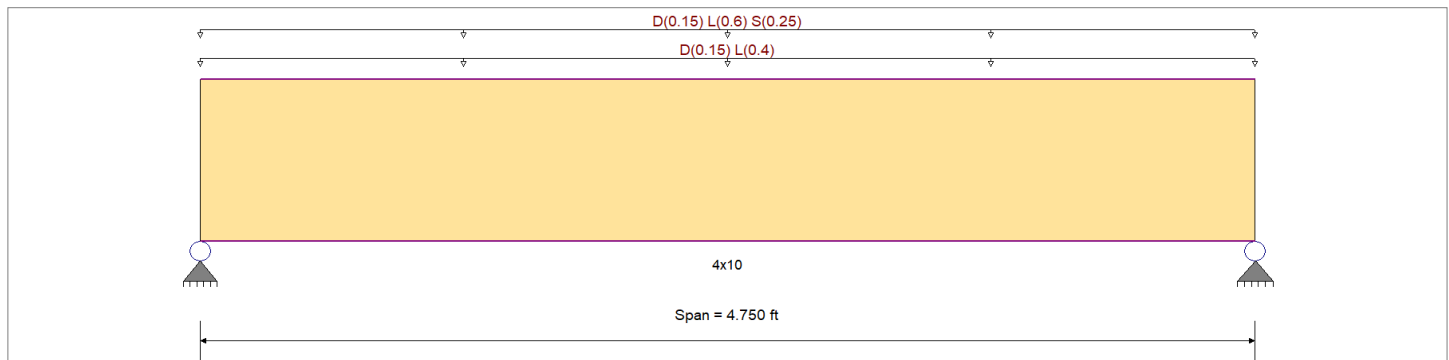
DESCRIPTION: NEW CRAWLSPACE BEAM

CODE REFERENCES

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

Material Properties

Analysis Method : Load Resistance Factor D	Fb +	900.0 psi	<i>E : Modulus of Elasticity</i>
Load Combination ASCE 7-16	Fb -	900.0 psi	Ebend- xx 1,600.0ksi
	Fc - Prll	1,350.0 psi	Eminbend - xx 580.0ksi
Wood Species : DouglasFir-Larch	Fc - Perp	625.0 psi	
Wood Grade : No.2	Fv	180.0 psi	
	Ft	575.0 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.

Beam self weight calculated and added to loading

Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 10.0 ft

Uniform Load : D = 0.0150, L = 0.060, S = 0.0250 ksf, Tributary Width = 10.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.761 : 1	Maximum Shear Stress Ratio	=	0.503 : 1
Section used for this span		4x10	Section used for this span		4x10
fb: Actual	=	1,419.50psi	fv: Actual	=	156.37 psi
F'b	=	1,866.24psi	F'v	=	311.04 psi
Load Combination	=	+1.20D+1.60L+0.50S	Load Combination	=	+1.20D+1.60L+0.50S
Location of maximum on span	=	2.375ft	Location of maximum on span	=	3.987ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection	0.031 in	Ratio = 1827	>=360	Span: 1 : L Only	
Max Upward Transient Deflection	0 in	Ratio = 0	<360	n/a	
Max Downward Total Deflection	0.041 in	Ratio = 1398	>=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	λ	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	Mu	fb	Fb	Vu	fv	Fv
+1.40D															0.0	0.00	0.0	0.0
Length = 4.750 ft	1		0.208	0.138	0.60	1.00	1.00	1.00	1.200	1.00	1.00	1.00	1.21	291.5	1,399.7	0.69	32.1	233.3
+1.20D+1.60L															0.0	0.00	0.0	0.0
Length = 4.750 ft	1		0.715	0.473	0.80	1.00	1.00	1.00	1.200	1.00	1.00	1.00	5.55	1,334.7	1,866.2	3.17	147.0	311.0
+1.20D+1.60L+0.50S															0.0	0.00	0.0	0.0
Length = 4.750 ft	1		0.761	0.503	0.80	1.00	1.00	1.00	1.200	1.00	1.00	1.00	5.90	1,419.5	1,866.2	3.38	156.4	311.0
+1.20D+L															0.0	0.00	0.0	0.0
Length = 4.750 ft	1		0.497	0.329	0.80	1.00	1.00	1.00	1.200	1.00	1.00	1.00	3.86	927.9	1,866.2	2.21	102.2	311.0
+1.20D															0.0	0.00	0.0	0.0
Length = 4.750 ft	1		0.134	0.088	0.80	1.00	1.00	1.00	1.200	1.00	1.00	1.00	1.04	249.8	1,866.2	0.59	27.5	311.0

DESCRIPTION: NEW CRAWLSPACE BEAM

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values			
			M	V	λ	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	Mu	fb	Fb	Vu	fv	Fv
+1.20D+L+1.60S						1.00	1.00	1.00	1.200	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 4.750 ft	1		0.643	0.425	0.80	1.00	1.00	1.00	1.200	1.00	1.00	1.00	4.99	1,199.1	1,866.2	2.85	132.1	311.0
+1.20D+1.60S						1.00	1.00	1.00	1.200	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 4.750 ft	1		0.279	0.185	0.80	1.00	1.00	1.00	1.200	1.00	1.00	1.00	2.17	521.0	1,866.2	1.24	57.4	311.0
+1.20D+L+0.50S						1.00	1.00	1.00	1.200	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 4.750 ft	1		0.434	0.287	1.00	1.00	1.00	1.00	1.200	1.00	1.00	1.00	4.21	1,012.7	2,332.8	2.41	111.6	388.8
+0.90D						1.00	1.00	1.00	1.200	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 4.750 ft	1		0.080	0.053	1.00	1.00	1.00	1.00	1.200	1.00	1.00	1.00	0.78	187.4	2,332.8	0.45	20.6	388.8
+1.20D+L+0.20S						1.00	1.00	1.00	1.200	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 4.750 ft	1		0.412	0.273	1.00	1.00	1.00	1.00	1.200	1.00	1.00	1.00	4.00	961.8	2,332.8	2.29	106.0	388.8

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	3.104	3.104
Max Upward from Load Combinations	3.104	3.104
Max Upward from Load Cases	2.375	2.375
D Only	0.729	0.729
+D+L	3.104	3.104
+D+S	1.323	1.323
+D+0.750L	2.510	2.510
+D+0.750L+0.750S	2.956	2.956
+0.60D	0.437	0.437
L Only	2.375	2.375
S Only	0.594	0.594

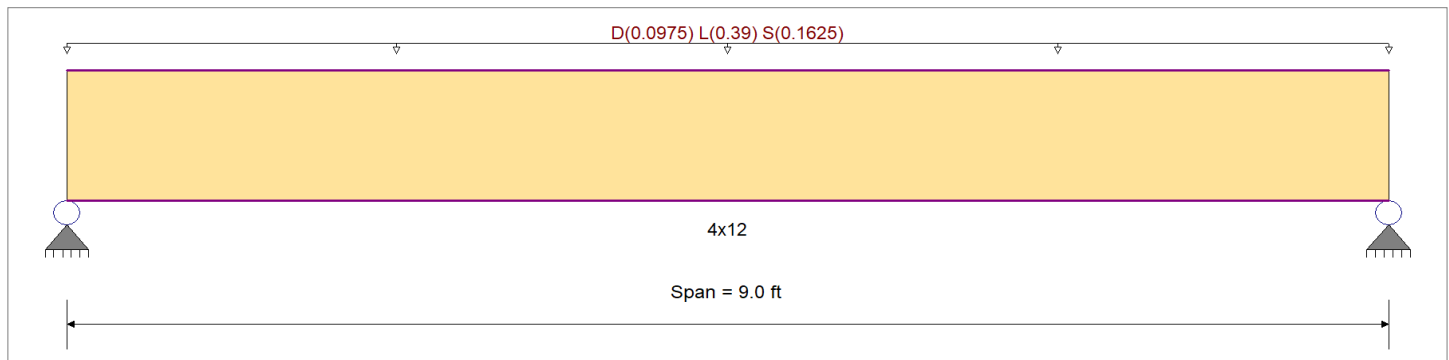
DESCRIPTION: NEW DEAK HEADER BEAM

CODE REFERENCES

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

Material Properties

Analysis Method : Load Resistance Factor D	Fb +	900.0 psi	<i>E : Modulus of Elasticity</i>	
Load Combination ASCE 7-16	Fb -	900.0 psi	Ebend- xx	1,600.0ksi
	Fc - Prll	1,350.0 psi	Eminbend - xx	580.0ksi
Wood Species : DouglasFir-Larch	Fc - Perp	625.0 psi		
Wood Grade : No.2	Fv	180.0 psi		
	Ft	575.0 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.

Beam self weight calculated and added to loading
 Uniform Load : D = 0.0150, L = 0.060, S = 0.0250 ksf, Tributary Width = 6.50 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.801 : 1	Maximum Shear Stress Ratio	=	0.365 : 1
Section used for this span		4x12	Section used for this span		4x12
fb: Actual	=	1,370.04psi	fv: Actual	=	113.55 psi
F'b	=	1,710.72psi	F'v	=	311.04 psi
Load Combination	=	+1.20D+1.60L+0.50S	Load Combination	=	+1.20D+1.60L+0.50S
Location of maximum on span	=	4.500ft	Location of maximum on span	=	8.080 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection	0.087 in	Ratio = 1239 >=360	Span: 1 : L Only		
Max Upward Transient Deflection	0 in	Ratio = 0 <360	n/a		
Max Downward Total Deflection	0.116 in	Ratio = 928 >=240	Span: 1 : +D+0.750L+0.750S		
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	λ	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	Mu	fb	Fb	Vu	fv	Fv	
+1.40D	Length = 9.0 ft	1	0.190	0.087	0.60	1.00	1.00	1.00	1.100	1.00	1.00	1.00	1.50	244.3	1,283.0	0.0	0.00	0.0	0.0
+1.20D+1.60L	Length = 9.0 ft	1	0.723	0.329	0.80	1.00	1.00	1.00	1.100	1.00	1.00	1.00	7.61	1,236.3	1,710.7	0.0	0.00	0.0	0.0
+1.20D+1.60L+0.50S	Length = 9.0 ft	1	0.801	0.365	0.80	1.00	1.00	1.00	1.100	1.00	1.00	1.00	8.43	1,370.0	1,710.7	0.0	0.00	0.0	0.0
+1.20D+L	Length = 9.0 ft	1	0.498	0.227	0.80	1.00	1.00	1.00	1.100	1.00	1.00	1.00	5.24	851.2	1,710.7	0.0	0.00	0.0	0.0
+1.20D	Length = 9.0 ft	1	0.122	0.056	0.80	1.00	1.00	1.00	1.100	1.00	1.00	1.00	1.29	209.4	1,710.7	0.0	0.00	0.0	0.0

DESCRIPTION: NEW DEAK HEADER BEAM

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values			
			M	V	λ	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	Mu	fb	Fb	Vu	fv	Fv
+1.20D+L+1.60S						1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 9.0 ft	1		0.748	0.341	0.80	1.00	1.00	1.00	1.100	1.00	1.00	1.00	7.87	1,279.1	1,710.7	2.78	106.0	311.0
+1.20D+1.60S						1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 9.0 ft	1		0.373	0.170	0.80	1.00	1.00	1.00	1.100	1.00	1.00	1.00	3.92	637.3	1,710.7	1.39	52.8	311.0
+1.20D+L+0.50S						1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 9.0 ft	1		0.461	0.210	1.00	1.00	1.00	1.00	1.100	1.00	1.00	1.00	6.06	984.9	2,138.4	2.14	81.6	388.8
+0.90D						1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 9.0 ft	1		0.073	0.033	1.00	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.97	157.1	2,138.4	0.34	13.0	388.8
+1.20D+L+0.20S						1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 9.0 ft	1		0.423	0.193	1.00	1.00	1.00	1.00	1.100	1.00	1.00	1.00	5.57	904.7	2,138.4	1.97	75.0	388.8

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	2.342	2.342
Max Upward from Load Combinations	2.342	2.342
Max Upward from Load Cases	1.755	1.755
D Only	0.477	0.477
+D+L	2.232	2.232
+D+S	1.208	1.208
+D+0.750L	1.793	1.793
+D+0.750L+0.750S	2.342	2.342
+0.60D	0.286	0.286
L Only	1.755	1.755
S Only	0.731	0.731