PCS Structural Solutions

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STRUCTURAL CALCULATIONS

FOR

MERCER ISLAND RESIDENCE
6838 96TH AVE SE
MERCER ISLAND, WA 98040

PREPARED BY
PCS STRUCTURAL *SOLUTIONS*

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MAY 10, 2022
21-201

DESIGN CRITERIA

PCS Structural Solutions

Project:	MERCER ISLAND RESIDENCE	Job Number:	21-201
Sheet:	of	Name:	BRT
Originating Office:	Tacoma	Date:	5/25/2021

DESIGN CRITERIA CHECKLIST

CODE: IBC 2018, ASCE 7-16 LOCATION: MERCER ISLAND, WA

VERTICAL DESIGN CRITERIA

	DEAD	LIVE	PARTITION	CONCENTRATED
VEGETATED ROOF:	80 PSF	25 PSF		
MEMBRANE ROOF:	30 PSF	25 PSF		
PROTECTED MEMBRANE ROOF:	40 PSF	40 PSF		
WOOD FLOOR:	20 PSF	40 PSF		
COVERED WALKWAY ROOF:	16 PSF	25 PSF		
COVERED WALKWAY FLOOR:	10 PSF	40 PSF		

WIND DESIGN CRITERIA

BASIC WIND SPEED (V) =	97 MPH	(Per ASCE 7-16 Sec. 26.5.1, Fig. 26.5-1A; 1B; 1C & 1D, or as required by Bld'g Dept.)
RISK CATEGORY:	II	(Per ASCE 7-16 Table 1.5-1 & IBC Table 1604.5)
EXPOSURE CATEGORY:	D	(Per ACSE 7-16 Section 26.7.3)
DIRECTIONALITY FACTOR (K_d):	0.85	(Per ASCE 7-16 Table 26.6-1)
GUST EFFECT FACTOR (G):	0.85	(Per ASCE 7-16 Section 26.11)
TOPOGRAPHIC FACTOR (K_{zt}):	1.00	(Per ASCE 7-16 Section 26.8.2)
MEAN ROOF HEIGHT:	40 FT	(See ASCE 7-16 Section 26.2 - Definitions)
ELEVATION:	0 FT	(See ASCE 7-16 Section 26.9)
ENCLOSURE CLASSIFICATION:	Enclosed	(See ASCE 7-16 Secion 26.2 & Table 26.13-1)
ROOF TYPE:	Monoslope	(See ASCE 7-16 Figure 27.3-1)
ROOF SLOPE (__:12):	0.00:12	(Enter vertical rise in 12 horizontal units)
θ (degrees):	0.00	

SEISMIC DESIGN CRITERIA

RISK CATEGORY:	I & II	(Per ASCE 7-16 Table 1.5-1 & IBC Table 1604.5)
SITE CLASS:	D	(Per IBC Section 1613.2.2, Assumed as "D" or per Geotech.)
IMPORTANCE FACTOR (I_E):	1	(Per ASCE 7-16 Table 1.5-2)
STRUCTURAL SYSTEM (R):	5	(Per ASCE 7-16 Table 12.2-1)
OVERSTRENGTH FACTOR (Ω_o):	2.5	(Per ASCE 7-16 Table 12.2-1)

INFORMATION BELOW FROM "EARTHQUAKE SPECTRAL RESPONSE ACCELERATION MAPS" PER USGS

LATITUDE:	47.541	S_S =	1.449	F_a =	1.000
LONGITUDE:	-122.209	S_1 =	0.501	F_v =	1.800

DEFLECTION CRITERIA

FLOOR (LIVE):	L/ 480	ROOF (LIVE):	L/ 360
FLOOR (TOTAL):	L/ 360	ROOF (TOTAL):	L/ 240
WALLS:	L/ 360	SPECIAL:	L/

SOIL DESIGN CRITERIA

REPORT: YES

SEE SOILS REPORT FOR ACTIVE, PASSIVE PRESSURES AND FRICTION COEFFICIENT

BEARING:	1500 PSF
ACTIVE:	VARIES
PASSIVE:	350 PCF
COEFFICIENT OF FRICTION:	0.30

MINIMUM FOOTING DIMENSIONS:

CONTINUOUS:	1'-4"
SPREAD:	1'-6"
FROST DEPTH:	1'-6"

PILE TYPE:	NONE		
VERTICAL CAPACITY :	N/A	LATERAL CAPACITY:	N/A
UPLIFT CAPACITY:	N/A	SIZE:	N/A

MATERIALS

CONCRETE

Footings/Piles:	3000 PSI	Columns:	4000 PSI
Slabs/Walls:	4000 PSI	Beams:	4000 PSI
-	-	-	-

REINFORCING

Steel Grade = 60 f_y = 60 KSI

STRUCTURAL STEEL

W-Flange Beams	ASTM A992	f_y =	50 KSI
Shapes & Plates	ASTM A36	f_y =	36 KSI
Pipes	ASTM A53, Grade B	f_y =	35 KSI
HSS Rect.	ASTM A500, Grade C	f_y =	50 KSI
HSS Round	ASTM A500, Grade C	f_y =	46 KSI

MASONRY

ASTM C90 f'_m = 1900 PSI SOLID GROUTED

GLULAM BEAMS

Simple Spans		Cantilevers
24F-V4	Grade =	24F-V8
1.80E+06 PSI	E =	1.80E+06 PSI
2400 PSI	$F_{b\ (BOTTOM)}$ =	2400 PSI
1850 PSI	$F_{b\ (TOP)}$ =	2400 PSI
240 PSI	F_v =	240 PSI

SCL PRODUCTS

	2x SCL	1¾" SCL	3½, 5¼ SCL
E =	1.30E+06 PSI	1.80E+06 PSI	2.00E+06 PSI
F_b =	1700 PSI	2600 PSI	2900 PSI
F_v =	285 PSI	285 PSI	285 PSI
F_c =	1400 PSI	2400 PSI	2600 PSI

FRAMING LUMBER

Joists & Studs	2x DF #2	2x HF #1	-
E =	1.60E+06 PSI	1.50E+06 PSI	-
F_b =	900 PSI	975 PSI	-
F_v =	180 PSI	150 PSI	-
F_c =	1350 PSI	1350 PSI	-
Beams & Headers	4x DF #2	4x HF #1	6x DF #1
E =	1.60E+06 PSI	1.50E+06 PSI	1.60E+06 PSI
F_b =	900 PSI	975 PSI	1350 PSI
F_v =	180 PSI	150 PSI	170 PSI
Posts & Timbers	6x DF #1	-	-
E =	1.60E+06 PSI	-	-
F_c =	1000 PSI	-	-

Project: MERCER ISLAND RESIDENCE

Job Number: 21-201

Sheet: ______ of ______

Name: BRT

Originating Office: Tacoma

Date: 05/25/21

PCS Structural Solutions

DESIGN CRITERIA - WIND

BASIC WIND SPEED (V):	97 MPH	MEAN ROOF HEIGHT:	40 FT
RISK CATEGORY:	II	GROUND ELEVATION FACTOR (Ke):	1.00
EXPOSURE CATEGORY:	D	ENCLOSURE CLASSIFICATION:	Enclosed
DIRECTIONALITY FACTOR (K_d):	0.85	ROOF TYPE:	Monoslope
GUST EFFECT FACTOR (G):	0.85	ROOF SLOPE (__:12):	0.0:12
TOPOGRAPHIC FACTOR (K_{zt}):	1.00	θ (degrees):	0.00

ASCE 7-16 CHAPTER 27: WIND LOADS ON BUILDINGS: MWFRS (DIRECTIONAL PROCEDURE)
PART 1: ENCLOSED AND PARTIALLY ENCLOSED BUILDINGS OF ALL HEIGHTS

NOTE: q_z and q_i have conservatively been taken equal to q_h.

HORIZONTAL WALL PRESSURES (Figure 27.3-1)

	External Pressures ($q*(GC_p)$):			Internal Pressures ($\pm q_i*(GC_{pi})$)
L/B:	Windward wall	Leeward wall	Sidewall	All walls
0-1	17.0	-10.6	-14.9	4.5
2		-6.4		
≥4		-4.2		

ROOF PRESSURES (Figure 27.3-1)

		External Pressures ($q*(GC_p)$):			Internal Pressures ($\pm q_i*(GC_{pi})$)
Wind Direction:	h/L:	Windward (Positive)	Windward (Negative)	Leeward	All Roofs
Normal to Ridge for θ ≥ 10°	≤0.25	N/A	N/A	N/A	4.5
	0.50	N/A	N/A	N/A	
	≥1.0	N/A	N/A	N/A	

	h/L:	Horizontal Distance from Windward Edge	External Pressures ($q*(GC_p)$):		Internal Pressures ($\pm q_i*(GC_{pi})$)
			Positive Pressure	Negative Pressure	All Roofs
Normal to Ridge for θ < 10° and Parallel to Ridge for All θ	≤0.5	0 to h	-3.8	-19.1	4.5
		h to 2h		-10.6	
		>2h		-6.4	
	≥1.0	0 to h/2	-3.8	-27.6	
		>h/2		-14.9	

ASCE 7-16 27.1.5: Minimum Design Wind Loads: The wind load used for design of the MWFRS shall not be less than 16 PSF multiplied by the wall area of the building, and 8 PSF multiplied by the roof area of the building projected on a vertical plane normal to the assumed wind direction. Wall and roof loads shall be applied simultaneously.

ASCE 7-16 CHAPTER 30: WIND LOADS: COMPONENTS AND CLADDING
PART 1: LOW-RISE BUILDINGS (h≤60 ft)

ROOF SURFACES

Effective Wind Area	POSITIVE PRESSURES	NEGATIVE PRESSURES					
		ZONE					
	ALL ZONES	1'	1	2	3	N/A	N/A
10 SF	16.0	-27.0	-47.0	-61.9	-84.4	N/A	N/A
20 SF	16.0	-27.0	-43.9	-58.0	-76.5	N/A	N/A
50 SF	16.0	-27.0	-39.8	-52.7	-65.9	N/A	N/A
100 SF	16.0	-27.0	-36.7	-48.7	-58.0	N/A	N/A

WALL SURFACES & ROOF OVERHANGS

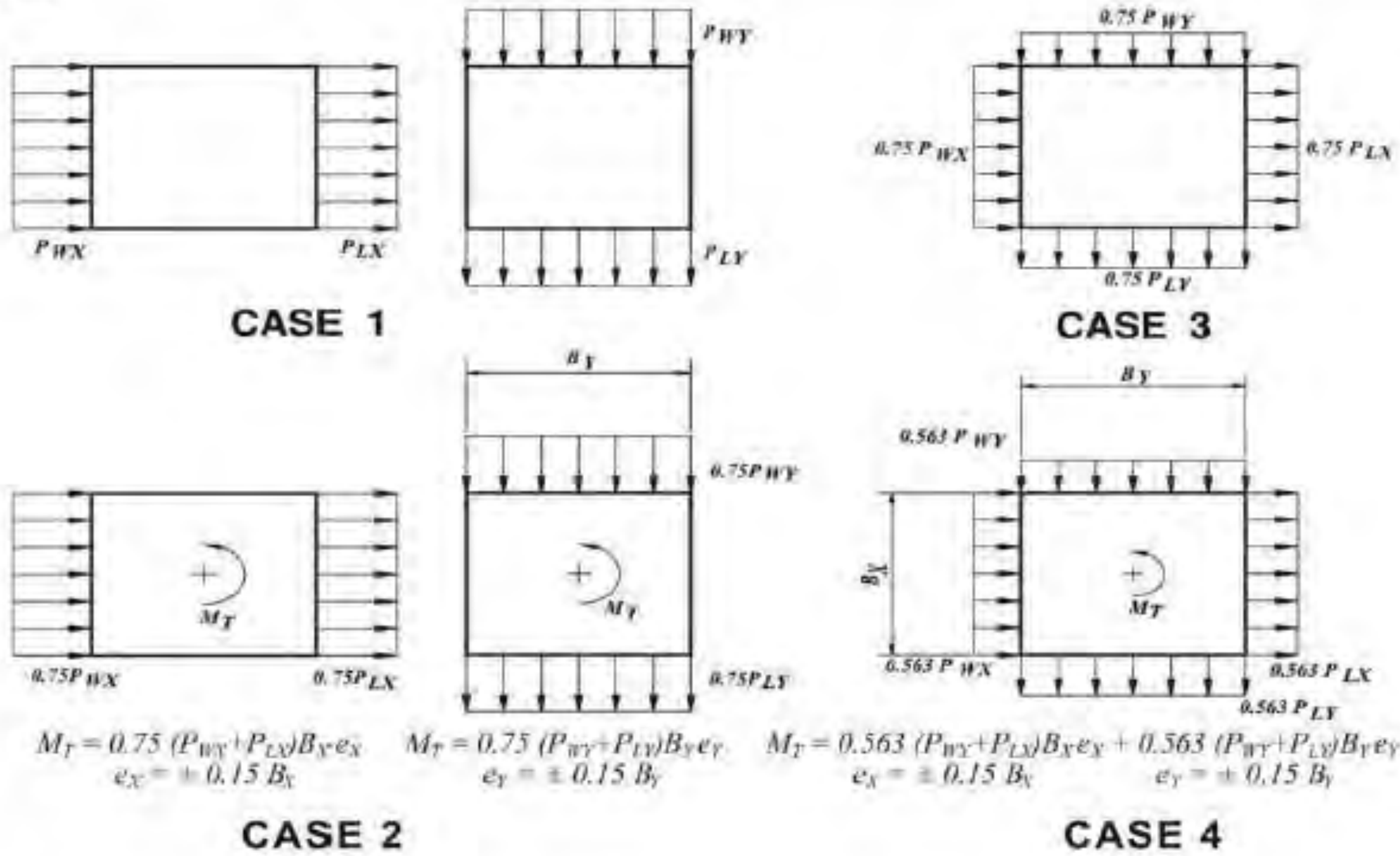
Effective Wind Area	WALL ZONES				ROOF OVERHANG ZONES					
	POSITIVE PRESSURES		NEGATIVE PRESSURES		NEGATIVE PRESSURES					
	4	5	4	5	1'	1	2	3	N/A	N/A
10 SF	29.5	29.5	-32.0	-39.5	-47.0	-47.0	-61.9	-84.4	N/A	N/A
20 SF	28.1	28.1	-30.6	-36.8	-46.2	-46.2	-56.6	-75.1	N/A	N/A
50 SF	26.4	26.4	-28.9	-33.3	-45.2	-45.2	-49.6	-62.8	N/A	N/A
100 SF	25.1	25.1	-27.6	-30.6	-44.5	-44.5	-44.3	-53.6	N/A	N/A
500 SF	22.0	22.0	-24.5	-24.5	-42.7	-42.7	-32.0	-32.0	N/A	N/A

ASCE 7-16 30.2.2: Minimum Design Wind Loads: The design wind pressure for C&C of buildings shall not be less than a net pressure of 16 PSF acting in either direction normal to the surface.

DESIGN CRITERIA - WIND

FIGURE 27.3-8: Main Wind Force Resisting System, Part 1 (All Heights): Design Wind Load Cases per ASCE 7-16

Diagrams



Notation

P_{WX}, P_{WY} = Windward face design pressure acting in the x, y principal axis, respectively.
P_{LX}, P_{LY} = Leeward face design pressure acting in the x, y principal axis, respectively.
$e(e_X, e_Y)$ = Eccentricity for the x, y principal axis of the structure, respectively.
M_T = Torsional moment per unit height acting about a vertical axis of the building.

Case 1. Full design wind pressure acting on the projected area perpendicular to each principal axis of the structure, considered separately along each principal axis.
Case 2. Three-quarters of the design wind pressure acting on the projected area perpendicular to each principal axis of the structure in conjunction with a torsional moment as shown, considered separately for each principal axis.
Case 3. Wind loading as defined in Case 1, but considered to act simultaneously at 75% of the specified value.
Case 4. Wind loading as defined in Case 2, but considered to act simultaneously at 75% of the specified value.

Notes

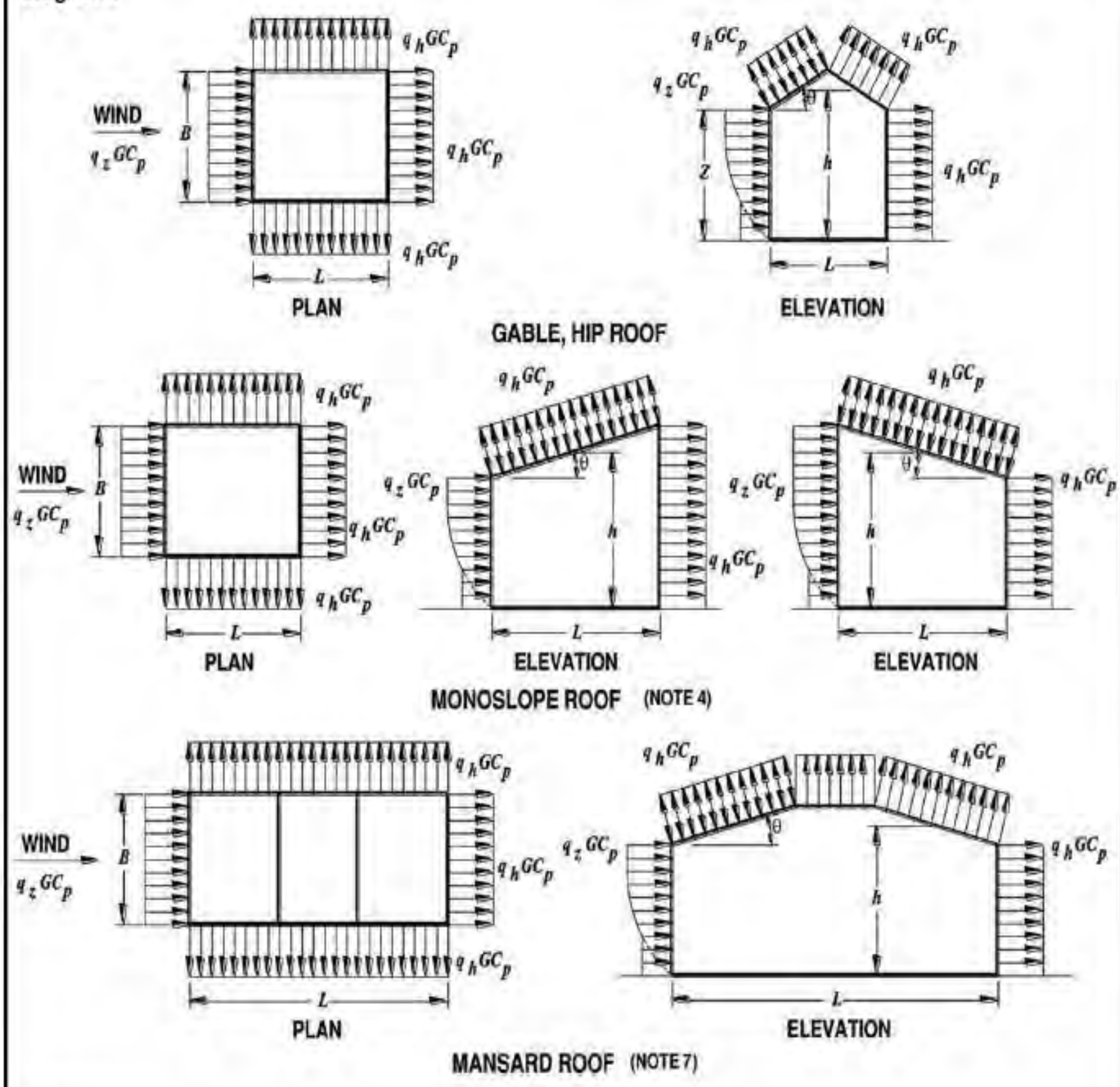
1. Design wind pressures for windward and leeward faces shall be determined in accordance with the provisions of Sections 27.3.1 and 27.3.2 as applicable for buildings of all heights.
2. Diagrams show plan views of buildings.

FIGURE 27.3-8 Main Wind Force Resisting System, Part 1 (All Heights): Design Wind Load Cases

DESIGN CRITERIA - WIND

FIGURE 27.3-1 Main Wind Force Resisting System, Part 1 (All Heights): External Pressure Coefficients, Cp, for Enclosed and Partially Enclosed Buildings - Walls and Roofs per ASCE 7-16

Diagrams



Notation

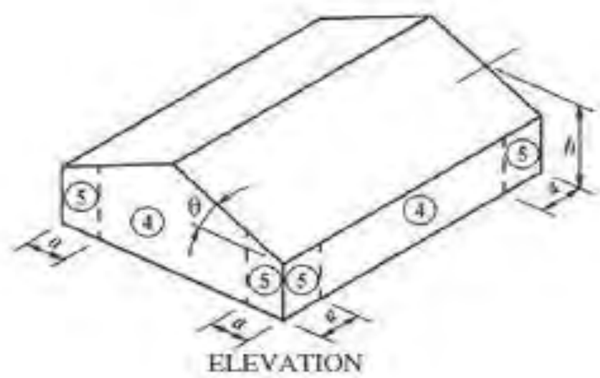
B = Horizontal dimension of building, in ft (m), measured normal to wind direction.
L = Horizontal dimension of building, in ft (m), measured parallel to wind direction.
h = Mean roof height, in ft (m), except that eave height shall be used for $\theta \leq 10$ degrees.
z = Height above ground, in ft (m).
G = Gust-effect factor.
q_z, q_h = Velocity pressure, in lb/ft² (N/m²), evaluated at respective height.
θ = Angle of plane of roof from horizontal, in degrees.

FIGURE 27.3-1 Main Wind Force Resisting System, Part 1 (All Heights): External Pressure Coefficients, C_p, for Enclosed and Partially Enclosed Buildings—Walls and Roofs

DESIGN CRITERIA - WIND

FIGURE 30.3-1: Components and Cladding [h ≤ 60 ft]: External Pressure Coefficients, (GCp), for Enclosed and Partially Enclosed Buildings - Walls

Diagram



Notation

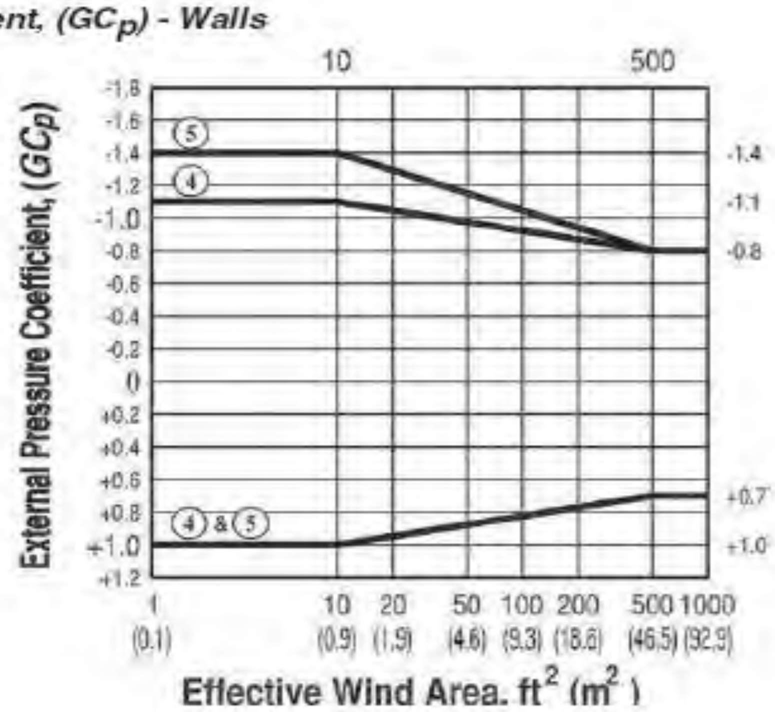
a = 10% of least horizontal dimension or $0.4h$, whichever is smaller, but not less than either 4% of least horizontal dimension or 3 ft (0.9 m).

Exception: For buildings with θ = 0° to 7° and a least horizontal dimension greater than 300 ft (90 m), dimension a shall be limited to a maximum of $0.8h$.

h = Mean roof height, in ft (m), except that eave height shall be used for θ ≤ 10°.

θ = Angle of plane of roof from horizontal, in degrees.

External Pressure Coefficient, (GC_p) - Walls



Notes

1. Vertical scale denotes (GCp) to be used with qh.
2. Horizontal scale denotes effective wind area, in ft^2 (m^2).
3. Plus and minus signs signify pressures acting toward and away from the surfaces, respectively.
4. Each component shall be designed for maximum positive and negative pressures.
5. Values of (GCp) for walls shall be reduced by 10% when θ ≤ 10°.

FIGURE 30.3-1 Components and Cladding [h ≤ 60 ft (h ≤ 18.3 m)]: External Pressure Coefficients, (GC_p), for Enclosed and Partially Enclosed Buildings—Walls

DESIGN CRITERIA - SEISMIC

ASCE 7-16 SECTION 12.8 - EQUIVALENT LATERAL FORCE PROCEDURE

OCCUPANCY CATEGORY:	I & II	LATITUDE:	47.541
SITE CLASS:	D	LONGITUDE:	-122.209
IMPORTANCE FACTOR (I_E):	1	S_S =	1.449
STRUCTURAL SYSTEM (R):	5	S_1 =	0.501
OVERSTRENGTH FACTOR (Ω_o):	2.5	F_a =	1.000
		F_v =	1.800

ASCE 7-16 SECTION 11.4 SEISMIC GROUND MOTION VALUES

Section 11.4.4 - Coefficients and Risk-Targeted Maximum Considered Earthquake (MCER) Spectral Response Acceleration Parameters

$S_{MS} = F_a*S_S =$ 1.449 $S_{M1} = F_v*S_1 =$ 0.902

Section 11.4.5 - Design Spectral Response Acceleration Parameters

$S_{DS} = 2/3*S_{MS} =$ 0.966 $S_{D1} = 2/3*S_{M1} =$ 0.601

ASCE 7-16 SECTION 11.6 - SEISMIC DESIGN CATEGORY - SECTION 12.8.2 - PERIOD DETERMINATION

ASCE 7-16 TABLE 11.6-1

SEISMIC DESIGN CATEGORY BASED ON S_{DS}

	RISK CATEGORY:		
	I & II	III	IV
< 0.167g	A	A	A
< 0.33g	B	B	C
< 0.50g	C	C	D
>= 0.50g	D	D	D
	D		

ASCE 7-16 TABLE 11.6-2

SEISMIC DESIGN CATEGORY BASED ON S_{D1}

	RISK CATEGORY:		
	I & II	III	IV
< 0.067g	A	A	A
< 0.133g	B	B	C
< 0.20g	C	C	D
>= 0.20g	D	D	D
	D		

Each building and structure shall be assigned to the most severe Seismic Design Category in accordance with Table 11.6-1 or Table 11.6-2, irrespective of the fundamental period of vibration of the structure.

PERIOD DETERMINATION:	
C_t =	0.02
h_n =	40 FT
x =	0.75
$T_a = C_t*h_n^x$ =	0.318

ASCE 7-16 SECTION 12.8.1.1 - SEISMIC RESPONSE COEFFICIENT

GENERAL EQUATION:	$C_S = S_{DS}/(R/I) =$	0.193	<--CONTROLS	EQ. 12.8-2
MAXIMUM:	CS = 1.5*SD1/(T*(R/I)) =	0.567		EQ. 12.8-3
MINIMUM:	$C_S = 0.044*S_{DS}*I > 0.01 =$	0.043		EQ. 12.8-5

For structures located where S1 > 0.6g

$C_S = 0.5*S_1/(R/I) =$ 0.000 EQ. 12.8-6

ASCE 7-10 SECTION 12.8.1 - SEISMIC BASE SHEAR

$V = C_S*W =$ **0.193*W**

W = the total dead load and applicable portion of other loads as indicated in Section 12.7.2

LATERAL

Hazards by Location

Search Information

Address: 6838 96th Ave SE, Mercer Island, WA 98040, USA

Coordinates: 47.5410943, -122.209757

Elevation: 32 ft

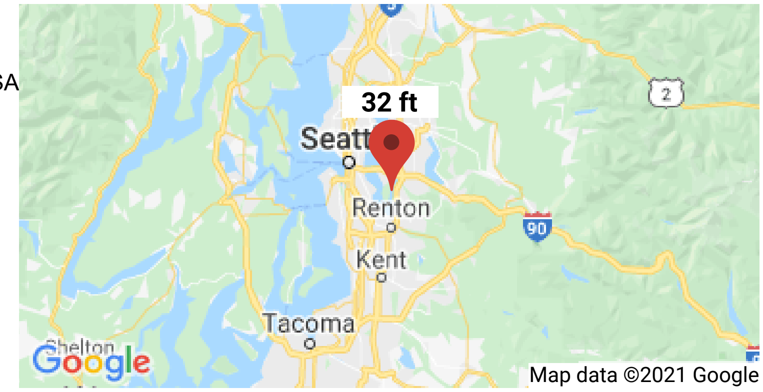
Timestamp: 2021-05-26T20:40:46.805Z

Hazard Type: Seismic

Reference Document: ASCE7-16

Risk Category: II

Site Class: D



Basic Parameters

Name	Value	Description
S_S	1.449	MCE_R ground motion (period=0.2s)
S_1	0.501	MCE_R ground motion (period=1.0s)
S_{MS}	1.449	Site-modified spectral acceleration value
S_{M1}	* null	Site-modified spectral acceleration value
S_{DS}	0.966	Numeric seismic design value at 0.2s SA
S_{D1}	* null	Numeric seismic design value at 1.0s SA

* See Section 11.4.8

Additional Information

Name	Value	Description
SDC	* null	Seismic design category
F_a	1	Site amplification factor at 0.2s
F_v	* null	Site amplification factor at 1.0s
CR_S	0.902	Coefficient of risk (0.2s)
CR_1	0.899	Coefficient of risk (1.0s)
PGA	0.62	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.682	Site modified peak ground acceleration
T_L	6	Long-period transition period (s)
SsRT	1.449	Probabilistic risk-targeted ground motion (0

SsRT	[illegible]	Probabilistic risk-targeted ground motion (0.2s)
SsUH	1.607	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	4.301	Factored deterministic acceleration value (0.2s)
S1RT	0.501	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.558	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	1.642	Factored deterministic acceleration value (1.0s)
PGAd	1.425	Factored deterministic acceleration value (PGA)

* See Section 11.4.8

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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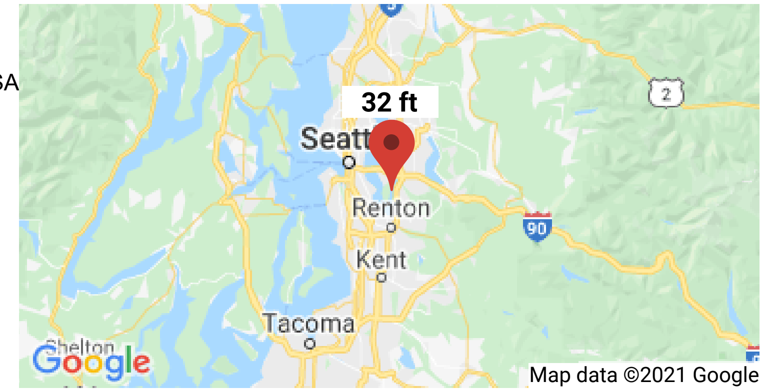
ATC Hazards by Location

Search Information



Address: 6838 96th Ave SE, Mercer Island, WA 98040, USA

Coordinates: 47.5410943, -122.209757

Elevation: 32 ft

Timestamp: 2021-05-26T20:39:48.869Z

Hazard Type: Snow

ASCE 7-16

Ground Snow Load ⚠ 16 lb/sqft

The reported ground snow load applies at the query location of 32 feet up to a maximum elevation of 320 feet with a tolerance of 100 feet.

ASCE 7-10

Ground Snow Load ⚠ 15 lb/sqft

The reported ground snow load applies at the query location of 32 feet up to a maximum elevation of 400 feet.

ASCE 7-05

Ground Snow Load ⚠ 15 lb/sqft

The reported ground snow load applies at the query location of 32 feet up to a maximum elevation of 400 feet.

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer.

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ATC Hazards by Location

Search Information

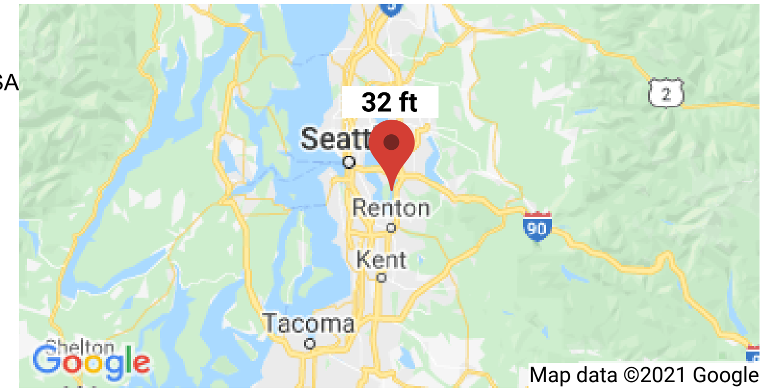
Address: 6838 96th Ave SE, Mercer Island, WA 98040, USA

Coordinates: 47.5410943, -122.209757

Elevation: 32 ft

Timestamp: 2021-05-26T20:40:22.265Z

Hazard Type: Wind



ASCE 7-16

MRI 10-Year	67 mph
MRI 25-Year	73 mph
MRI 50-Year	78 mph
MRI 100-Year	83 mph
Risk Category I	92 mph
Risk Category II	97 mph
Risk Category III	104 mph
Risk Category IV	108 mph

ASCE 7-10

MRI 10-Year	72 mph
MRI 25-Year	79 mph
MRI 50-Year	85 mph
MRI 100-Year	91 mph
Risk Category I	100 mph
Risk Category II	110 mph
Risk Category III-IV	115 mph

ASCE 7-05

ASCE 7-05 Wind Speed	85 mph

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

LATERAL

WIND:

SEE DESIGN CRITERIA SPREADSHEET FOR WIND PARAMETERS AND PRESSURE CALCULATIONS...

$h = 35\text{ft}$

WALL - $L/B = 80\text{ft}/62\text{ft} = 1.3$ ⟶ WINDWARD WALL PRESSURE = 17.0 PSF
LEEWARD WALL PRESSURE = 9.4 PSF
INTERNAL WALL PRESSURE = ± 4.5 PSF

WINDWARD WALL PRESSURE = 17.0 PSF - (-4.5 PSF) = 21.5 PSF

OR = 17.0 PSF - (+4.5 PSF) = 12.5 PSF

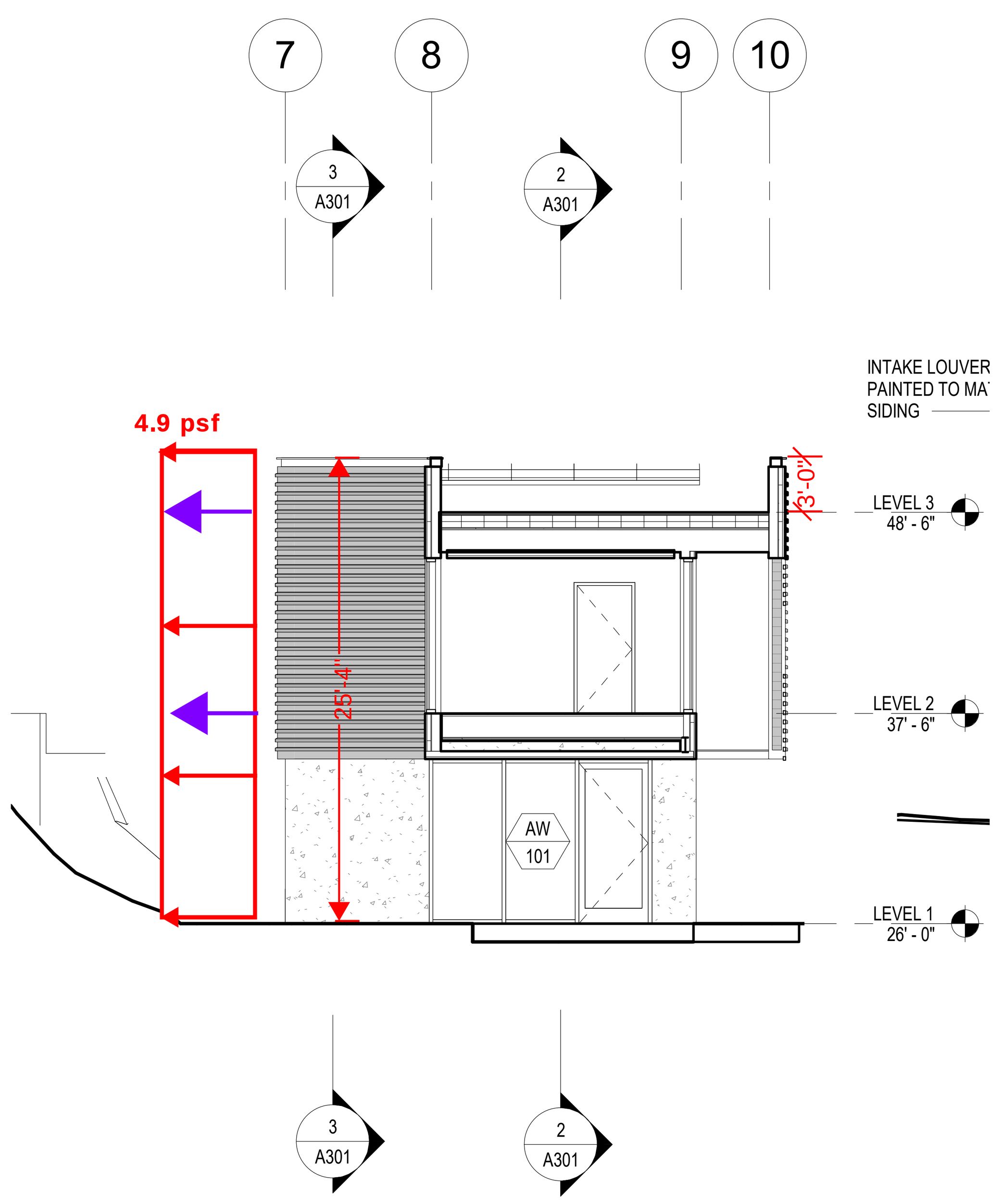
LEEWARD WALL PRESSURE = 9.4 PSF - (+4.5 PSF) = 4.9 PSF

OR = 9.4 PSF - (-4.5 PSF) = 13.9 PSF

21.5 PSF + 4.9 PSF = 26.4 PSF

12.5 PSF + 13.9 PSF = 26.4 PSF

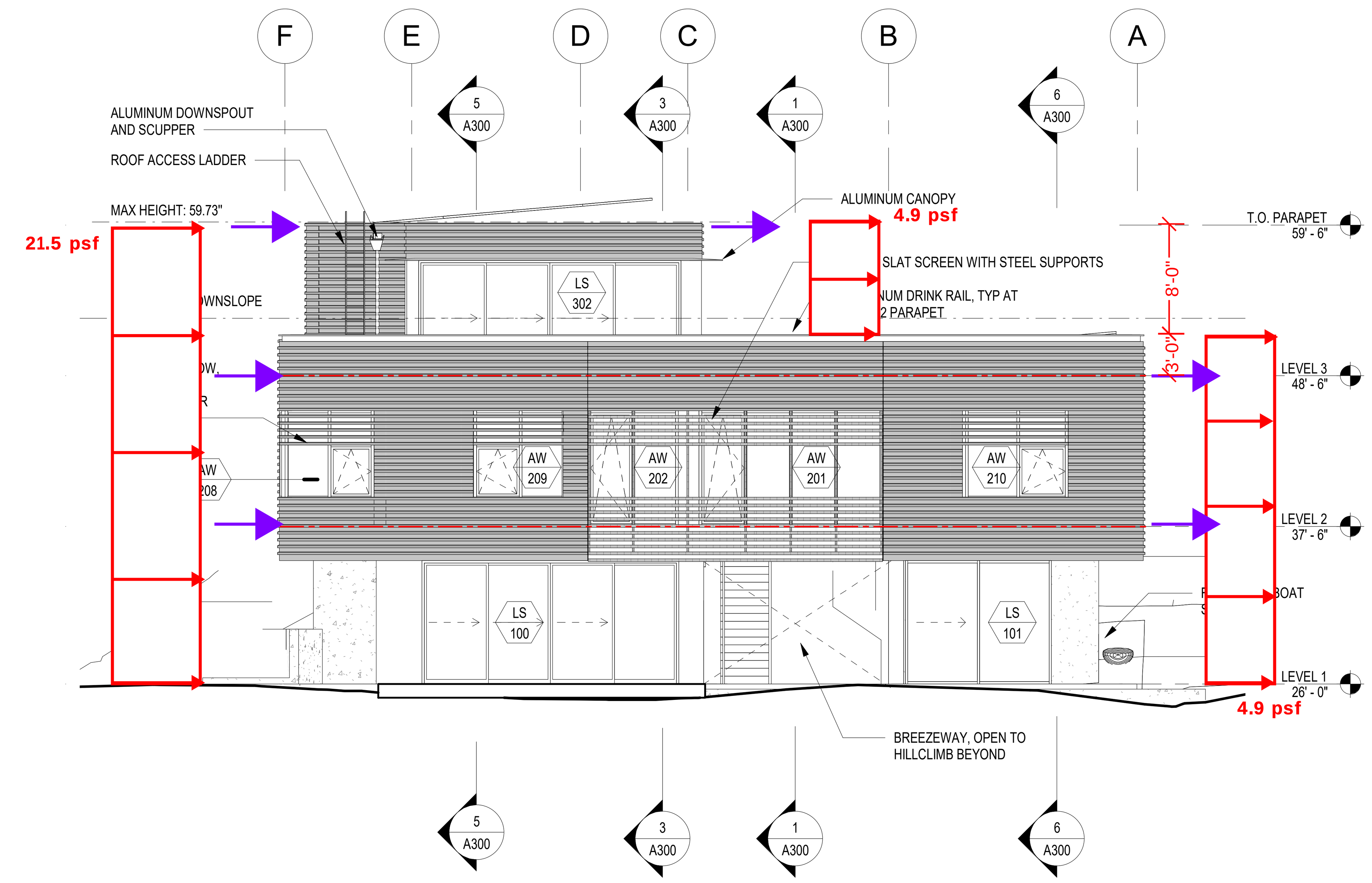
ROOF - FLAT ROOF ∴ NO HORIZONTAL PRESSURE



5 A200 **SOUTH ELEVATION - BREEZEWAY**
1/8" = 1'-0"

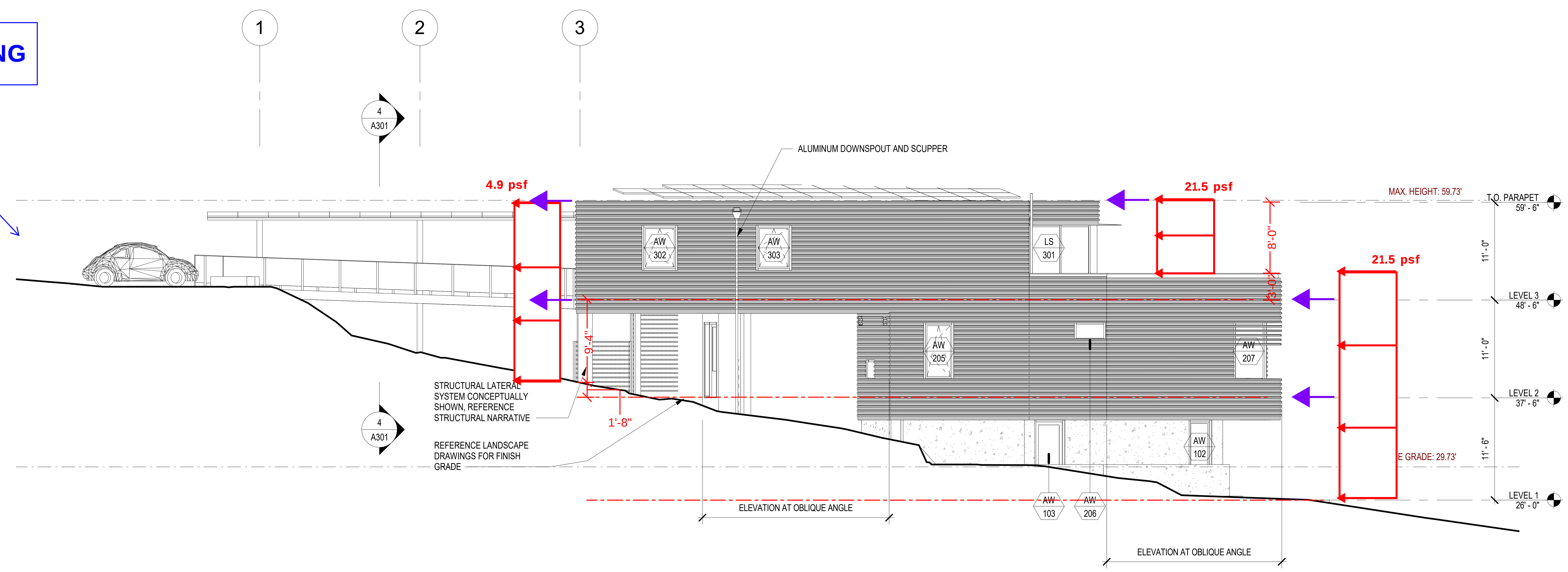
E/W LOADING

WIND LOADING (ALL LOADS ARE ULTIMATE LEVEL)



2 A200 **EAST ELEVATION**
1/8" = 1'-0"

N/S LOADING



1 A200 **SOUTH ELEVATION**
1/8" = 1'-0"

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MERCER ISLAND, WA 98040

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BUILDING ELEVATIONS
A200

LATERAL

WIND: SEE MAPS FOR CONTROLLING WIND PRESSURE LOADING IN N/S + E/W DIRECTIONS...

E/W DIRECTION:

$$V_R = 21.5\,\text{psf}\,(4\text{ft})(30\text{ ft}) + 4.9\,\text{psf}\,(5.5\text{ft})(30\text{ft}) = 3.4^k$$

$$V_3 = 21.5\,\text{psf}\,(3\text{ft} + 5.5\text{ft} + 4\text{ft})(62.5\text{ft}) + 4.9\,\text{psf}\left[(11\text{ft})(30\text{ft}) + (5.5\text{ft})(32\text{ft})\right] = 19.3^k$$

$$V_2 = 21.5\,\text{psf}\,(5.5\text{ft} + 5.75\text{ft})(62.5\text{ft}) + 4.9\,\text{psf}\,(5.75\text{ft} + 5.5\text{ft})(32\text{ft}) = 16.9^k$$

$$V_{BASE} = (3.4^k + 19.3^k + 16.9^k) = \underline{\underline{39.6^k}}$$

N/S DIRECTION:

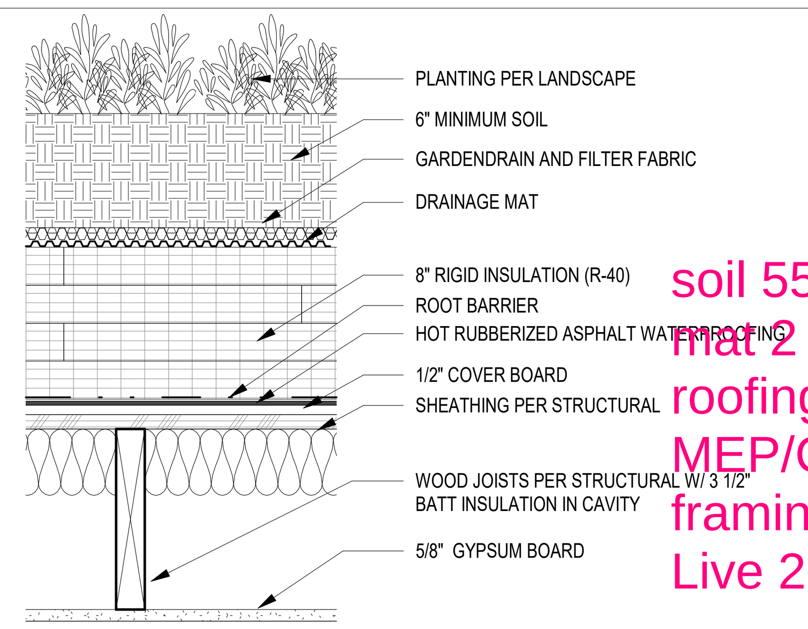
$$V_R = 21.5\,\text{psf}\,(4\text{ft})(60\text{ ft}) + 4.9\,\text{psf}\,(4\text{ ft})(60\text{ ft}) = 6.4^k$$

$$V_3 = 21.5\,\text{psf}\,(3\text{ft} + 5.5\text{ft} + 4\text{ft})(80\text{ ft}) + 4.9\,\text{psf}\left[(3\text{ft} + 5.5\text{ft} + 4\text{ft})(67\text{ft})\right] = 25.6^k$$

$$V_2 = 21.5\,\text{psf}\,(5.5\text{ft} + 5.75\text{ft})(80\text{ ft}) + 4.9\,\text{psf}\,(5.75\text{ft} + 5.5\text{ft})(67\text{ft}) = 23.0^k$$

$$V_{BASE} = (6.4^k + 25.6^k + 23.0^k) = \underline{\underline{55.0^k}}$$

ROOF ASSEMBLIES

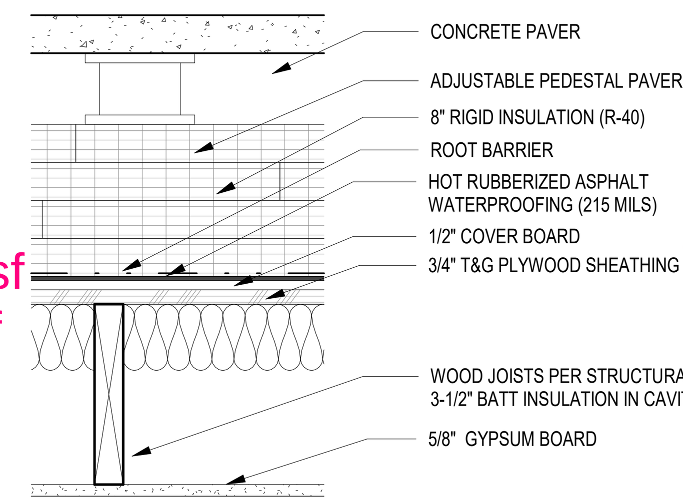


soil 55 psf
mat 2 psf
roofing/insul 5 psf
MEP/Ceiling 5 psf
framing 10 psf
Live 25 psf

R1 VEGETATED ROOF

DL = 78 PSF
LL = 25 PSF

U VALUE: xxx
FIRE RATING: xx

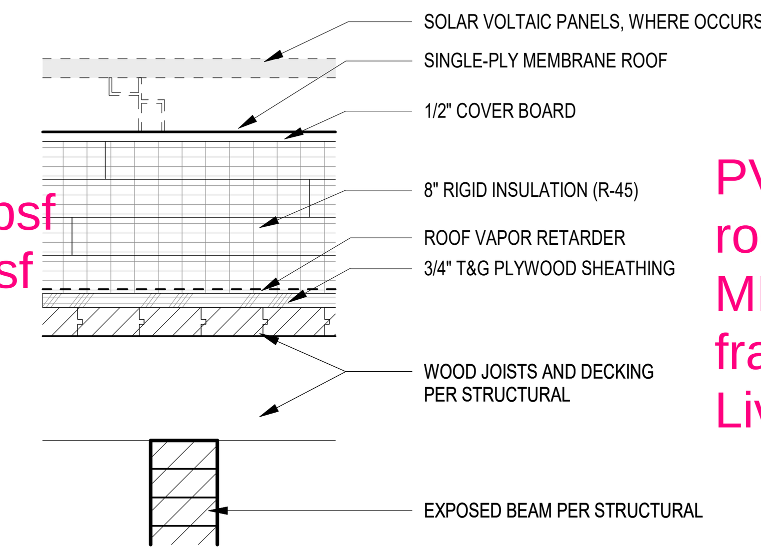


paver 18 psf
roofing/insul 5 psf
MEP/Ceiling 5 psf
framing 10 psf
Live 40 psf

R2 PROTECTED MEMBRANE ROOF

U VALUE: xxx
FIRE RATING: xxx
STC:xxx

DL = 38 PSF
LL = 40 PSF



PV Array 10 psf
roofing/insul 5 psf
MEP/Ceiling 5 psf
framing 10 psf
Live 25 psf

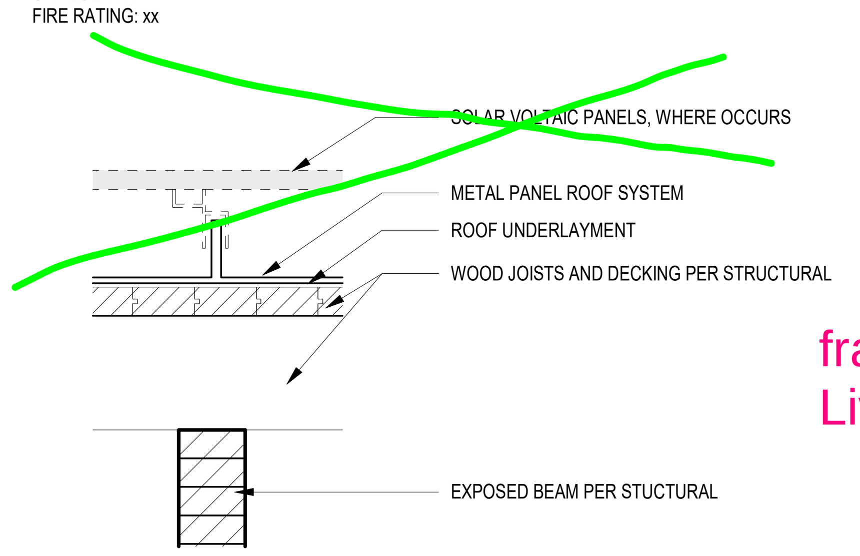
W/O PV ARRAY

R3 MEMBRANE ROOF

U VALUE: xxx
FIRE RATING: xxx
STC:xxx

DL = 30 PSF
LL = 25 PSF

DL = 20 PSF
LL = 25 PSF



framing 6 psf
Live 25 psf

BRIDGE FLOOR

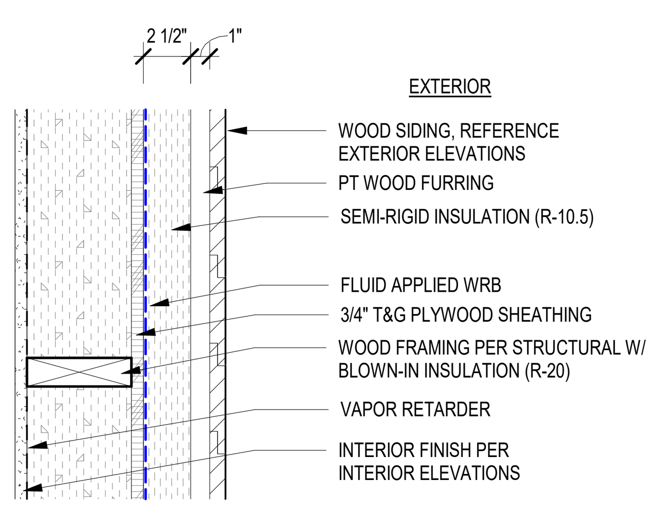
R4 METAL PANEL - UNINSULATED

U VALUE: xxx
FIRE RATING: xxx
STC:xxx

DL = 6 PSF
LL = 25 PSF

DL = 10 PSF
LL = 40 PSF

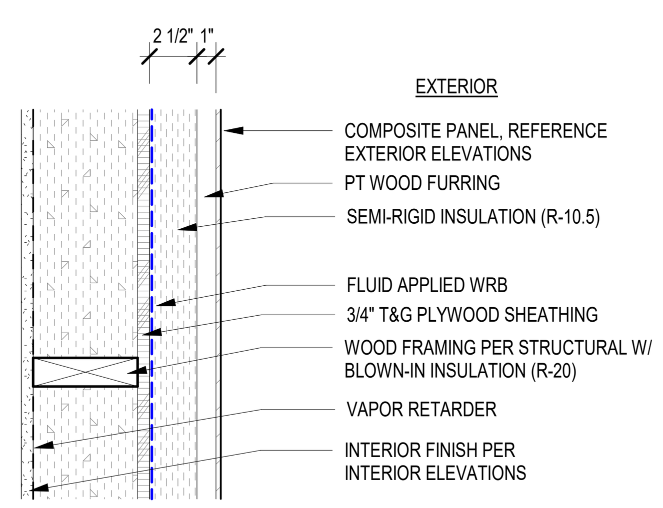
EXTERIOR WALL ASSEMBLIES



SECTION

W1 WOOD SIDING

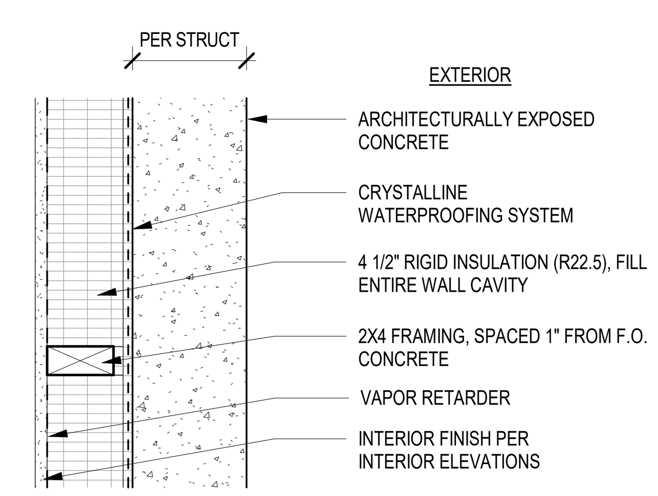
U VALUE: 0.055
FIRE RATING: UNRATED



SECTION

W2 COMPOSITE BOARD SIDING

U VALUE: 0.055
FIRE RATING: UNRATED

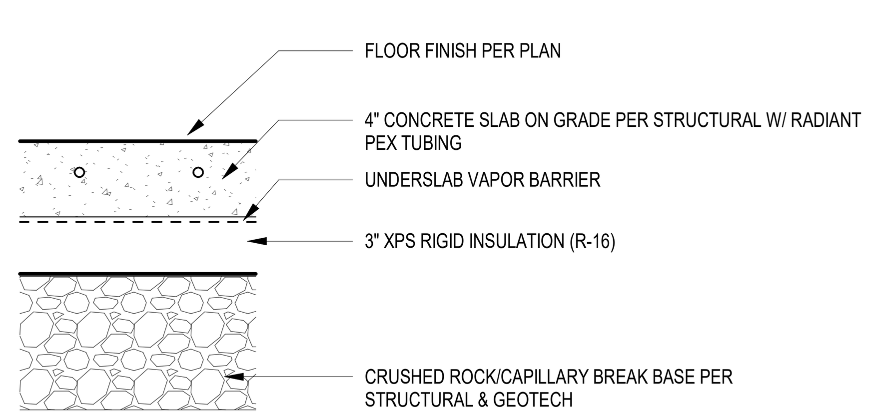


SECTION

W3 FURRING WALL @ CONC.

U VALUE: 0.055
FIRE RATING: UNRATED

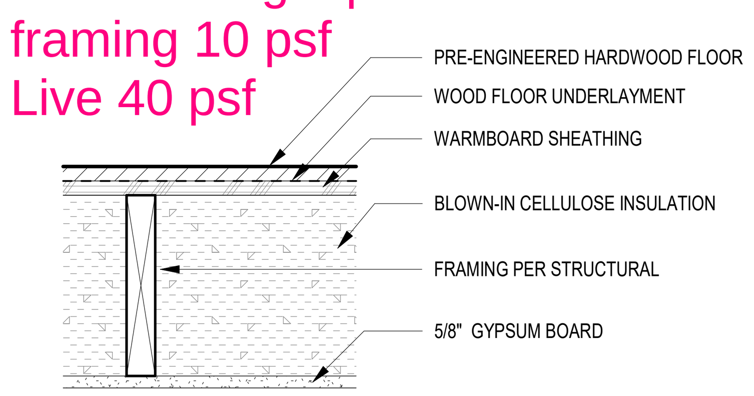
FLOOR ASSEMBLIES



F1 CONCRETE SLAB-ON-GRADE

U VALUE: 0.025
FIRE RATING: N/A

flooring/topping 5 psf
MEP/Ceiling 5 psf
framing 10 psf
Live 40 psf

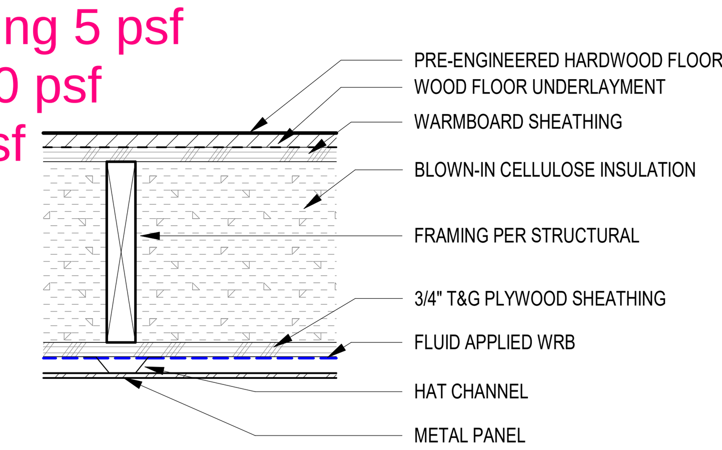


F2 WOOD FLOOR

U VALUE: xxx
FIRE RATING: xxx

DL = 20 PSF
LL = 40 PSF

flooring/topping 5 psf
MEP/Ceiling 5 psf
framing 10 psf
Live 40 psf



F3 WOOD FLOOR / METAL SOFFIT

U VALUE: xxx
FIRE RATING: xxx

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EXTERIOR ASSEMBLIES

A010

GENERAL FLOOR PLAN NOTES

FLOOR WEIGHT = (1,755 SF + 27 SF) (20 PSF) = 35.7 K

1 A121 **LEVEL 2 FLOOR PLAN**

1/8" = 1'-0"

0' 4' 8' 16'

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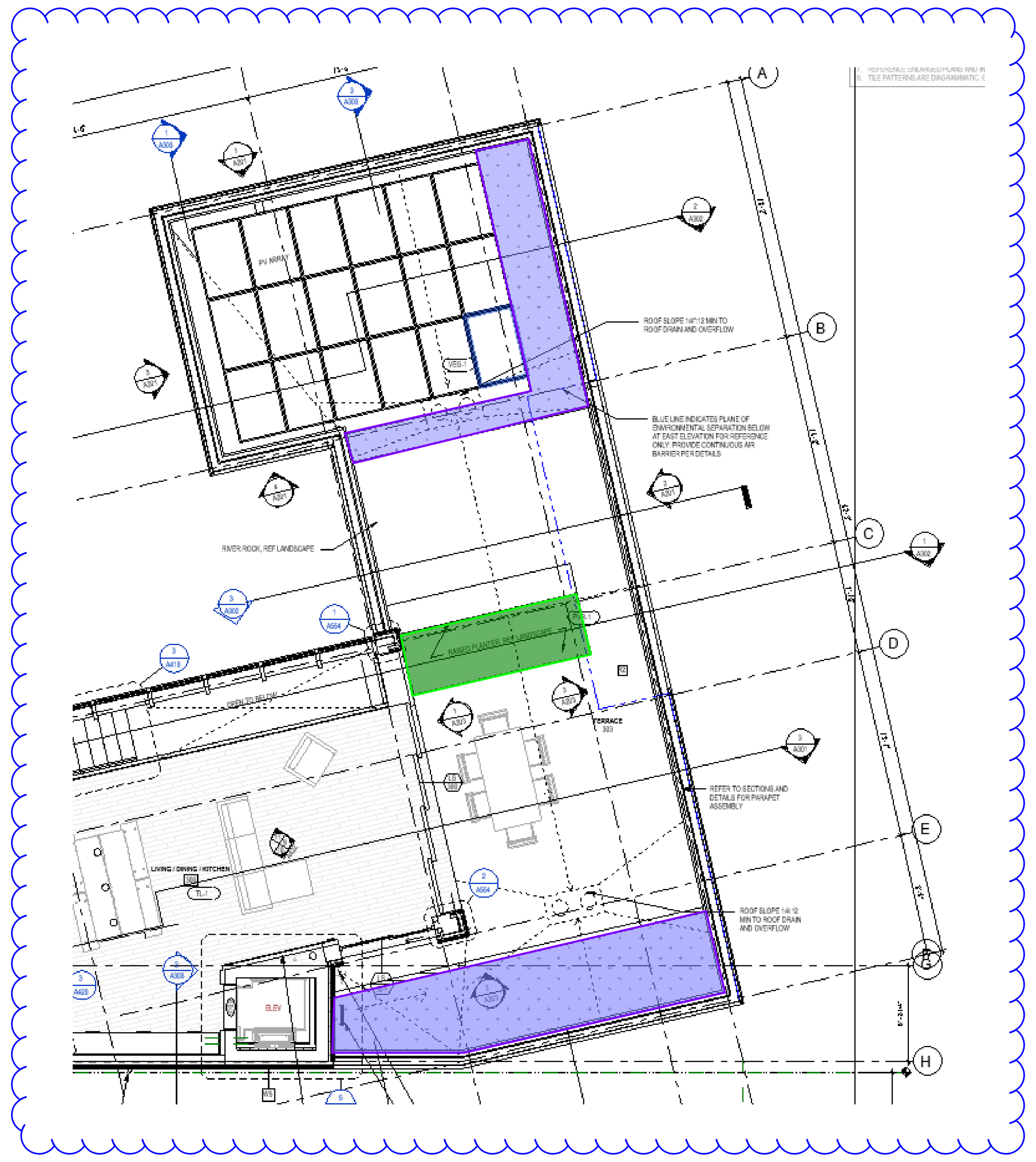
LEVEL 2 - FLOOR PLAN

A121



UPDATED ROOF PLAN. HALF VEGETATED ROOF STILL CONSERVATIVE

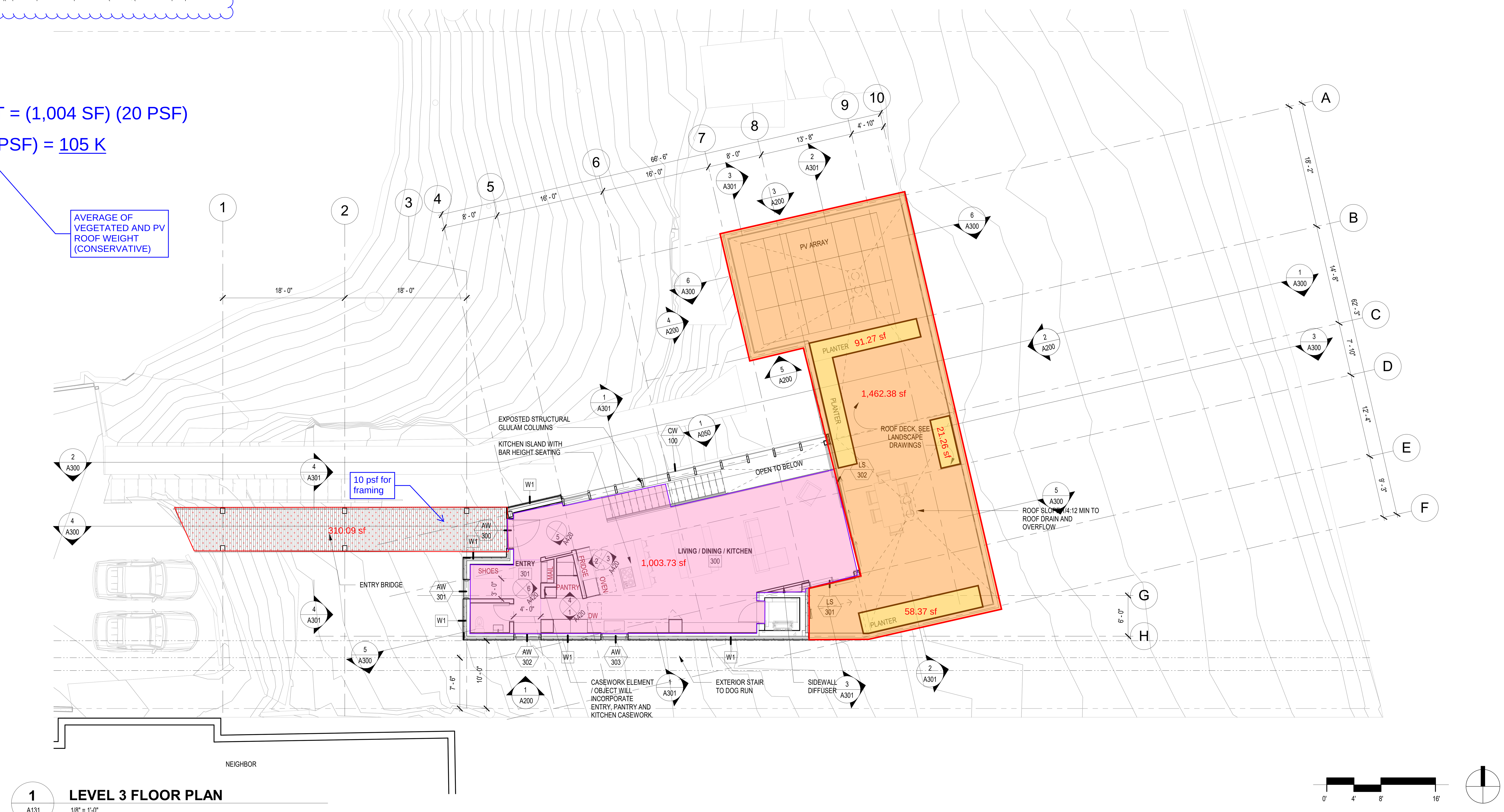
AREA SCHEDULE (GSF)

Name	Area
LEVEL 1 / OFFICE	342.91 SF
LEVEL 1	867.35 SF
LEVEL 2	2098.81 SF
LEVEL 3	1130.79 SF
GARAGE	583.28 SF
	5023.14 SF

GENERAL FLOOR PLAN NOTES

FLOOR WEIGHT = (1,004 SF) (20 PSF)
+ (1463 SF) (58 PSF) = 105 K

AVERAGE OF VEGETATED AND PV ROOF WEIGHT (CONSERVATIVE)



1 A131 LEVEL 3 FLOOR PLAN
1/8" = 1'-0"

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LEVEL 3 - FLOOR PLAN

A131

GENERAL ROOF PLAN NOTES

1. SEE SECTIONS AND DETAILS FOR ROOF TYPE CALL OUTS.

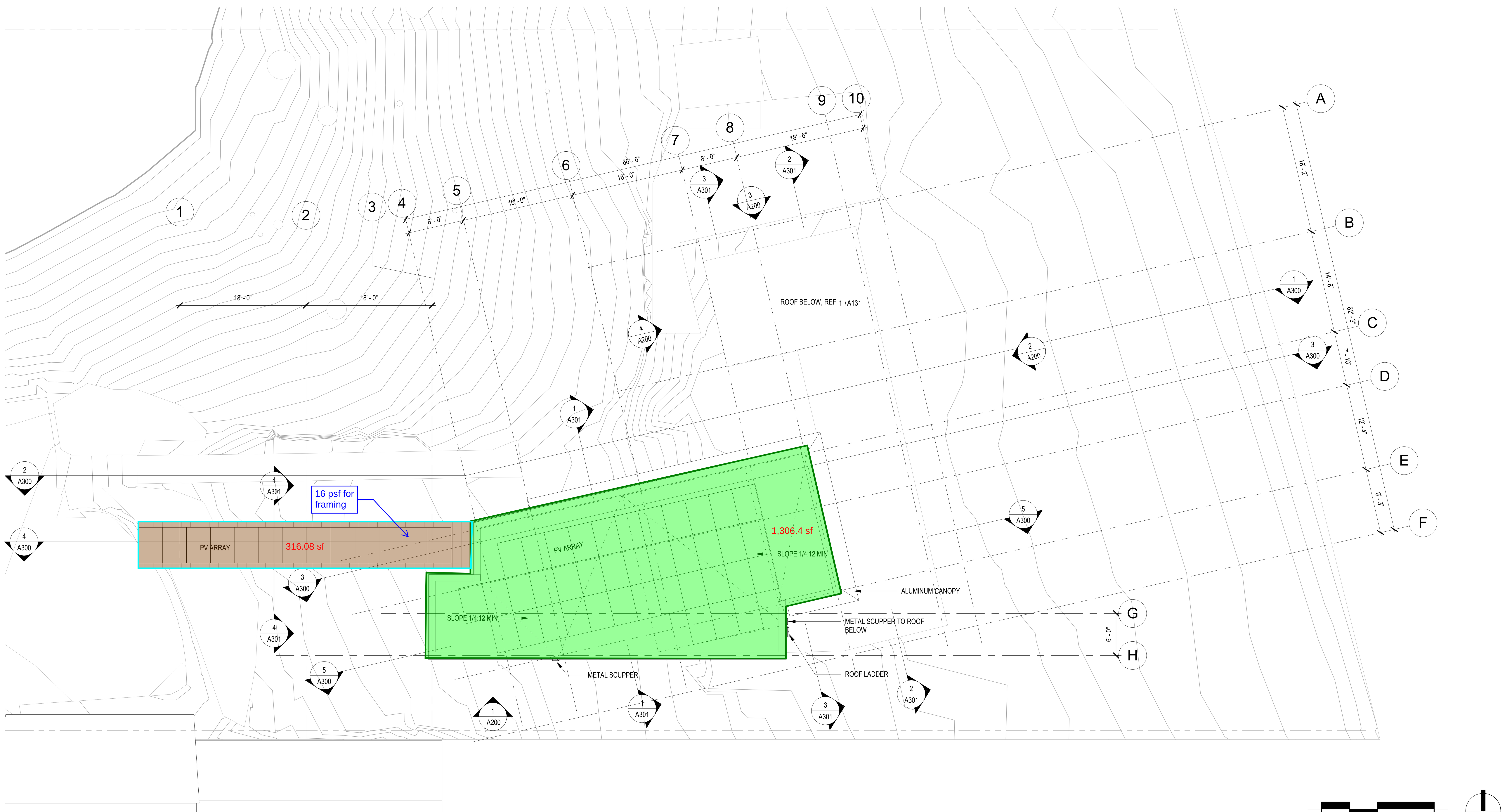
SEC C411 RENEWABLES

A. QUANTITY OF RENEWABLES REQUIRED IS [put calculation here]. [XX] kW PROVIDED.
B. REFER TO SHEETS E[xxx] FOR ADDITIONAL PV INFORMATION.

SEC C412 SOLAR READINESS

A. THE SOLAR ZONE WHICH COMPLIES WITH REQUIREMENTS FOR UNSHADED AREA WITHIN THIS SECTION IS AS SHOWN IN THE TABULATION ABOVE. THE PORTION OF THE ROOF AREA PROVIDED IN SOLAR ZONE IS [xx% (xxx SF/Roof area minus skylight area)].
B. REFER TO SHEETS E[xxx] FOR FUTURE PV INTERCONNECTION PROVISIONS.

ROOF WEIGHT = (1307 SF) (30 PSF) = 39.3 K



1 A141 **ROOF PLAN**
1/8" = 1'-0"

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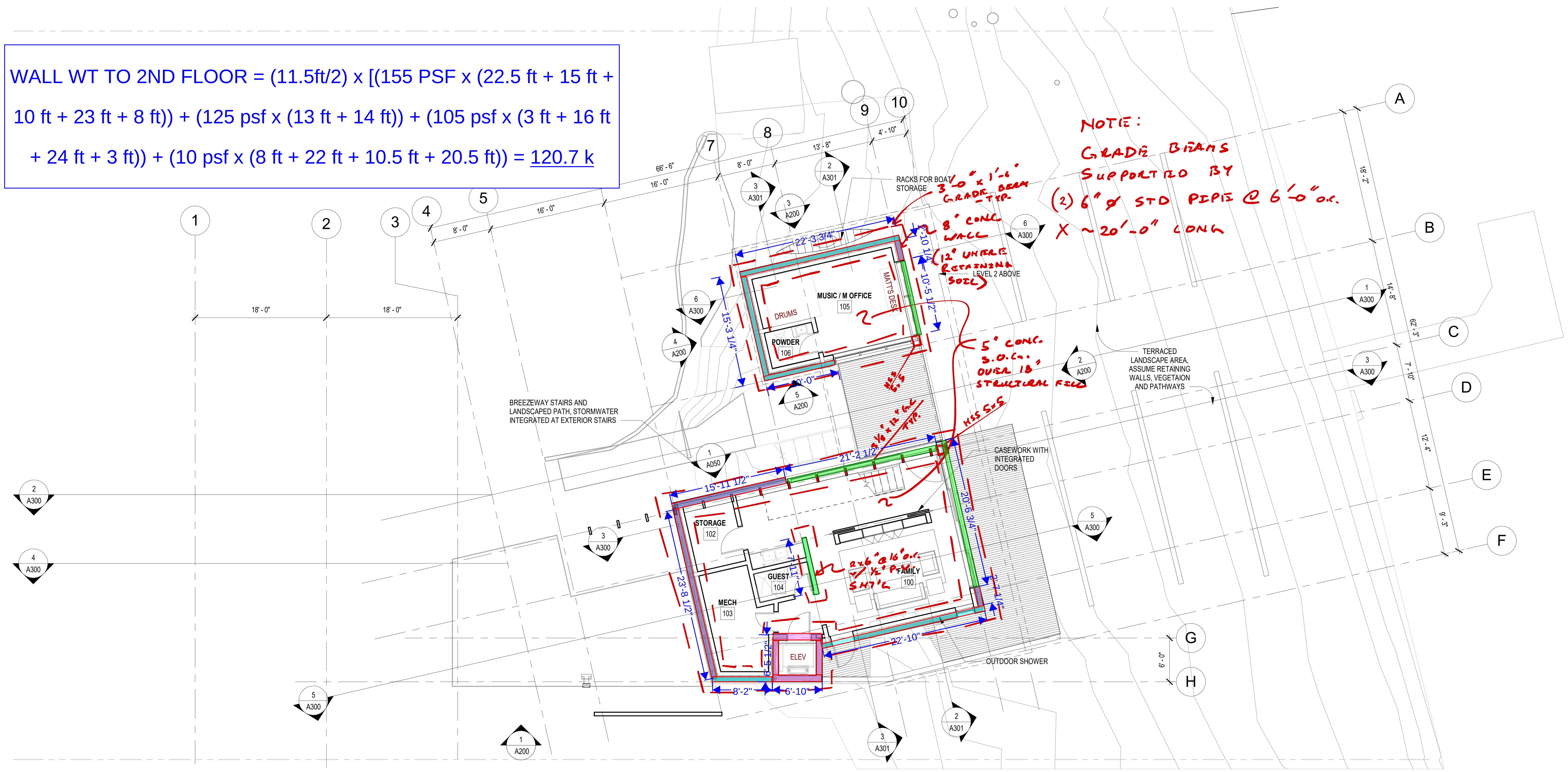
ROOF PLAN
A141

GENERAL FLOOR PLAN NOTES

WALL WT TO 2ND FLOOR = (11.5ft/2) x [(155 PSF x (22.5 ft + 15 ft + 10 ft + 23 ft + 8 ft)) + (125 psf x (13 ft + 14 ft)) + (105 psf x (3 ft + 16 ft + 24 ft + 3 ft)) + (10 psf x (8 ft + 22 ft + 10.5 ft + 20.5 ft)) = 120.7 k



12" CONC. WALL	150 PSF	+ 5PSF @ EXTERIOR FOR CLADDING
10" CONC. WALL	125 PSF	
8" CONC. WALL	100 PSF	
WOOD S/W/GLASS CURTAIN WALL	10 PSF	

1 A111 **LEVEL 1 FLOOR PLAN**
1/8" = 1'-0"

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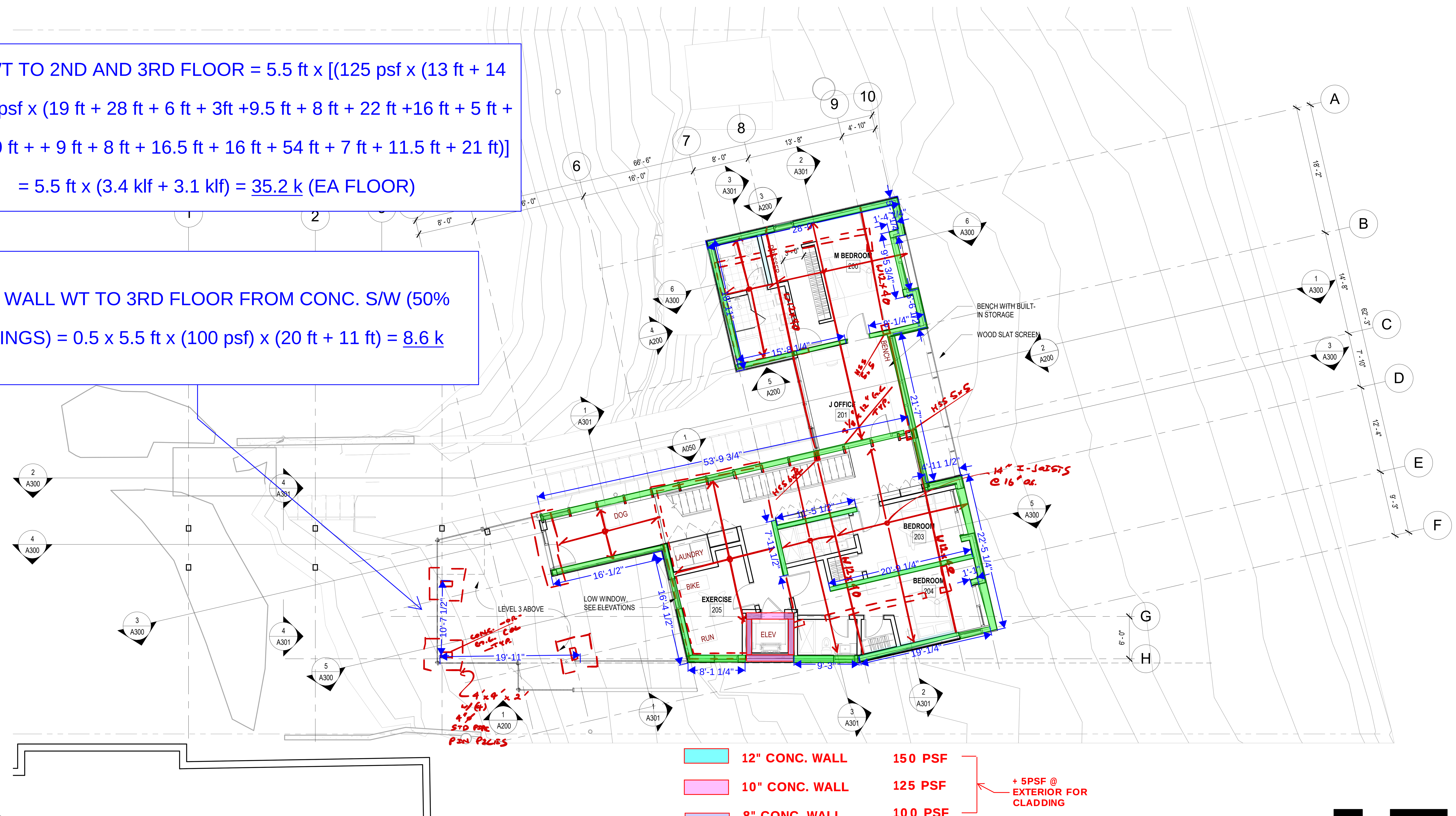
LEVEL 1 - FLOOR PLAN

S111

GENERAL FLOOR PLAN NOTES

WALL WT TO 2ND AND 3RD FLOOR = 5.5 ft x [(125 psf x (13 ft + 14 ft)) + (10 psf x (19 ft + 28 ft + 6 ft + 3ft +9.5 ft + 8 ft + 22 ft +16 ft + 5 ft + 24 ft + 19 ft + + 9 ft + 8 ft + 16.5 ft + 16 ft + 54 ft + 7 ft + 11.5 ft + 21 ft)] = 5.5 ft x (3.4 klf + 3.1 klf) = 35.2 k (EA FLOOR)

ADD'L WALL WT TO 3RD FLOOR FROM CONC. S/W (50% OPENINGS) = 0.5 x 5.5 ft x (100 psf) x (20 ft + 11 ft) = 8.6 k



12" CONC. WALL	150 PSF	+ 5PSF @ EXTERIOR FOR CLADDING
10" CONC. WALL	125 PSF	
8" CONC. WALL	100 PSF	
WOOD S/W/GLASS CURTAIN WALL	10 PSF	

1 LEVEL 2 FLOOR PLAN
A121 1/8" = 1'-0"

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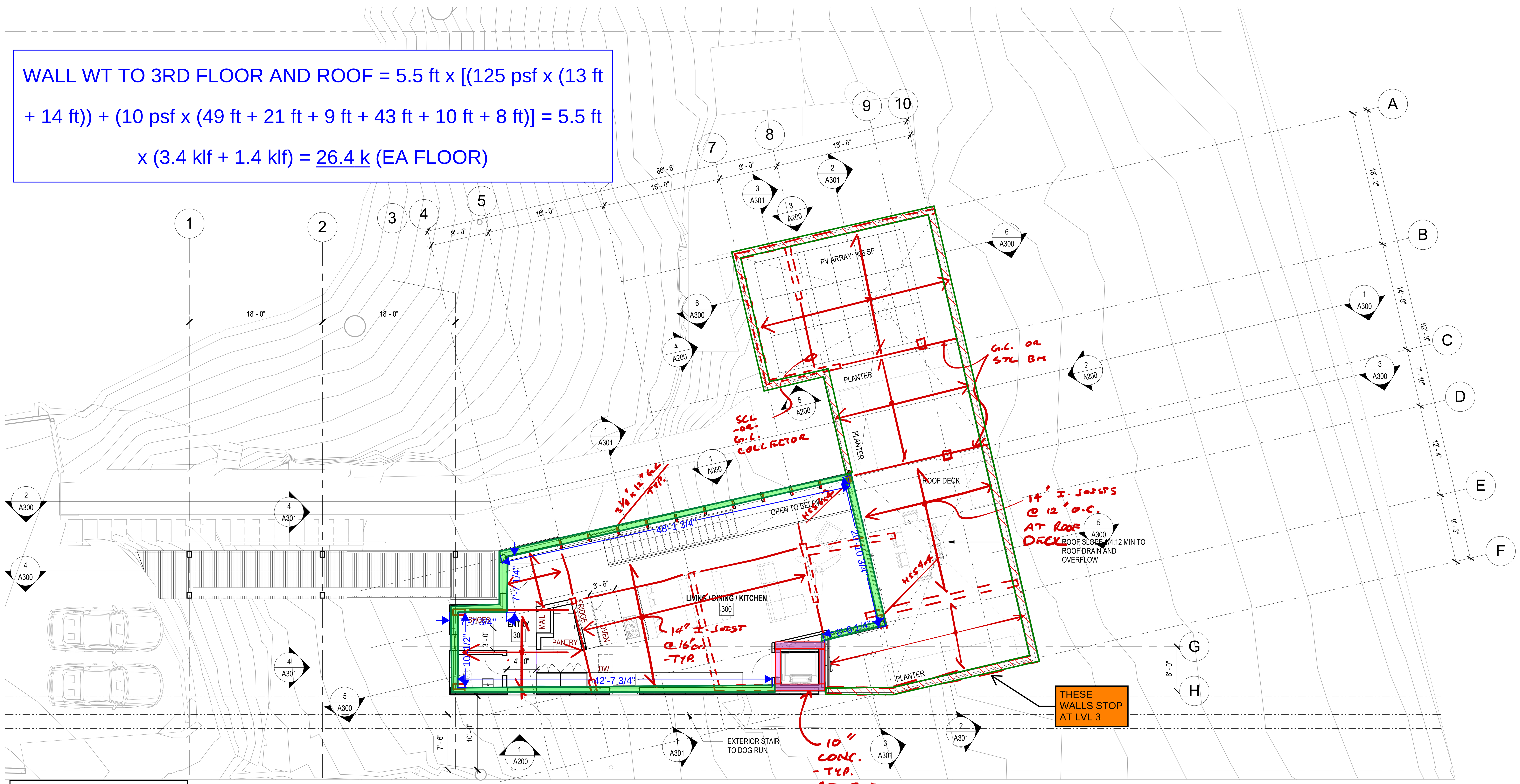
LEVEL 2 - FLOOR PLAN
S121

AREA SCHEDULE (GSF)	
Name	Area
LEVEL 1 / OFFICE	343.00 SF
LEVEL 1	867.35 SF
LEVEL 2	2097.90 SF
LEVEL 3	1130.79 SF
GARAGE	572.78 SF
	5011.81 SF

GENERAL FLOOR PLAN NOTES

WALL WT TO 3RD FLOOR AND ROOF = 5.5 ft x [(125 psf x (13 ft + 14 ft)) + (10 psf x (49 ft + 21 ft + 9 ft + 43 ft + 10 ft + 8 ft)] = 5.5 ft x (3.4 klf + 1.4 klf) = 26.4 k (EA FLOOR)



12" CONC. WALL	150 PSF	+ 5PSF @ EXTERIOR FOR CLADDING
10" CONC. WALL	125 PSF	
8" CONC. WALL	100 PSF	
WOOD S/W/GLASS CURTAIN WALL	10 PSF	

1 A131 LEVEL 3 FLOOR PLAN
1/8" = 1'-0"

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LEVEL 3 - FLOOR PLAN

S131

GENERAL ROOF PLAN NOTES

1. SEE SECTIONS AND DETAILS FOR ROOF TYPE CALL OUTS.

SEC C411 RENEWABLES

A. QUANTITY OF RENEWABLES REQUIRED IS [put calculation here]. [XX] kW PROVIDED.
B. REFER TO SHEETS E[xxx] FOR ADDITIONAL PV INFORMATION.

SEC C412 SOLAR READINESS

A. THE SOLAR ZONE WHICH COMPLIES WITH REQUIREMENTS FOR UNSHADED AREA WITHIN THIS SECTION IS AS SHOWN IN THE TABULATION ABOVE. THE PORTION OF THE ROOF AREA PROVIDED IN SOLAR ZONE IS [xx% (xxx SF/Roof area minus skylight area)].
B. REFER TO SHEETS E[xxx] FOR FUTURE PV INTERCONNECTION PROVISIONS.

12" CONC. WALL	150 PSF	+ 5PSF @ EXTERIOR FOR CLADDING
10" CONC. WALL	125 PSF	
8" CONC. WALL	100 PSF	
WOOD S/W/GLASS CURTAIN WALL	10 PSF	

1 A141 ROOF PLAN
1/8" = 1'-0"

0' 4' 8' 16'

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ROOF PLAN

S141

SEISMIC

SEE MAPS FOR SEISMIC WEIGHT CALCS...

$$W_2 = \underbrace{120.7^k}_{1^{st}\text{ WALL}} + \underbrace{35.2^k}_{2^{ND}\text{ WALL}} + \underbrace{35.7^k}_{\text{FLOOR}} = 156.4^k$$

$$W_3 = \underbrace{35.2^k}_{2^{ND}\text{ WALL}} + \underbrace{26.4^k}_{3^{RD}\text{ WALL}} + \underbrace{2.4}_{\text{BRIDGE FLOOR}} + \underbrace{105^k}_{\text{FLOOR}} + \underbrace{8.6^k}_{\text{CONC. S/W WEST SIDE}} = 177^k$$

$$W_R = \underbrace{26.4^k}_{3^{RD}\text{ WALL}} + \underbrace{39.3^k}_{\text{ROOF}} + \underbrace{4.0^k}_{\text{BRIDGE ROOF}} = 69.7^k$$

C_s, FROM DESIGN CRITERIA SPREADSHEET

* S_S CONTROLS OVER S_1

$$V_2 = 156.4^k (0.193) = 30.2^k$$

$$V_3 = 177^k (0.193) = 34.2^k$$

$$V_R = 69.7^k (0.193) = 13.5^k$$

$$V_{ULT} = 77.9^k > \begin{matrix} 55.0^k \\ 39.6^k \end{matrix} \therefore$$

$\boxed{\text{EQ CONTROLS BOTH DIRECTIONS}}$

SEE VERT. FORCE DISTRIBUTION SPREADSHEET FOR STORY + DIAPHRAGM FORCE CALCS...

$F_2 = 15.1^k$ $\quad$ $F_{P2} = 5.9^k$

$F_3 = 11.8^k$ $\quad$ $F_{P3} = 8.4^k$

$F_R = 4.4^k$ $\quad$ $F_{PR} = 4.4^k$

VERTICAL DISTRIBUTION OF SEISMIC FORCES

Level	h_x (ft)	w_x(k)	$w_x h_x^k$ (k-ft)	$w_x h_x^k/\Sigma w_i h_i^k$ (%)	F_x (k)	F_{tot} (k)	F_{asd} (k)
Roof	33.5	13.5	452.25	29%	4.3	4.33	0.20
3rd	22.5	34.2	769.50	49%	7.4	11.71	0.34
2nd	11.5	30.2	347.30	22%	3.33	15.03	0.15
Sum Σ		77.9	1569.05		15.03		

k= 1
C_s= 0.193

INPUTS
OUTPUTS

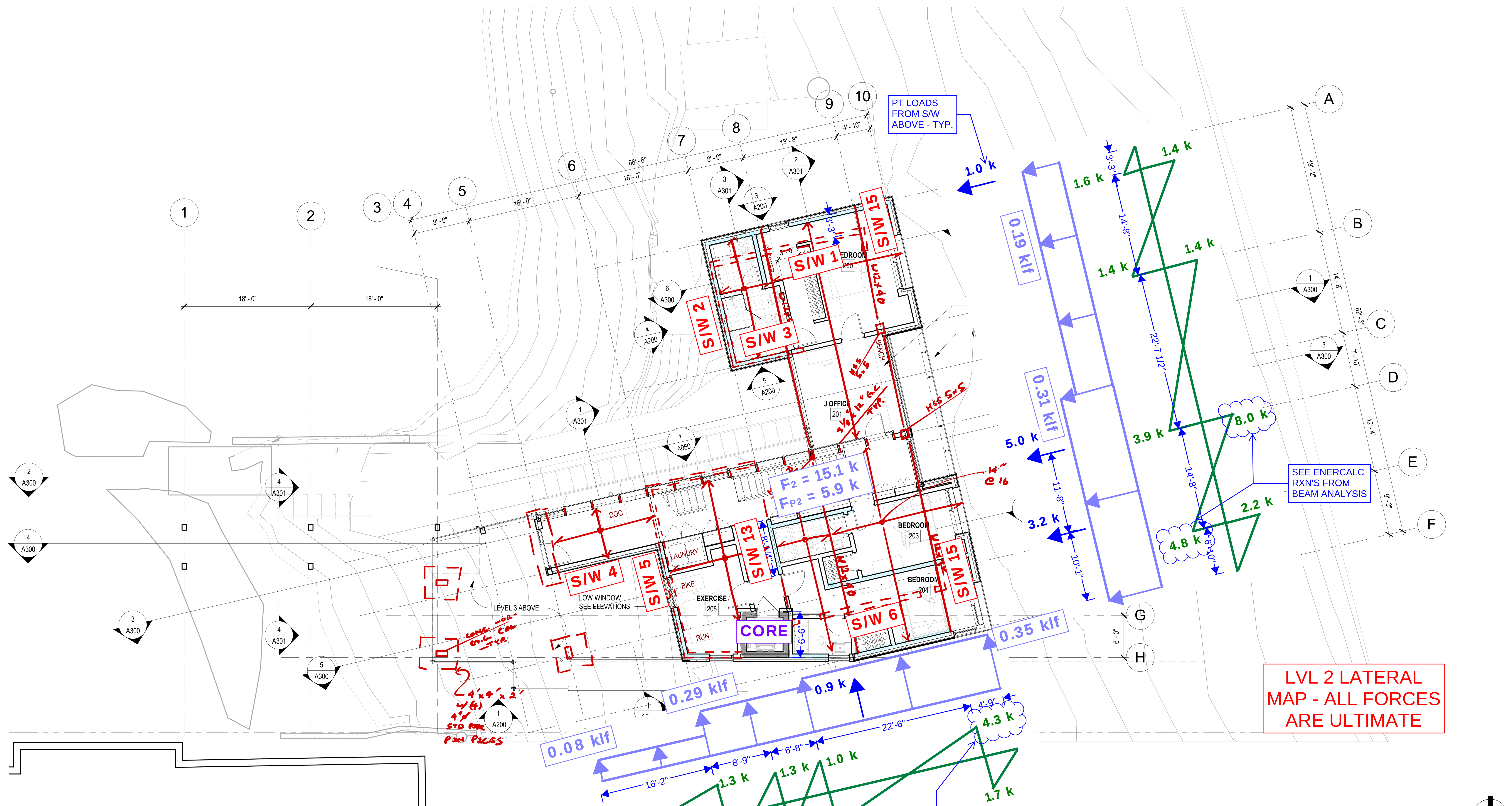
S_{DS}= 0.966
I= 1

DIAPHRAGM DESIGN SEISMIC FORCES

Level	w_{px} (k)	Σw_i (k)	F_x (k)	ΣF_i (k)	$\Sigma F_x/\Sigma w_{px}$	Max Code Diaphragm Force $\Sigma F_x/\Sigma w_{px}$, MIN, or MAX	F_{px} (k)	$\gamma=F_{px}/F_x$
Roof	13.5	13.5	4.33	4.33	0.32	0.32	4.33	1.00
3rd	34.2	47.7	7.37	11.71	0.25	0.25	8.39	1.14
2nd	30.2	77.9	3.33	15.03	0.19	0.19	5.83	1.75
Sum Σ	77.9		15.03					

MAX F_{px} (k)= $0.4S_{DS}Iw_{px}$= 0.3864 $*w_{px}$
MIN F_{px} (k)= $0.2S_{DS}Iw_{px}$= 0.1932 $*w_{px}$

GENERAL FLOOR PLAN NOTES



1 LEVEL 2 FLOOR PLAN
A121 1/8" = 1'-0"

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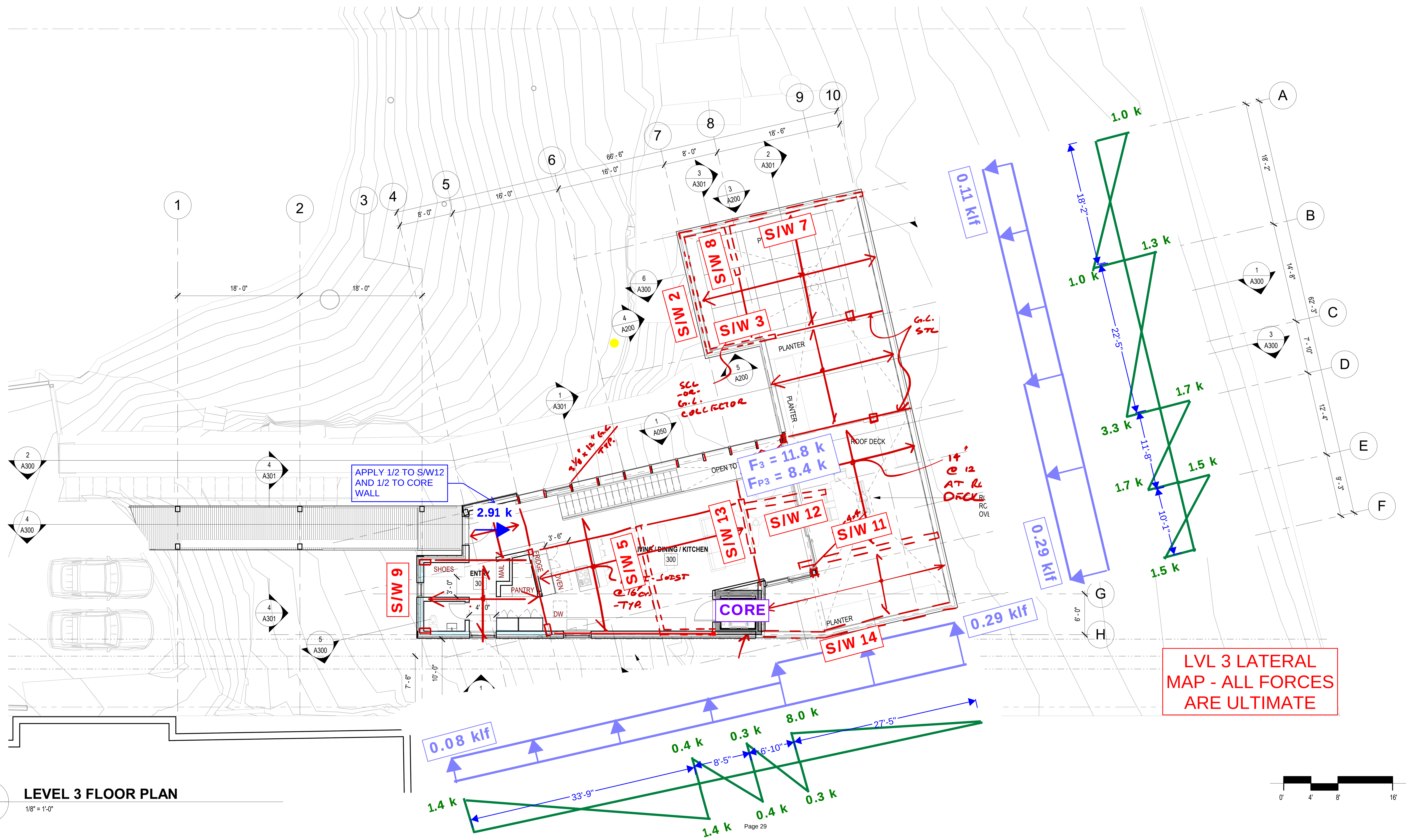
LEVEL 2 - FLOOR PLAN

S121

AREA SCHEDULE (GSF)	
Name	Area
LEVEL 1 / OFFICE	343.00 SF
LEVEL 1	867.35 SF
LEVEL 2	2097.90 SF
LEVEL 3	1130.79 SF
GARAGE	572.78 SF
	5011.81 SF

GENERAL FLOOR PLAN NOTES



1 LEVEL 3 FLOOR PLAN
A131 1/8" = 1'-0"

MILLER HULL
The Miller Hull Partnership, LLP
Architecture and Planning
Polson Building
71 Columbia, Sixth Floor
Seattle, WA 98104
Phone: 206.682.6837
Contact: Name

PCS Structural Solutions

STAMP

NOT FOR CONSTRUCTION

MERCER ISLAND HOUSE

6838 96TH AVE SE
MERCER ISLAND, WA 98040

SUBMITTAL

100% SCHEMATIC DESIGN

MAY 21, 2021

REVISIONS

No.	Description	Date

Drawn: Author
Checked: Checker
M|H Proj No.: A20.0085.00
Issue Date: MAY 21, 2021

SHEET

LEVEL 3 - FLOOR PLAN

S131

GENERAL ROOF PLAN NOTES

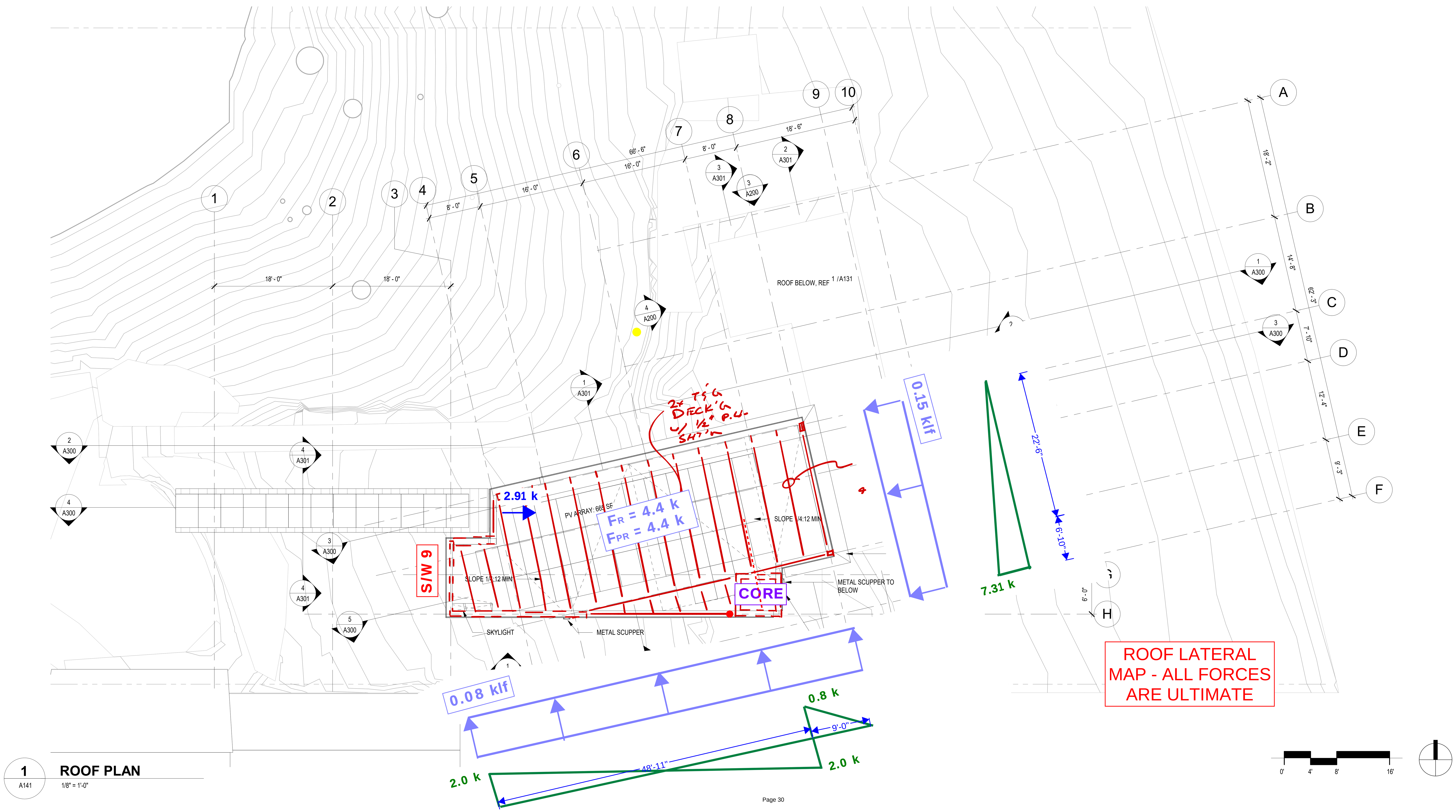
1. SEE SECTIONS AND DETAILS FOR ROOF TYPE CALL OUTS.

SEC C411 RENEWABLES

A. QUANTITY OF RENEWABLES REQUIRED IS [put calculation here]. [XX] kW PROVIDED.
B. REFER TO SHEETS E[xxx] FOR ADDITIONAL PV INFORMATION.

SEC C412 SOLAR READINESS

A. THE SOLAR ZONE WHICH COMPLIES WITH REQUIREMENTS FOR UNSHADED AREA WITHIN THIS SECTION IS AS SHOWN IN THE TABULATION ABOVE. THE PORTION OF THE ROOF AREA PROVIDED IN SOLAR ZONE IS [xx% (xxx SF/Roof area minus skylight area)].
B. REFER TO SHEETS E[xxx] FOR FUTURE PV INTERCONNECTION PROVISIONS.



1 ROOF PLAN
A141
1/8" = 1'-0"

MILLER HULL

The Miller Hull Partnership, LLP
Architecture and Planning
Polson Building
71 Columbia, Sixth Floor
Seattle, WA 98104

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STAMP

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MERCER ISLAND, WA 98040

SUBMITTAL

100% SCHEMATIC DESIGN

MAY 21, 2021

REVISIONS

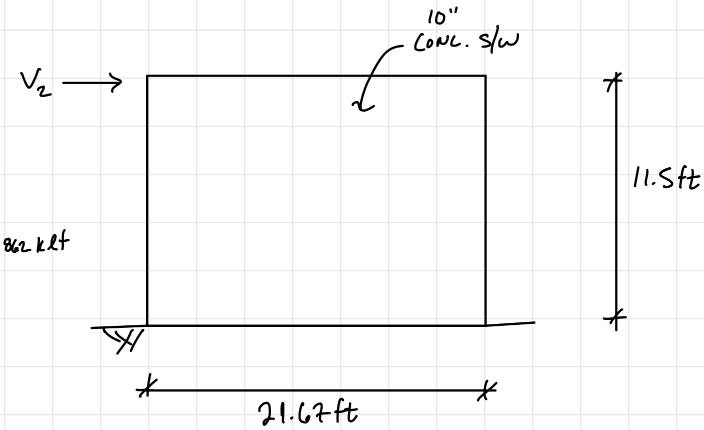
No.	Description	Date

Drawn: Author
Checked: Checker
M|H Proj No.: A20.0085.00
Issue Date: MAY 21, 2021

SHEET

ROOF PLAN
S141

S/W 1



ρ

$V_2 = 1.3\left(1.4^k + 1.6^k\right) = 4.0^k$

$D_2 = 0.6\left(150psf\right)\left(11.5ft\right)\left(\frac{10in}{12in/ft}\right) = 0.862\ klf$

SHEAR: $d = 0.8\ell_w = 0.8\left(21.67ft\right) = 17.3ft = 208in$

$h = 12in$

$\phi V_c = \left(0.6\right)2\left(1.0\right)\sqrt{4000psi}\left(10in\right)\left(208in\right) = \underline{\underline{157^k}} \gg 4.0^k$ ∴ USE MIN. REINF. FOR SHEAR

MIN REINF.: $A_s = 0.002\left(18in\right)\left(10in\right) = 0.36\ in^2 \rightarrow$ $\boxed{\#5 @ 18"\ o.c.\ E.F.}$

FOUNDATION: 1'-6" x 2'-0" FTG $\rightarrow w_{ftg} = 450plf\left(0.6\right) = 270\ plf$

SLIDING: $\left(270\ plf + 862\ plf\right)\left(21.67ft\right)\left(0.3\right) > 4000\ lb$ ← COEFFICIENT OF FRICTION

$\underline{\underline{7{,}359\ lb}} > 4000\ lb$ ✓ OK

S/W 2

15.25ft CONSERVATIVE

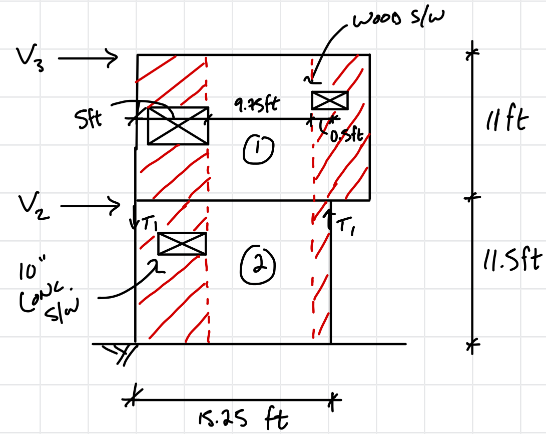
PROPORTION OF LOAD ALONG GRID 7

$$V_2 = 1.3\left(1.0^k + 4.6^k\right)\left(\frac{15.25ft}{15.25ft + 7.83ft + 6.5ft}\right) = 3.8^k$$

$$V_3 = 1.3\,(0.7)\left(8.0^k + 0.3^k\right)\left(\frac{15.25ft}{15.25ft + 7.83ft + 6.5ft}\right) = 3.9^k$$

$$D_2 = 0.6\,(150psf)\left(\tfrac{10in}{12in/ft}\right)(11.5ft) = 0.862\,klf$$

$$D_3 = 0.6\,(10psf)(11ft) = 0.066\,klf$$



(1) SHEAR: $V_1 = 3.9^k / 9.75\,ft = \underline{\underline{0.400\,klf}} \rightarrow$ $\boxed{10d \text{ @ } 6'' \text{ O.C.}}$

OVERTURNING: $3.9^k(11ft) - 0.066\,klf\,(9.75ft)(9.75ft/2) \le 9.75\,ft\,(T_1)$

$T_1 = \underline{\underline{4.1^k}} \rightarrow$ $\boxed{\text{HDU 4}}$

(2) SHEAR: $d = 0.8\ell_w = 0.8\,(9.75ft) = 7.8\,ft = 93.6\,in$

$h = 10\,in$

$$\phi V_c = (0.6)\,2\,(1.0)\sqrt{4000\,psi}\,(10in)(93.6in) = \underline{\underline{71.0^k}} >> 9.4^k$$ ∴ USE MIN. REINF. FOR SHEAR

MIN REINF.: $A_s = 0.002\,(18in)(10in) = 0.36\,in^2 \rightarrow$ $\boxed{\#5 \text{ @ } 18'' \text{ o.c. E.F.}}$

FOUNDATION: 3'-0" x 1'-6" FTG $\rightarrow$

$w_{flr} = 0.6\,(4ft)(15psf) = 0.036\,klf$

$w_{ftg} = 675\,plf\,(0.6) = 405\,plf$

$W_{RETURNS} = 2\,(3ft)(1.5ft)(2(3ft))(150pcf)(0.6) = 4860\,lb$

SLIDING: $\left[(405\,plf + 862\,plf + 36\,plf + 66\,plf)(18\,ft)(0.3)\right] > 7{,}700\,lb$ (0.3 = COEFFICIENT OF FRICTION)

$+ 4860\,lb$

$\underline{\underline{12{,}252\,lb}} > 7{,}700\,lb$ ✓OK

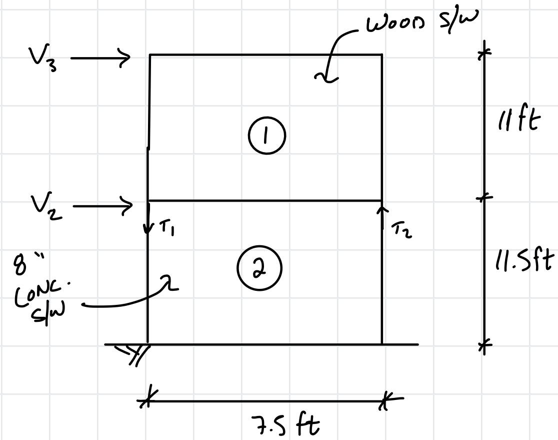
S/W 3

$V_2 = 1.3\,(1.4^k + 1.4^k) = 3.8^k$ (ρ)

$V_3 = 1.3\,(0.7)(1.0^k + 1.3^k) = 2.1^k$

$D_2 = 0.6\,(150\,psf)\underbrace{(11.5\,ft)}_{(8\,in/12\,in/ft)} = 0.690\,klf$

$D_3 = 0.6\,(10\,psf)(11\,ft) = 0.066\,klf$



① **SHEAR:** $V_1 = 2.1^k / 7.5\,ft = \underline{\underline{0.280\,klf}} \rightarrow$ $\boxed{10d\ @\ 6"\ O.C.}$

OVERTURNING: $2.1^k(11ft) - 0.066klf\,(7.5\,ft)(7.5\,ft/2) \le 7.5\,ft\,(T_1)$

$T_1 = \underline{\underline{2.84^k}} \rightarrow$ $\boxed{HDU\ 2}$

② **SHEAR:** $d = 0.8 l_w = 0.8\,(10\,ft) = 8\,ft = 96\,in$

$h = 12\,in$

$\phi V_c = (0.6)\,2\,(1.0)\sqrt{4000\,psi}\,(8\,in)(96\,in) = \underline{\underline{58.2^k}} >> 6.8^k$ ∴ USE MIN. REINF. FOR SHEAR

MIN REINF.: $A_s = 0.002\,(18\,in)(8\,in) = 0.288\,in^2 \rightarrow$ $\boxed{\#5\ @\ 18"\ o.c.\ E.F.}$

FOUNDATION: 1'-6" x 2'-0" FTG $\rightarrow$

$w_{FLR} = 0.6\,(9\,ft)(60\,PSF) = 0.324\,klf$

$w_{Ftg} = 450\,plf\,(0.6) = 270\,plf$

$W_{RETURN} = (3ft)(1.5ft)(2(3ft))(150pcf)(0.6) = 2430\,lb$

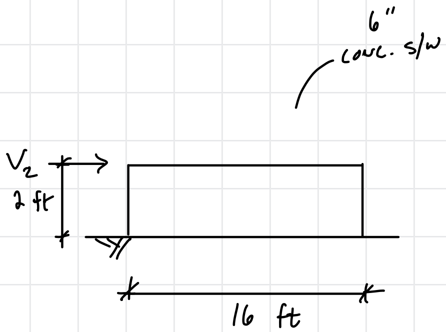
SLIDING: $[(270\,plf + 690\,plf + 324\,plf + 66\,plf)(10\,ft)(0.3)] > 5{,}900\,lb$ (0.3 = COEFFICIENT OF FRICTION)

$+\ 2{,}430\,lb$

$\underline{\underline{6{,}480\,lb}} > 5{,}900\,lb$ ✓ OK

PCS Structural Solutions	Project: MERCER ISLAND RESIDENCE		Job No: 21-201
	Subject: LATERAL	Sheet: S/W 4	Name: BRT
	Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland		Date: 5-27-21

$\boxed{S/W\ 4}$



$$V_2 = 1.3\,(3.9^k + 8.0^k) = 15.5^k$$

$$D_2 = 0.6\,(62.5\,psf)(4\ ft) = 0.150\ klf$$

SHEAR:

$$d = 0.8\,l_w = 0.8\,(16\ ft) = 12.8\ ft = 153\ in$$

$$h = 6\ in$$

$$\phi V_c = (0.6)\,2\,(1.0)\sqrt{4000\,psi}\,(6\,in)(153\,in) = \underline{\underline{69.6^k}} >> 15.5^k$$

∴ USE MIN. REINF. FOR SHEAR

MIN REINF.:

$$A_s = 0.002\,(12\,in)(6\,in) = 0.144\,in^2 \rightarrow \boxed{\#4\ @\ 12"\ o.c.\ E.F.}$$

$$w_{SOIL} = 0.66\,klf\,(0.6) = 0.40\,klf$$

$$w_{STEM} = 0.75\,klf\,(0.6) = 0.045\,klf$$

$$w_{FLR} = 0.15\,klf$$

FOUNDATION: 3'-0" x 1'-6" FTG $\longrightarrow$ $w_{ftg} = 675\,plf\,(0.6) = 405\,plf$

$$w_{RETURN} = \big[(7\,ft)(2\,ft)(2(7\,ft))(150\,pcf)\big](0.6) = 20,940\ lb$$
$$+ (11\,ft)(1\,ft)(2\,ft)(150\,pcf)$$

SLIDING:

$$\Big\{\Big[(0.15\,klf + 0.405\,klf \overset{+0.045\,klf\,+\,0.40\,klf}{}) (16\,ft) + 17,640\ lb\Big]\Big\}(\underset{\text{COEFFICIENT OF FRICTION}}{0.3}) > 15,500\ lb\,(0.7)$$
$$+\ 350\,pcf\,(1/2)(2\,ft)(3\,ft)(2\,ft)$$

$$\underline{\underline{12,192\ lb}} > 10,850\ lb \quad \checkmark \underline{\underline{ok}}$$

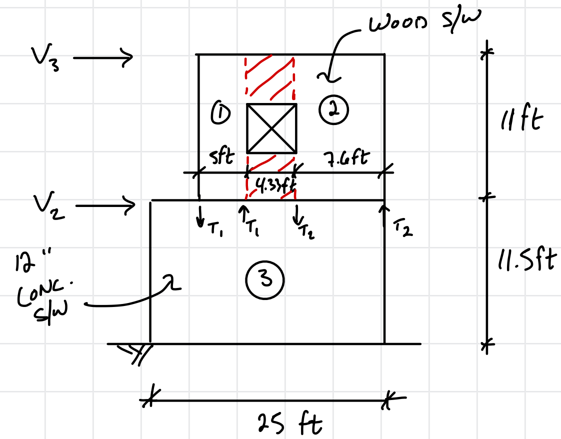
S/W 5

$$V_2 = 1.3\,(1.3^k + 1.3^k) = 3.4^k$$

$$V_3 = 1.3\,(0.7)(0.4^k + 1.4^k) = 1.7^k$$

$$D_2 = 0.6\,(150\,psf)(11.5\,ft) = 1.035\,klf$$

$$D_3 = 0.6\,(10\,psf)(11\,ft) = 0.066\,klf$$



① **SHEAR:** $V_1 = 1.7^k / (5ft + 7.6ft) = \underline{\underline{0.135\,klf}}$ → $\boxed{10d\ @\ 6''\ O.C.}$

OVERTURNING: $(0.135\,klf)(5ft)(11ft) - 0.066\,klf\,(5\,ft)(5\,ft/2) \leq 5\,ft\,(T_1)$

$T_1 = \underline{\underline{1.32^k}}$ → $\boxed{HDU\ 2}$

② **SHEAR:** $V_2 = 1.7^k / (5ft + 7.6ft) = \underline{\underline{0.135\,klf}}$ → $\boxed{10d\ @\ 6''\ O.C.}$

OVERTURNING: $(0.135\,klf)(7.6ft)(11ft) - 0.066\,klf\,(7.6\,ft)(7.6\,ft/2) \leq 7.6\,ft\,(T_1)$

$T_2 = \underline{\underline{1.24^k}}$ → $\boxed{HDU\ 2}$

③

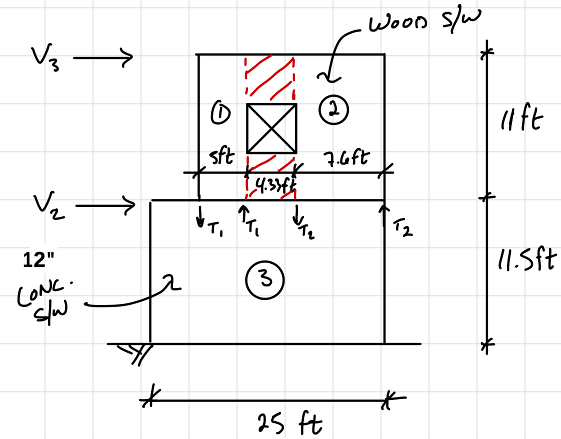
SHEAR: $d = 0.8\ell_w = 0.8\,(25\,ft) = 20\,ft = 240\,in$

$h = 12\,in$

$$\phi V_c = (0.6)\,2\,(1.0)\sqrt{4000\,psi}\,(12\,in)(240\,in) = \underline{\underline{218^k}} >> 5.9^k \quad \therefore \text{ USE MIN. REINF. FOR SHEAR}$$

MIN REINF.: $A_s = 0.002\,(12\,in)(12\,in) = 0.432\,in^2$ → $\boxed{\#5\ @\ 18''\ o.c.\ E.F.}$

S/W 5



For grade bm brg calcs

$w_L = 1.6(16ft)(40psf) = 1.03 klf$

$w_{FLR} = 0.6[(8ft)(15psf)] = 0.144 klf$

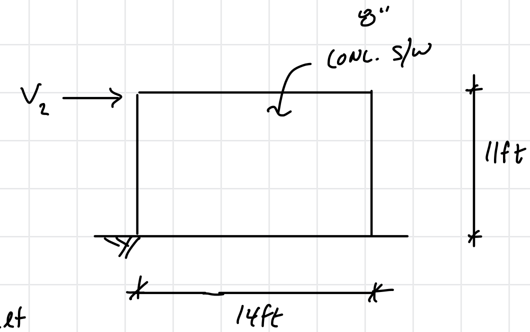
FOUNDATION: 7'-0" × 2'-0" FTG → $w_{ftg} = 2100 plf\,(0.6) = 1260 plf$

$W_{RETURN} = (7ft)(2ft)(2(7ft))(150pcf)(0.6) = 17,640 lb$

SLIDING: $[(1035 plf + 1260 plf + 144 plf + 66 plf)(25 ft)(0.3)]$ (coefficient of friction) $+ 17,640 lb > 5,100 lb$

$36,427 lb > 5,100 lb$ ✓ OK

S/W 6



$V_2 = 1.3\,(22^k + 8.0^k) = 13.3^k$

$D_2 = 0.6\,(100\,psf)(11.5\,ft) = 690$ klf

SHEAR: $d = 0.8\ell_w = 0.8\,(14\ ft) = 11.2\ ft = 134\ in$
$h = 8\ in$

$\phi V_c = (0.6)\,2\,(1.0)\sqrt{4000\,psi}\;(8\,in)\,(134\,in) = \underline{\underline{81.4^k}} \gg 13.3^k$ ∴ USE MIN. REINF. FOR SHEAR

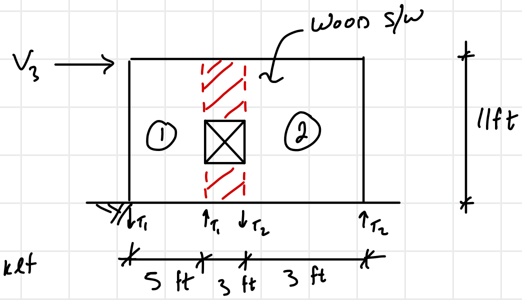
MIN REINF.: $A_s = 0.002\,(12\ in)\,(8\ in) = 0.288\ in^2 \rightarrow$ $\boxed{\#5 @ 18"\ o.c.\ E.F.}$

FOUNDATION: 1'-6" x 2'-0" FTG $\rightarrow$ $w_{flr} = 0.6\,(4.5ft)(60\,psf) = 0.162$ klf
$w_{ftg} = 450\,plf\,(0.6) = 270\,plf$
$W_{RETURN} = (3ft)(1.5ft)(2(3ft))(150\,pcf)(0.6) = 2430\ lb$

SLIDING: $\left[(270\,plf)\,(162\,plf \times 14\ ft)\right.$ (24ft x) (0.3) ← COEFFICIENT OF FRICTION $> 13,300\ lb$
$+\,(690\,plf \times (23ft + 11ft + 11ft + 3.33ft))]$ $+\ 2,430\ lb$
$+\ 350\,pcf\,(3ft + 6ft)(1/2)(2\ ft)$ $+$ $\left(\frac{10\,in}{12\,in/ft}\right)(6.83ft + 4.67ft)\,(11.5ft)\,(150\,pcf)\,(0.6)\,(0.3)$
PASSIVE SOIL RESISTANCE

$1944\,lb + 681\,lb + 5,864\,lb + 3,150\,lb + 2,775\,lb = \underline{\underline{14,614\ lb}} > 13,300\ lb$ ✓ OK

S/W 7



$$V_3 = \overset{\rho}{1.3}\,(0.7)\,(1.0^k) = 0.91^k$$

$$D_3 = 0.6\,(10\text{ psf})\,(11\text{ ft}) = 0.066\text{ klf}$$

① SHEAR: $V_1 = 0.91^k / (5\text{ ft} + 3\text{ ft}) = \underline{\underline{0.12\text{ klf}}}$ → $\boxed{10d\ @\ 6"\ \text{O.C.}}$

OVERTURNING: $(0.12\text{ klf})(5\text{ ft})(11\text{ ft}) - 0.066\text{ klf}\,(5\text{ ft})(5\text{ ft}/2) \le 5\text{ ft}\,(T_1)$

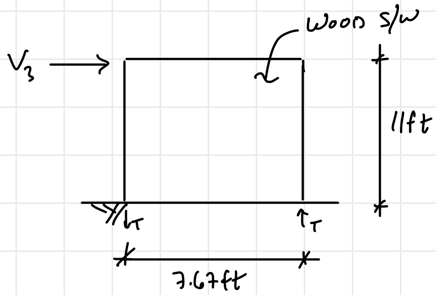
$T_1 = \underline{\underline{1.16^k}}$ → $\boxed{\text{HDU 2}}$

② SHEAR: $V_2 = 0.91^k / (5\text{ ft} + 3\text{ ft}) = \underline{\underline{0.12\text{ klf}}}$ → $\boxed{10d\ @\ 6"\ \text{O.C.}}$

OVERTURNING: $(0.12\text{ klf})(3\text{ ft})(11\text{ ft}) - 0.066\text{ klf}\,(3\text{ ft})(3\text{ ft}/2) \le 3\text{ ft}\,(T_1)$

$T_2 = \underline{\underline{1.23^k}}$ → $\boxed{\text{HDU 2}}$

S/W 8



$D = 0.6\,(11\ ft)(10_{PSF}) = 0.066\ klf$

$V_3 = 1.3\,(0.7)\left(\dfrac{(7.67ft/2)}{15.25ft + 7.83ft + 6.5ft + 7.67ft}\right)(8^k + 0.3^k) = 0.78^k$

RELATIVE LENGTH OF WALL ON GRID
7 – ASSUME ½ WALL LENGTH B/C CORE WALL TAKES MAJORITY OF LOAD BASED ON REL. STIFF.

SHEAR: $v = 0.78^k / 7.67ft = 0.102\ klf$ $\boxed{10d\ @\ 6"\ O.C.}$

OVERTURNING: $0.78^k\,(11ft) - 0.066\ klf\,(7.67ft)(7.67ft/2) \le 7.67ft\,(T)$

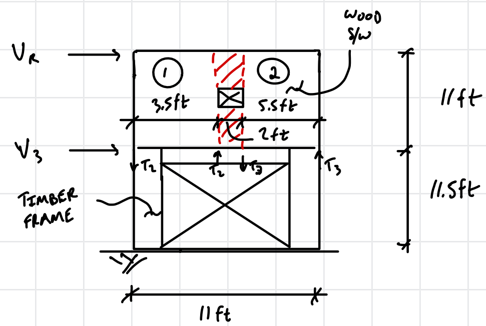
$T = 0.87^k$ $\boxed{HDU\ 2}$

S/W 9

$V_3 = 1.3\,(0.7)(1.4^k) = 1.3^k$

$V_R = 1.3\,(0.7)(2.0^k) = 1.9^k$

$D_R = 0.6\,(10\,psf)\,(11ft) = 0.066\,klf$



① **SHEAR:** $V_1 = 1.3^k / (3.5ft + 5.5ft) = \underline{\underline{0.145\ klf}} \rightarrow$ $\boxed{10d\ @\ 6''\ O.C.}$

OVERTURNING: $(0.145\,klf)(3.5ft)(11ft) - 0.066\,klf\,(3.5\,ft)(3.5\,ft/2) \le 3\,ft\,(T_1)$

$T_1 = \underline{\underline{1.73^k}} \rightarrow$ $\boxed{HDU\ 2}$

② **SHEAR:** $V_2 = 1.3^k / (3.5ft + 5.5ft) = \underline{\underline{0.145\ klf}} \rightarrow$ $\boxed{10d\ @\ 6''\ O.C.}$

OVERTURNING: $(0.145\,klf)(5.5)(11ft) - (0.066\,klf)(5.5\,ft)(5.5\,ft/2) \le 5\,ft\,(T_1)$

$T_1 = \underline{\underline{1.56^k}} \rightarrow$ $\boxed{HDU\ 2}$

FOUNDATION

OVERTURNING: $1.3^k(24ft) + 1.9^k(13ft) \le 10ft\,\overbrace{(5.5ft \times 5.5ft \times 2ft \times 150pcf \times 0.6)}^{5.44k} + \overset{\text{WALL WT}}{4.0\,k\text{-}ft}$ ← 0.4^k

$55.9\,k\text{-}ft \le 58.5\,k\text{-}ft$

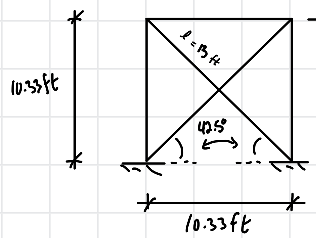
SLIDING: $1.3^k + 1.9^k = 3.2^k \le 0.3\,(5.44^k + 0.4^k) + 0.35\,kcf\,(2ft \times 5.5ft \times 0.5 \times 2ft \times 2)$

$3.2^k \le 1.75^k + 7.7^k = 9.45^k$ ✓ok

$\boxed{\text{USE } 5.5ft \times 5.5ft \times 2ft \text{ FTG.}}$

$\boxed{S/W\ 9}$ SEE ENERCALC FOR MEMBER DESIGN...

$\boxed{\text{FRAME}}$



$\rightarrow (1.3^k + 1.9^k)/0.7 = 6^k$ ← BACK TO ULT. LOAD

SFRS H, FROM ASCE 12.2-1

R = 3

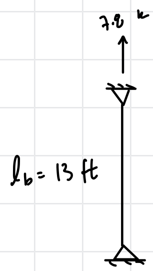
$\underset{R=3}{10.33\text{ft}} + \underset{R=6.5}{16\text{ft}} + \underset{R=5}{13\text{ft}} = 39.33\text{ft}$

$3\left(\frac{10.33\text{ft}}{39.33\text{ft}}\right) + 6.5\left(\frac{16\text{ft}}{39.33\text{ft}}\right) + 5\left(\frac{13\text{ft}}{39.33\text{ft}}\right) = 5.1$ ∴ USE R = 5 FROM ORIGINAL LAT. ANALYSIS

RATIO OF R FACTORS IN N-S DIR. RELATIVE TO LENGTHS

BRACE:

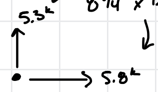
$P_{BRACE} = 6^k\left(\frac{13\ \text{ft}}{10.1\ \text{ft}}\right) = \underline{\underline{7.8^k}}$

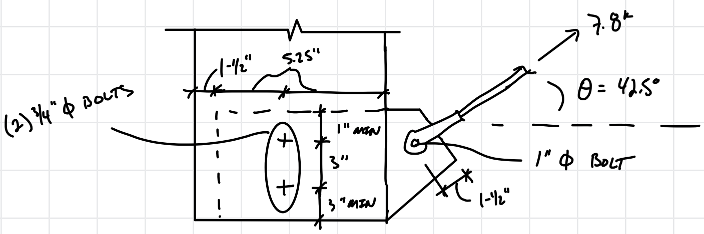


$\phi T_n = 0.9\,(36\text{ksi})\left(\frac{\pi(0.75\text{in})^2}{4}\right) = \underline{\underline{14.3^k}} > 7.8^k$

∴ $\boxed{\text{USE } 3/4''\ \phi \text{ ROD}}$

$\boxed{\text{BASE CONNECTION}}$





CLEVIS: FROM AISC T15-5, No. 3 CLEVIS $\rightarrow \phi T_N = 37.5^k > 7.8^k$ ✓ok

1" ϕ BOLT: $\phi r_n = \underline{\underline{35.9^k}} > 7.8^k$ (BEARING + TEAR-OUT; FROM AISC, TABLE 7-5) $\qquad \phi r_n = \underline{\underline{63.6^k}} > 7.8^k$ (ϕF_{nv}; AISC, TABLE 7-1) ✓ok

Wood Column

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: COLUMN

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Analysis Method	Allowable Stress Design			
End Fixities	Top & Bottom Pinned			
Overall Column Height			10.33 ft	
(Used for non-slender calculations)				
Wood Species	SP/SP			
Wood Grade	24F-V4			
Fb +	2400 psi	Fv	210 psi	
Fb -	1650 psi	Ft	975 psi	
Fc - Prll	1350 psi	Density	26.84 pcf	
Fc - Perp	650 psi			
E : Modulus of Elasticity . . .		x-x Bending	y-y Bending	Axial
	Basic	1700	1500	1700 ksi
	Minimum	900	790	

Wood Section Name	8.75x12
Wood Grading/Manuf.	Western
Wood Member Type	GLB
Exact Width	8.750 in
Exact Depth	12.0 in
Area	105.0 in^2
Ix	1,260.0 in^4
Iy	669.92 in^4

Allow Stress Modification Factors

Cf or Cv for Bending	1.0
Cf or Cv for Compressio	1.0
Cf or Cv for Tension	1.0
Cm : Wet Use Factor	1.0
Ct : Temperature Fact	1.0
Cfu : Flat Use Factor	1.0
Kf : Built-up columns	1.0 *NDS 15.3.2*
Use Cr : Repetitive ?	No

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 1(
Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 1(

Applied Loads

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

Column self weight included : 202.167 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 10.330 ft, E = 18.10 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS	Max. Axial+Bending Stress Ratio =	**0.06308 : 1**
	Load Combination	+D+0.70E
	Governing NDS Forumla	Comp Only, fc/Fc'
	Location of max.above base	0.0 ft
	At maximum location values are .	
	Applied Axial	12.872 k
	Applied Mx	0.0 k-ft
	Applied My	0.0 k-ft
	Fc : Allowable	1,943.31 psi
PASS	Maximum Shear Stress Ratio =	**0.0 : 1**
	Load Combination	+0.60D+0.70E
	Location of max.above base	10.330 ft
	Applied Design Shear	0.0 psi
	Allowable Shear	336.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.0 k	Bottom along Y-Y	0.0 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .

Along Y-Y 0.0 in at 0.0 ft above base
for load combination : n/a
Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

Other Factors used to calculate allowable stresses . . .

Bending	Compression	Tension

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
D Only	0.900	0.956	0.001658	PASS	0.0 ft	0.0	PASS	10.330 ft
+D+0.70E	1.600	0.900	0.06308	PASS	0.0 ft	0.0	PASS	10.330 ft
+D+0.5250E	1.600	0.900	0.04756	PASS	0.0 ft	0.0	PASS	10.330 ft
+0.60D	1.600	0.900	0.000594	PASS	0.0 ft	0.0	PASS	10.330 ft
+0.60D+0.70E	1.600	0.900	0.06269	PASS	0.0 ft	0.0	PASS	10.330 ft

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction k @ Base	@ Top	Y-Y Axis Reaction @ Base	@ Top	Axial Reaction @ Base	My - End Moments k-ft @ Base	@ Top	Mx - End Moments @ Base	@ Top
D Only					0.202				
+D+0.70E					12.872				

Wood Column

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: BEAM

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Analysis Method	Allowable Stress Design			
End Fixities	Top & Bottom Pinned			
Overall Column Height			10.33 ft	
(Used for non-slender calculations)				
Wood Species	DF/DF			
Wood Grade	24F-V4			
Fb +	2200 psi	Fv	265 psi	
Fb -	1850 psi	Ft	1100 psi	
Fc - Prll	1650 psi	Density	31.21 pcf	
Fc - Perp	650 psi			
E : Modulus of Elasticity . . .		x-x Bending	y-y Bending	Axial
	Basic	1800	1600	1800 ksi
	Minimum	950	850	

Wood Section Name	8.75x12	
Wood Grading/Manuf.	Western	
Wood Member Type	GLB	
Exact Width	8.750 in	
Exact Depth	12.0 in	
Area	105.0 in^2	
Ix	1,260.0 in^4	
Iy	669.92 in^4	

Allow Stress Modification Factors		
Cf or Cv for Bending	1.0	
Cf or Cv for Compressio	1.0	
Cf or Cv for Tension	1.0	
Cm : Wet Use Factor	1.0	
Ct : Temperature Fact	1.0	
Cfu : Flat Use Factor	1.0	
Kf : Built-up columns	1.0	*NDS 15.3.2*
Use Cr : Repetitive ?	No	

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 1(
Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 1(

Applied Loads

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

Column self weight included : 235.083 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 10.330 ft, E = 18.10 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS	Max. Axial+Bending Stress Ratio =	**0.05332 : 1**
	Load Combination	+D+0.70E
	Governing NDS Forumla	Comp Only, fc/Fc'
	Location of max.above base	0.0 ft
	At maximum location values are .	
	Applied Axial	12.905 k
	Applied Mx	0.0 k-ft
	Applied My	0.0 k-ft
	Fc : Allowable	2,304.99 psi
PASS	Maximum Shear Stress Ratio =	**0.0 : 1**
	Load Combination	+0.60D+0.70E
	Location of max.above base	10.330 ft
	Applied Design Shear	0.0 psi
	Allowable Shear	424.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.0 k	Bottom along Y-Y	0.0 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .

Along Y-Y 0.0 in at 0.0 ft above base
for load combination : n/a
Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

Other Factors used to calculate allowable stresses . . .

Bending	Compression	Tension

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
D Only	0.900	0.946	0.001593	PASS	0.0 ft	0.0	PASS	10.330 ft
+D+0.70E	1.600	0.873	0.05332	PASS	0.0 ft	0.0	PASS	10.330 ft
+D+0.5250E	1.600	0.873	0.04023	PASS	0.0 ft	0.0	PASS	10.330 ft
+0.60D	1.600	0.873	0.000583	PASS	0.0 ft	0.0	PASS	10.330 ft
+0.60D+0.70E	1.600	0.873	0.05293	PASS	0.0 ft	0.0	PASS	10.330 ft

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction (k) @ Base	@ Top	Y-Y Axis Reaction @ Base	@ Top	Axial Reaction @ Base	My - End Moments (k-ft) @ Base	@ Top	Mx - End Moments @ Base	@ Top
D Only					0.235				
+D+0.70E					12.905				

Wood Column

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: Grid H Lvl 2 Collector

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Analysis Method	Allowable Stress Design	Wood Section Name	**5.125x12**
End Fixities	Top & Bottom Pinned	Wood Grading/Manuf.	Western
Overall Column Height	19 ft	Wood Member Type	GLB

(Used for non-slender calculations)

Wood Species	SP/SP		
Wood Grade	24F-V4		
Fb +	2,400.0 psi	Fv	210.0 psi
Fb -	1,650.0 psi	Ft	975.0 psi
Fc - Prll	1,350.0 psi	Density	26.840 pcf
Fc - Perp	650.0 psi		

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1,700.0	1,500.0	1,700.0 ksi
Minimum	900.0	790.0	

Exact Width	**5.125** in
Exact Depth	**12.0** in
Area	61.50 in^2
Ix	738.0 in^4
Iy	134.611 in^4

Allow Stress Modification Factors

Cf or Cv for Bending	1.0
Cf or Cv for Compressio	1.0
Cf or Cv for Tension	1.0
Cm : Wet Use Factor	1.0
Ct : Temperature Fact	1.0
Cfu : Flat Use Factor	1.0
Kf : Built-up columns	1.0 *NDS 15.3.2*
Use Cr : Repetitive ?	No

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 1
Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 1

Applied Loads

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

Column self weight included : 217.795 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 19.0 ft, E = 14.80 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS	Max. Axial+Bending Stress Ratio =	**0.4695 : 1**
	Load Combination	+D+0.70E
	Governing NDS Forumla	Comp Only, fc/Fc'
	Location of max.above base	0.0 ft
	At maximum location values are .	
	Applied Axial	10.578 k
	Applied Mx	0.0 k-ft
	Applied My	0.0 k-ft
	Fc : Allowable	366.313 psi
PASS	Maximum Shear Stress Ratio =	**0.0 : 1**
	Load Combination	+0.60D+0.70E
	Location of max.above base	19.0 ft
	Applied Design Shear	0.0 psi
	Allowable Shear	336.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.0 k	Bottom along Y-Y	0.0 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .

Along Y-Y 0.0 in at 0.0 ft above base
for load combination : n/a

Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

Other Factors used to calculate allowable stresses . . .

Bending	Compression	Tension

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
D Only	0.900	0.295	0.009871	PASS	0.0 ft	0.0	PASS	19.0 ft
+D+0.70E	1.600	0.170	0.4695	PASS	0.0 ft	0.0	PASS	19.0 ft
+D+0.5250E	1.600	0.170	0.3546	PASS	0.0 ft	0.0	PASS	19.0 ft
+0.60D	1.600	0.170	0.005801	PASS	0.0 ft	0.0	PASS	19.0 ft
+0.60D+0.70E	1.600	0.170	0.4657	PASS	0.0 ft	0.0	PASS	19.0 ft

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction (k) @ Base	@ Top	Y-Y Axis Reaction @ Base	@ Top	Axial Reaction @ Base	My - End Moments (k-ft) @ Base	@ Top	Mx - End Moments @ Base	@ Top
D Only					0.218				
+D+0.70E					10.578				

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: Beams

CODE REFERENCES

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

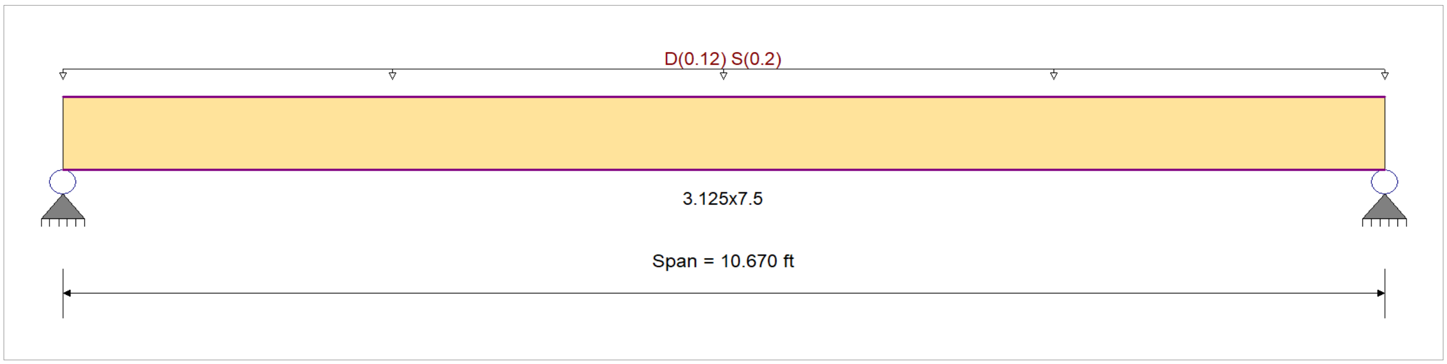
Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2018

Wood Species DF/DF
Wood Grade 24F-V/poc1

Beam Bracing Beam is Fully Braced against lateral-torsional buckling

Fb +	2,200.0 psi	*E : Modulus of Elasticity*	
Fb -	1,850.0 psi	Ebend- xx	1,800.0 ksi
Fc - Prll	1,650.0 psi	Eminbend - xx	950.0 ksi
Fc - Perp	650.0 psi	Ebend- yy	1,600.0 ksi
Fv	265.0 psi	Eminbend - yy	850.0 ksi
Ft	1,100.0 psi	Density	31.210 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 8.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.749** : 1	Maximum Shear Stress Ratio	=	**0.364** : 1
Section used for this span		**3.125x7.5**	Section used for this span		**3.125x7.5**
fb: Actual	=	1,894.91 psi	fv: Actual	=	111.00 psi
Fb: Allowable	=	2,530.00 psi	Fv: Allowable	=	304.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	5.335 ft	Location of maximum on span	=	10.670 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.297 in	Ratio =	431	>=360	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0	<360	n/a
Max Downward Total Deflection	0.482 in	Ratio =	265	>=240	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0	<240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 10.670 ft	**1**	0.368	0.179	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.78	729.10	1980.00	0.67	42.71	238.50
+D+S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 10.670 ft	**1**	0.749	0.364	1.15	1.000	1.00	1.00	1.00	1.00	1.00	4.63	1,894.91	2530.00	1.73	111.00	304.75
+D+0.750S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 10.670 ft	**1**	0.634	0.308	1.15	1.000	1.00	1.00	1.00	1.00	1.00	3.91	1,603.46	2530.00	1.47	93.92	304.75
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 10.670 ft	**1**	0.124	0.060	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.07	437.46	3520.00	0.40	25.62	424.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.4822	5.374		0.0000	0.000

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: Beams

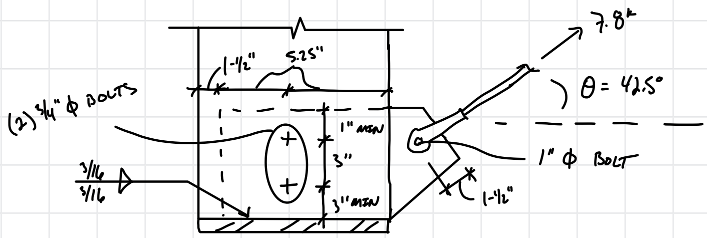
Vertical Reactions

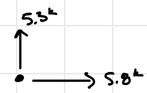
Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.734	1.734
Overall MINimum	1.067	1.067
D Only	0.667	0.667
+D+S	1.734	1.734
+D+0.750S	1.468	1.468
+0.60D	0.400	0.400
S Only	1.067	1.067

S/W 9

BASE CONNECTION



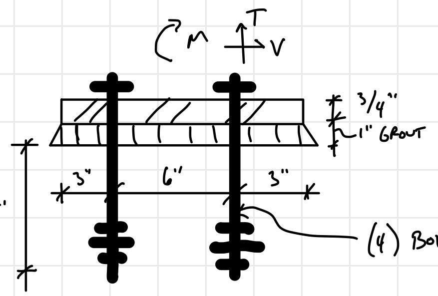


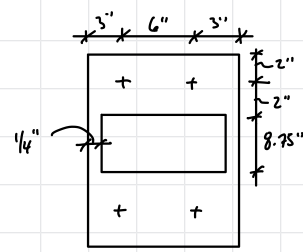
(2) 1" φ BOLTS: SEE SPREADSHEET FOR SINGLE BOLT DOUBLE SHEAR CONNECTION ... Z = 4417 lb (1.6) (2) = 14.1k > 5.3k ✓OK
*2.5 = 13.25k

*2.5 = 13.25k
WELD: 22.27 (1/4") (2) (10.5") = 116k > 5.8k ✓OK

BASE PL + ANCHORAGE:

T = 5.3k *2.5 = 13.25k
M = 5.3k (1.5ft) = 7.95k *2.5 = 19.875k
V = 5.8k *2.5 = 13.25k





omega

SEE HILTI OUTPUT FOR DESIGN...

www.hilti.com

Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	TIMBER BRACE FRAME	Date:	5/4/2022
Fastening point:			

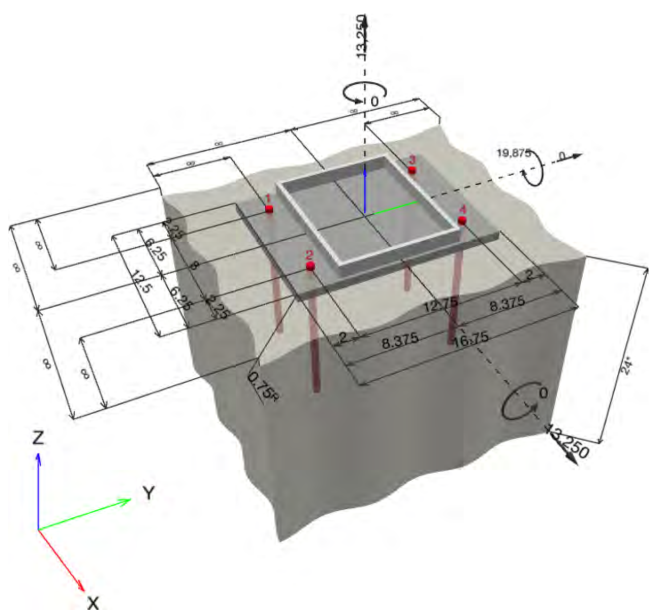
Specifier's comments:

1 Input data

Anchor type and diameter:	**Heavy Hex Head ASTM F 1554 GR. 36 5/8**
Item number:	not available
Effective embedment depth:	h_{ef} = 12.000 in.
Material:	ASTM F 1554
Evaluation Service Report:	Hilti Technical Data
Issued I Valid:	- | -
Proof:	Design Method ACI 318-14 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.750 in.
Anchor plate[R] :	l_x x l_y x t = 12.500 in. x 16.750 in. x 0.750 in.; (Recommended plate thickness: not calculated)
Profile:	Rectangular HSS (AISC), HSS12X10X.375; (L x W x T) = 12.000 in. x 10.000 in. x 0.375 in.
Base material:	cracked concrete, 3000, f_c' = 3,000 psi; h = 24.000 in.
Reinforcement:	tension: condition B, shear: condition B;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.2.3.4.3 (d))
	Shear load: yes (17.2.3.5.3 (c))

[R] - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [in.] & Loading [lb, in.lb]

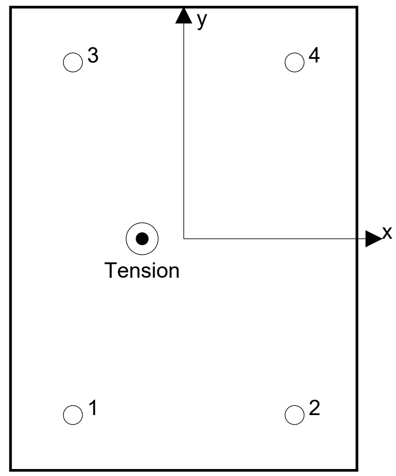


Company:		Page:	2
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	TIMBER BRACE FRAME	Date:	5/4/2022
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	$N = 13,250; V_x = 13,250; V_y = 0;$ $M_x = 0; M_y = 19,875; M_z = 0;$	yes	85

2 Load case/Resulting anchor forces



Anchor reactions [lb]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	4,555	3,312	3,312	0
2	2,070	3,312	3,312	0
3	4,555	3,312	3,312	0
4	2,070	3,312	3,312	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-1.500/0.000): 13,250 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	4,555	9,831	47	OK
Pullout Strength*	4,555	8,455	54	OK
Concrete Breakout Failure**	13,250	44,212	30	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

* highest loaded anchor **anchor group (anchors in tension)

3.1 Steel Strength

N_{sa} [lb]	ϕ	ϕ N_{sa} [lb]	N_{ua} [lb]
13,108	0.750	9,831	4,555

3.2 Pullout Strength

N_p [lb]	$\psi_{c,p}$	λ_a	ϕ	$\phi_{seismic}$	ϕ N_{pn} [lb]	N_{ua} [lb]
16,104	1.000	1	0.700	0.750	8,455	4,555

3.3 Concrete Breakout Failure

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$c_{a,min}$ [in.]	c_{ac} [in.]	$\psi_{c,N}$
2,145.00	1,296.00	∞	-	1.000

$e_{c1,N}$ [in.]	$\psi_{ec1,N}$	$e_{c2,N}$ [in.]	$\psi_{ec2,N}$	$\psi_{ed,N}$	k_{cr}
1.500	0.923	0.000	1.000	1.000	16

λ_a	N_b [lb]	ϕ	$\phi_{seismic}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
1.000	55,121	0.700	0.750	44,212	13,250

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi\ V_n$	Status
Steel Strength*	3,312	5,112	65	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	13,250	127,722	11	OK
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

* highest loaded anchor **anchor group (relevant anchors)

4.1 Steel Strength

V_{sa} [lb]	ϕ	ϕ V_{sa} [lb]	V_{ua} [lb]
7,865	0.650	5,112	3,312

4.2 Pryout Strength

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$c_{a,min}$ [in.]	k_{cp}	c_{ac} [in.]	$\psi_{c,N}$
2,145.00	1,296.00	∞	2	∞	1.000

$e_{c1,V}$ [in.]	$\psi_{ec1,V}$	$e_{c2,V}$ [in.]	$\psi_{ec2,V}$	$\psi_{ed,N}$	k_{cr}
0.000	1.000	0.000	1.000	1.000	16

λ_a	N_b [lb]	ϕ	$\phi_{seismic}$	ϕ V_{cpg} [lb]	V_{ua} [lb]
1.000	55,121	0.700	1.000	127,722	13,250

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.539	0.648	5/3	85	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

Company:		Page:	5
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	TIMBER BRACE FRAME	Date:	5/4/2022
Fastening point:			

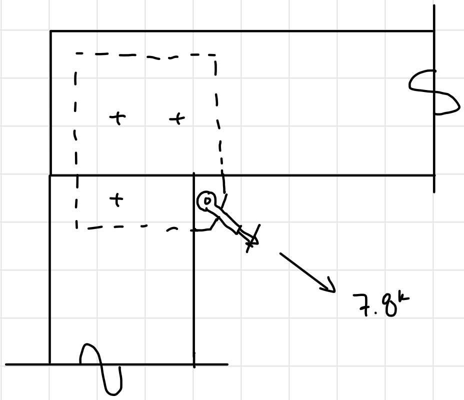
6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-14, Chapter 17, Section 17.2.3.4.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.2.3.4.3 (b), Section 17.2.3.4.3 (c), or Section 17.2.3.4.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.2.3.5.3 (a), Section 17.2.3.5.3 (b), or Section 17.2.3.5.3 (c).
- Section 17.2.3.4.3 (b) / Section 17.2.3.5.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.2.3.4.3 (c) / Section 17.2.3.5.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.2.3.4.3 (d) / Section 17.2.3.5.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.

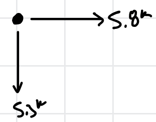
Fastening meets the design criteria!

S/W 9

Beam Connection



Clevis + Bolt ✓ok per base connection check



Vert.

(2) 1" ϕ Bolts: See spreadsheet for single bolt double shear connection ... $Z_{\parallel} = 4417\,lb\,(1.6) = 7.06^k$

$Z_{\perp} = 2113\,lb\,(1.6) = 3.38^k$

$10.44^k > 5.3^k$ ✓ok

Horiz.

(2) 1" ϕ Bolts: See spreadsheet for single bolt double shear connection ... $Z_{\parallel} = 4417\,lb\,(1.6)(2) = 14.1^k > 5.3^k$ ✓ok

Single Bolt in Wood to Wood Connections
Design for Double Shear Connections

Input

t_s	4
t_m	0.75
F_{em}	87024.00
F_{es}	5600.00
D	0.75
F_{yb}	45000
θ_{max}	0

Intermediate Calculations

R_e	15.54
k_3	0.53
K_θ	1.00

Yield Modes (lowest design value be used)

	Mode I_m	Mode I_s	Mode III_s	Mode IV
Z values (lbs)	12237.75	8400.00	4931.59	4416.87

NDS Equations 8.3-1 through 8.3-4

Results	**Z = 4416.87**

Input for side member	
Angle of Member (degrees)	0
radians	0.000
Diameter of Fastener (inch)	0.75
Specfic Gravity of wood member	0.5
Output	
F_{ell}	5600 psi
$F_{e(perpendicula}$	2578.1 psi
Results	
Dowel Bearing Strength $F_{e\theta}$	**5600.00** psi

Input for main member	
Angle of Member (degrees)	0
radians	0.000
Diameter of Fastener (inch)	0.75
Specfic Gravity of wood member	7.77
Output	
F_{ell}	87024 psi
$F_{e(perpendicula}$	137692.3 psi
Results	
Dowel Bearing Strength $F_{e\theta}$	**87024.00** psi

Single Bolt in Wood to Wood Connections
Design for Double Shear Connections

Input

t_s	4
t_m	0.75
F_{em}	87024.00
F_{es}	2578.14
D	0.75
F_{yb}	45000
θ_{max}	90

Intermediate Calculations

R_e	33.75
k_3	0.58
K_θ	1.25

Yield Modes (lowest design value be used)

	Mode I_m	Mode I_s	Mode III_s	Mode IV
Z values (lbs)	9790.20	3093.76	2113.10	2437.62

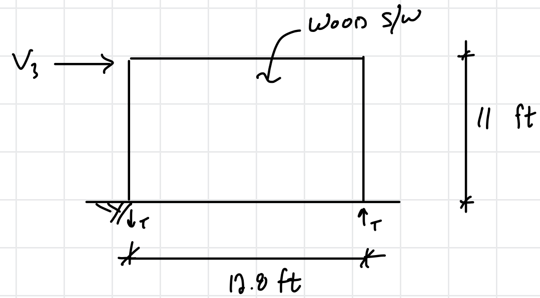
NDS Equations 8.3-1 through 8.3-4

Results	**Z = 2113.10**

Input for side member		
Angle of Member (degrees)	90	
radians	1.571	
Diameter of Fastener (inch)	0.75	
Specfic Gravity of wood member	0.5	
Output		
F_{ell}	5600	psi
$F_{e(perpendicula}$	2578.1	psi
Results		
Dowel Bearing Strength $F_{e\theta}$	**2578.14**	psi

Input for main member		
Angle of Member (degrees)	0	
radians	0.000	
Diameter of Fastener (inch)	0.75	
Specfic Gravity of wood member	7.77	
Output		
F_{ell}	87024	psi
$F_{e(perpendicula}$	137692.3	psi
Results		
Dowel Bearing Strength $F_{e\theta}$	**87024.00**	psi

S/W 11



$D = 0.6(11\ ft)(10_{PSF}) = 0.066\ klf$

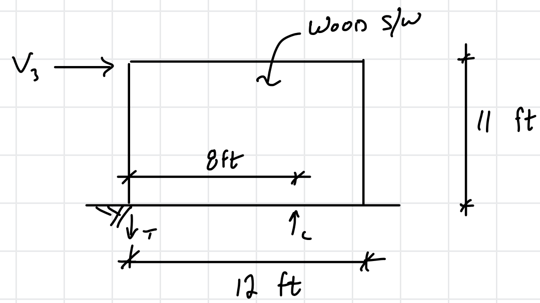
$V_3 = 1.3(0.7)(1.7^k + 1.5^k) = 3.0\ k$

SHEAR: $V_3 = 3.0^k / 12.8\ ft = 0.235\ klf$　$\boxed{10d @ 6" O.C.}$

OVERTURNING: $3.0^k (11\ ft) - 0.066\ klf (12.8\ ft)(12.8\ ft/2) \leq 12.8\ ft\ (T)$

$T = 2.16^k$　$\boxed{HDU\ 2}$

S/W12



$D = 0.6(11\ ft)(10_{PSF}) = 0.066\ klf$

$V_3 = 1.3(0.7)(3.3^k + 1.7^k + 1.46^k) = 5.88^k$

SHEAR: $V_3 = 5.88^k / 12\ ft = 0.490\ klf$ $\boxed{10d @ 3'' O.C.}$

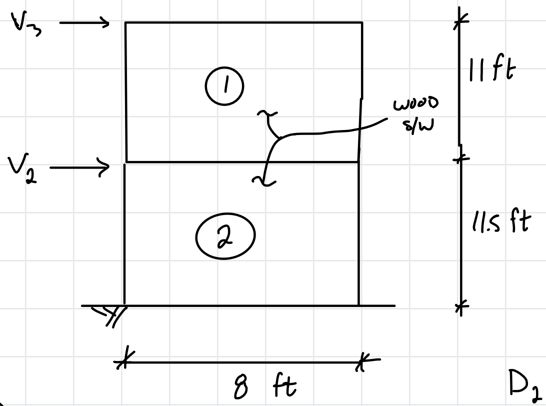
OVERTURNING: $5.88^k(11\ ft) - 0.066\ klf(12\ ft)(12\ ft/2) \leq 8\ ft\ (T)$

$T = 7.5^k$ $\boxed{HDU\ 8}$

PCS Structural Solutions

Project: MERCER ISLAND RESIDENCE | Job No: 21-201
Subject: LATERAL | Sheet: S/W 13 | Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland | Date: 5-27-21

S/W13



$D_2 = 0.6\,(10\text{ psf})(11.5\text{ft}) = 0.066\text{ klf}$

$D_3 = 0.6\,(10\text{psf})(11\text{ft}) = 0.066\text{ klf}$

$V_2 = \overset{\rho}{1.3}\,(0.7)(5.6^k)\left(\frac{8\text{ ft}}{8\text{ft}+6.5\text{ft}+9.75'}\right) = 1.7^k$

$V_3 = 1.3\,(0.7)(8.3^k)\left(\frac{8\text{ ft}}{8\text{ft}+6.5\text{ft}+9.75'}\right) = 2.5^k$

1 **SHEAR:** $V_1 = 2.5^k / (8\text{ ft}) = \underline{\underline{0.32\text{ klf}}} \rightarrow$ $\boxed{10d @ 4'' \text{ O.C.}}$

OVERTURNING: $2.5^k(11\text{ft}) - 0.066\text{ klf}\,(8\text{ ft})(8\text{ ft}/2) \le 8\text{ ft}\,(T_1)$

$T_1 = \underline{\underline{3.2^k}} \rightarrow$ $\boxed{\text{HDU 4}}$

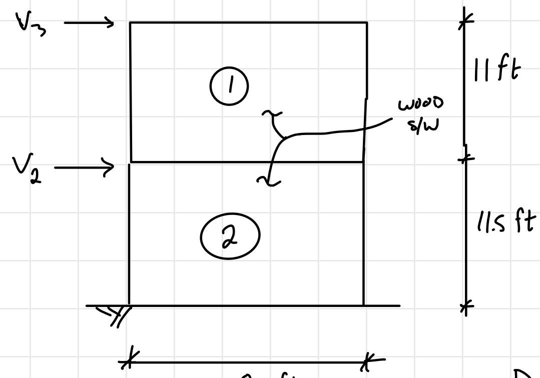
2 **SHEAR:** $V_2 = (1.7^k + 2.5^k)/(8\text{ft}) = \underline{\underline{0.525\text{ klf}}} \rightarrow$ $\boxed{10d @ 3'' \text{ O.C.}}$

OVERTURNING: $1.7^k(11.5\text{ft}) + 2.5^k(22.5\text{ft}) - (0.066\text{klf} + 0.066\text{ klf})(8\text{ ft})(4\text{ ft}) \le 8\text{ ft}\,(T_1)$

$T_1 = \underline{\underline{9.0^k}} \rightarrow$ $\boxed{\text{HDU 11}}$

PCS Structural Solutions	Project: MERCER ISLAND RESIDENCE		Job No: 21-201
	Subject: LATERAL	Sheet S/W 13	Name: BRT
	Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland		Date: 5-27-21

$\boxed{S/W13}$



$$V_2 = \overset{\rho}{1.3}\,(0.7)(5.6^k)\left(\frac{8\text{ ft}}{8\text{ft}+6.5\text{ft}+15\text{ft}}\right) = 1.7^k$$

$$V_3 = 1.3\,(0.7)(8.3^k)\left(\frac{8\text{ ft}}{8\text{ft}+6.5\text{ft}+15\text{ft}}\right) = 2.5^k$$

$$D_2 = 0.6\,(10\text{ psf})(11.5\text{ft}) = 0.066\text{ klf}$$

$$D_3 = 0.6\,(10\text{psf})(11\text{ft}) = 0.066\text{ klf}$$

$$w_{flr} = 0.6\,(20\text{ft})(15\text{ psf}) = 0.180\text{ klf}$$

FOUNDATION: 4'-0" x 1'-6" FTG → $w_{ftg} = 900\text{ plf}\,(0.6) = 540\text{ plf}$

OVERTURNING:

$$1.7^k(11.5\text{ft}) + 2.5^k(23.5\text{ft}) \le \left(\underbrace{0.132\text{ klf}}_{\text{WALL WT}} + \underbrace{0.3\text{ klf}(0.6)}_{\text{FLR. WT.}}\right)(8\text{ft})(4\text{ft}) + \left(\underbrace{0.900\text{ klf}}_{\text{FTG WT. } (4\text{ft}\times 1'\text{-}6")} + \underbrace{0.440\text{ klf}}_{\text{SOIL WT ABOVE FTG}}\right)(14\text{ ft})(7\text{ft})(0.6)$$

STEM WALL + 0.075klf (0.6)

$$80\text{ k-ft} \le 90.2\text{ k-ft}$$ ✓ OK

SLIDING:

$$\left[(900\text{ plf}(14\text{ ft}) + (180\text{plf} + 132\text{ plf})(8\text{ft})\right]\underbrace{(0.3)}_{\text{COEFFICIENT OF FRICTION}} + \underbrace{350\text{pcf}(4\text{ft})(1/2)(1.5\text{ft})}_{\text{PASSIVE SOIL RESISTANCE}} > 3{,}450\text{ lb}$$

$$5{,}580\text{ lb} > 4{,}200\text{ lb}$$ ✓ OK

BEARING:

$$e = \frac{80\text{ k-ft}}{12.9\text{ k}} = 6.2\text{ ft} > b/6 = \frac{14\text{ ft}}{6} = 2.33\text{ ft}$$

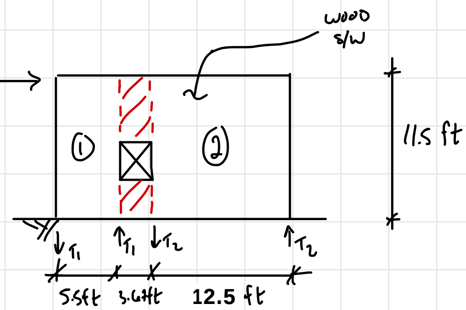
$$\therefore f_b = \frac{12.9\text{ k}}{(4\text{ft})(14\text{ ft})} + \frac{6(80\text{ k-ft})}{4\text{ ft}\,(14\text{ ft})^2} = 1.46\text{ ksf} < 1.5\text{ksf}(1.33) = 2.0\text{ ksf}$$ ✓ OK

$\boxed{\text{USE 4 ft CONT. FTG.}}$

S/W14

$$V_3 = 1.3\,\overset{\rho}{}\,(0.7)\,(1.5^k)\left(\frac{5.5ft + 14.67ft}{5.5ft + 14.67ft + 15ft}\right) = 0.8^k$$

$$D_3 = 0.6\,(10\ psf)(11\ ft) = 0.066\ klf$$



RELATIVELY NO HD FORCE @ T_2

T_1, T_2 RESOLVED BY CANT. STL BEAMS BELOW...

① SHEAR: $V_1 = 0.8^k / (5.5ft + 14.67ft) = \underline{\underline{0.04\ klf}}$ → 10d @ 6" O.C.

OVERTURNING: $(0.04\ klf)(5.5ft)(11ft) - 0.066\ klf\,(5.5\ ft)(5.5ft/2) \leq 5\ ft\,(T_1)$

$T_1 = \underline{\underline{0.29^k}}$ → HDU 2

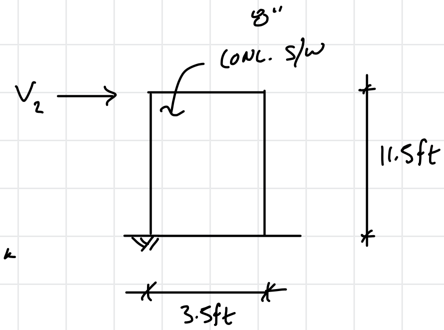
BY ENGINEERING JUDGEMENT, INCLUSION OF 30% OF ORTHOGONAL LOAD FOR NON-PARALLEL SYSTEM REQUIREMENT WILL NOT RESULT IN NEEDING OVER HDU2 OR MORE THAN 10d @ 6" O.C.

② SHEAR: $V_2 = 0.8^k / (5.5\ ft + 12.5') = \underline{\underline{0.05\ klf}}$ → 10d @ 6" O.C.

OVERTURNING: $(0.04\ klf)(12.5')(11ft) - 0.066\ klf\,(12.5ft)(12.5ft/2) \leq 12.5\ ft\,(T_1)$

$T_2 = \underline{\underline{0.03^k}}$ → **HDU 2**

$\boxed{S/W\ 15}$



$V_2 = 1.3\,(4.3^k + 1.7^k) = 7.8^k / 2 = 3.9^k$

$D_2 = 0.6\,(100\,psf)(11.5ft) = 0.690\,klf$

SHEAR: $d = 0.8 l_w = 0.8\,(3.5\,ft) = 2.8\,ft = 33.6\,in$

$h = 8\,in$

$\phi V_c = (0.6)\,2\,(1.0)\sqrt{4000\,psi}\,(8\,in)(33.6\,in) = \underline{\underline{20.4^k}} >> 3.9^k$ ∴ USE MIN. REINF. FOR SHEAR

MIN REINF.: $A_s = 0.002\,(12\,in)(8\,in) = 0.288\,in^2 \rightarrow$ $\boxed{\#5 @ 18"\ o.c.\ E.F.}$

FOUNDATION: 3'-0" x 1'-6" FTG $\rightarrow$

$w_{FLR} = 0.6\,(11.75ft)(15\,psf) = 0.105\,klf$

$w_{Ftg} = 675\,plf\,(0.6) = 405\,plf$

$W_{RETURN} = (3ft)(1.5ft)(2(3ft))(150\,pcf)(0.6) = 2430\,lb$

SLIDING: $\left[(405\,plf\,(10\,ft) + (690\,plf + 105\,plf)(3.5ft)\right]$ (0.3) COEFFICIENT OF FRICTION $+ 350\,pcf\,(4\,ft)(1/2)(1.5ft)$ PASSIVE SOIL RESISTANCE $+ 2430\,lb$ $> 3{,}900\,lb$

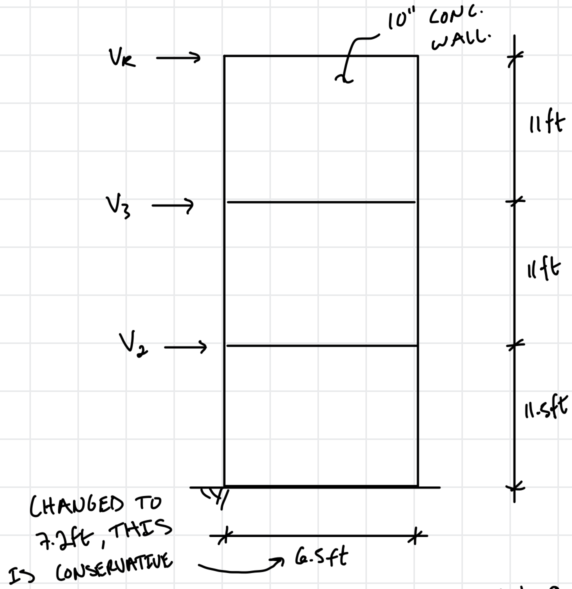
$\underline{\underline{5{,}529\,lb}} > 3{,}900\,lb$ ✓OK

PCS Structural Solutions

Project: Mercer Island Residence | Job No: 21-201
Subject: Lateral | Sheet: Core Wall | Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland | Date: 5-27-21

CORE WALL

CONTROLS OVER OTHER WALLS → **EAST WALL:**



$d = 0.8 l_w = 0.8 (6.5ft)(12in/ft)$
$= 62.4in$

$h = 10in$

$V_R = 2.8^k (1.3) = 3.8^k$
$V_3 = 8.3^k (1.3) = 10.9^k$
$V_2 = 5.6^k (1.3) = 7.3^k$

$V_{TOT} = 22^k$

USE SECTION @ OPENING TO BE CONSERVATIVE

SHEAR: $\phi V_n = 0.6 (2)(1.0)\sqrt{4000psi}\,(40 in)(10in) = \underline{\underline{30.4^k}} >> 22^k$ ✓OK ∴ USE MIN. REINF. FOR SHEAR

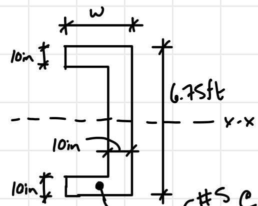
MIN REINF.: $A_s = 0.002 (12in)(10 in) = 0.24 in^2$ → $\boxed{\#5 @ 12" O.C.}$

OTHER SIDES

✓OK BY INSPECTION, W/ MIN. SHEAR REINF.
B/C LESS LOAD + SAME WALL LENGTH + THICKNESS
AS EAST SIDE OF CORE WALL ...

Project: MERCER ISLAND RESIDENCE | Job No: 21-201
Subject: LATERAL | Sheet: CORE WALL | Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland | Date: 5-27-21

CORE WALL



$w = (7.2ft \times 12)/2 = 43in$

OR $= (11ft \times 12)(0.25) = 33in$ ← CONTROLS

#5 @ 18" O.C. E.F.

↳ $A_s = 3\ (0.31in^2)(2\ \text{FACES}) = 1.86\ in^2$

MOMENT:

$$a = \frac{1.86in^2\ (60{,}000ksi)}{0.85\,(4000psi)(33in)} = 1.0in$$

$$\phi M_n = 0.9\,(1.86in^2)(60{,}000psi)\left(71in - \frac{1.0in}{2}\right) = \underline{\underline{590k\cdot ft}} > 456\ k\cdot ft \quad \checkmark \text{ok}$$

BOUNDARY ELEMENTS:

$$f = \frac{P_u}{A_g} + \frac{M_u\,(l_w/2)}{I_g} \le 0.2 f'_c$$

$$D_u = 27^k\,(1.2) = 32.4^k$$

$$M_u = 3.9^k\,(33.5ft) + 10.9^k\,(22.5ft) + 7.3^k\,(11.5ft) = 456.5\ k\cdot ft = 5472\ k\cdot in$$

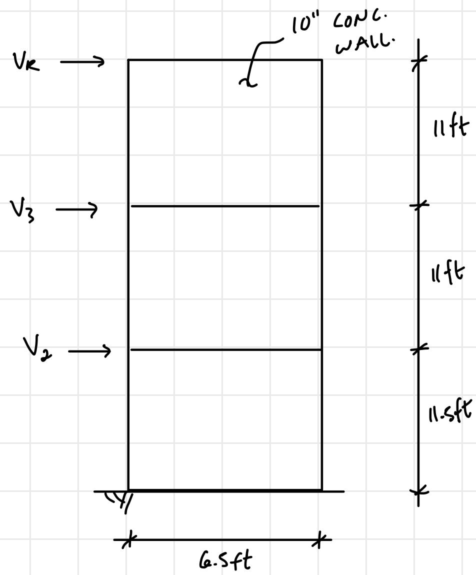
$$f = \left(\frac{32.4\ k}{(10in)(78in)}\right) + \left(\frac{5472k\cdot in\,(78in/2)}{(10in)(78in)^3/12}\right) = 0.582ksi \le 0.2\,(3000psi) = 0.600ksi$$

∴ $\boxed{\text{NO BOUNDARY ELEMENTS REQ'D, PER ACI 18.10.6.3}}$

Seattle | 1011 Western Avenue, Suite 810 | Seattle, WA 98104 | 206.292.5076
Tacoma | 1250 Pacific Avenue, Suite 701 | Tacoma, WA 98402 | 253.383.2797
Portland | 101 SW Main Street, Suite 280 | Portland, OR 97204 | 503.232.3746
www.pcs-structural.com

CORE WALL

EAST WALL:



$d = 0.8 l_w = 0.8 (6.5ft)(12in/ft)$
$= 62.4in$

$h = 10in$

$V_R = 2.8^k (1.3) = 3.8^k$
$V_3 = 8.3^k (1.3) = 10.9^k$
$V_2 = 5.6^k (1.3) = 7.3^k$

$V_{TOT} = 22^k$

FOUNDATION: 9'-2" x 8'-10" x 1'-6" FTG →

$w_{FLR} = 0.6 (8ft \; {}^{+4ft}) (15 PSF \; {}^{(6.5ft)}) = 702 lb$

$w_{ftg} = 18,218 lb (0.6) = 10,931 lb$

$W_{WALL} = 150pcf (0.6) \left(\frac{10in}{12in/ft}\right) (9.17ft(2) + 8.83ft(2)) (35ft)$
$= 94,500 lb$

GLOBAL OVERTURNING:

$$\overbrace{7.3^k (13ft) + 3.8^k (35ft) + 10.9^k (24ft)}^{\text{EAST WALL}} + \underbrace{[0.7^k (24ft) + 2.3^k (13ft)]}_{\text{WEST WALL}}(0.7) \le [(\underbrace{10,931 lb}_{\text{FTG. WT.}} + \underbrace{702 lb}_{\text{FLR WT}} + \underbrace{94,500 lb}_{\text{WALL WT.}})(4.5ft)] + \overbrace{[2(3ft)(1.5ft)(150pcf)(6ft)(0.6)]}^{\text{GRID E FTG}}$$
$$+ \underbrace{[36ft^2 (0.6)(110pcf)(1.5ft)(4.5ft)]}_{\text{SOIL WT.}} + [(5.17ft)(4.83ft)(150pcf)(5in/12in/ft)(0.6)(4.5ft)]$$
$$+ \overbrace{[(11.5ft)(150pcf)(8in/12in/ft)(0.6)(1.17ft)(6ft)]}^{\text{SLAB WT}}$$
$$+ \overbrace{[(8ft)(11.5ft)(0.6)(150psf)(1.5ft)]}^{\text{GRID H WALL}} + \underbrace{[(8ft)(7ft)(2ft)(150pcf)(0.6)(3.5ft)]}_{\text{GRID H FTG.}} =$$

GRID E WALL

$522.2 k \cdot ft \le 477,598 lb \cdot ft + 4,860 lb \cdot ft + 4,213 lb \cdot ft + 16,038 lb \cdot ft + 4,843 lb \cdot ft + 12,420 lb \cdot ft + 35,280 lb \cdot ft$

$522.2 k \cdot ft \le 555.2 k \cdot ft$ ✓ OK

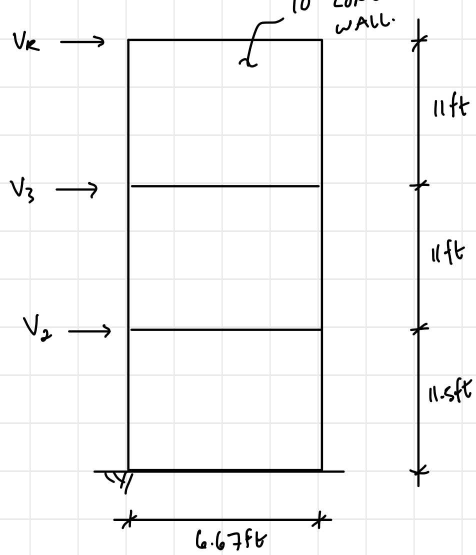
SLIDING: $(10,931 lb + 702 lb + 94,500 lb)(0.3) > 24,100 lb$
$3564 lb + 937 lb$

$\underline{\underline{36,178 lb}} > 24,100 lb$ ✓ OK

CHECK TO VERIFY NO O/T BY ITSELF DUE TO GAP B/T WEST & SOUTH WALL

CORE WALL

WEST WALL:



$V_R = 1.4^k (1.3)(0.7)(0.75) = 0.96^k$

$V_3 = 0.7^k (1.3)(0.7)(0.75) = 0.48^k$

$V_2 = 2.3^k (1.3)(0.7)(0.75) = 1.57^k$

$h = 10\text{in}$

FOUNDATION: 9'-2" × 8'-10" × 1'-6" FTG →

$w_{ftg} = 150\text{pcf}(0.6)\left(\frac{24\text{ in}}{12\text{ in/ft}}\right)(3\text{ft})(8.67\text{ft}) = 4.68^k$

$W_{wall} = 150\text{pcf}(0.6)\left(\frac{10\text{ in}}{12\text{ in/ft}}\right)(6.67\text{ft})(33.5\text{ft}) = 16.76^k$

GLOBAL OVERTURNING:

$0.96^k(33.5\text{ft}) + (0.48^k)(22.5\text{ft}) + (1.57^k)(11.5\text{ft}) \le 16.76^k(6.67\text{ft}/2) + (4.68^k)(6.67\text{ft}/2)$

$61.02\text{ k.ft} \le 71.5\text{ k.ft}$ ✓ OK w/o ENGAGING REST OF WALL / FOOTING

CORE WALL

CONTROLS OVER NORTH

SOUTH WALL:

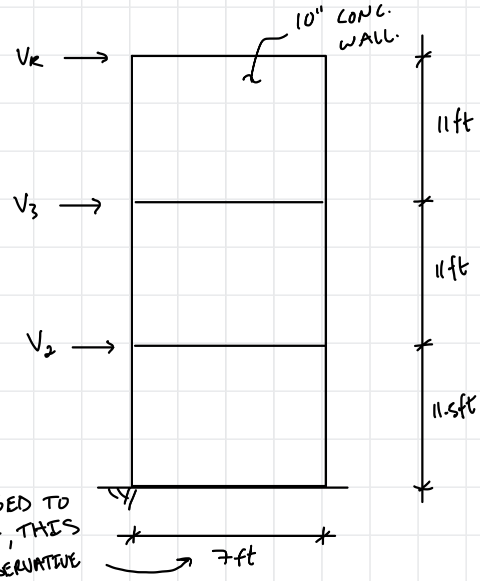
NON-PARALLEL SYSTEM

$V_R = 7.31^k (1.3) + 0.3(2.8^k) = 10.4^k$

$V_3 = 1.5^k (1.3) + 0.3(2.8^k) = 2.8^k$

$V_2 = 0^k (1.3) + 0.3(5.6^k) = 1.7^k$

$V_{TOT} = 14.9^k$



CHANGED TO 6.67ft, THIS IS CONSERVATIVE

$d = 0.8 l_w = 0.8(6.5ft)(12in/ft)$
$= 62.4in$

$h = 10in$

SHEAR: $14.9^k < 22^k$ ∴ EAST WALL CONTROLS

MIN REINF.: $A_s = 0.002 (12in)(10in) = 0.24 in^2 \rightarrow \boxed{\#5 @ 12" O.C.}$

MOMENT: $10.4^k(33.5ft) + 2.8^k(22.5ft) + 1.7^k(11.5ft) = 431 k\text{-}ft < 456 k\text{-}ft$

∴ EAST WALL CONTROLS

DIAPHRAGMS

15/32", RATED SHT'G, w/ 10d @ 6" O.C., CASE 1 $\longrightarrow$ 510 plf/2 = 255 plf
CASE 3 $\longrightarrow$ 380 plf/2 = 190 plf

ROOF (N/S)

EAST WALL: (CASE 1)

COLLECTOR LENGTH

$2.8^k(0.7)/x < 255 \text{ plf} \longrightarrow \underline{\underline{x = 7.69 \text{ ft}}}$

COLLECTOR 3 FORCE = 2.8^k (ULT.)

S/W 9:

$2.0^k(0.7)/9\text{ft} < 255 \text{ plf}$
$156 \text{ plf} < 255 \text{ plf}$ ✓OK ∴ NO COLLECTOR NEEDED

SOUTH WALL: (CASE 3)

COLLECTOR LENGTH

$7.31^k(0.7)/(x+6.8\text{ft}) < 190 \text{ plf} \longrightarrow \underline{\underline{x = 20.2 \text{ ft}}}$ COLLECTOR NEEDED

COLLECTOR 1 FORCE = 7.31^k (ULT.)

FORCE THRU WOOD S/W TO WOOD BM COLLECTOR BELOW

DIAPHRAGMS

15/32", RATED SHT'G, w/ 10d @ 6" O.C., CASE 1 ⟶ 510 plf/2 = 255 plf
CASE 3 ⟶ 380 plf/2 = 190 plf

3RD FLR (N/S)

SCALE STORY FORCE FROM SHEAR MAP TO DIAPHRAGM FORCE...

$\eta = 8.4^k / 11.8^k = 0.72$

S/W 9 : $1.4^k(0.72)(0.7)/11ft < 255$ plf
65 plf < 255 plf ✓ok ∴ NO COLLECTOR NEEDED

S/W 5 : $1.8^k(0.72)(0.7)/12.5ft < 190$ plf
73 plf < 190 plf ✓ok ∴ NO COLLECTOR NEEDED

WEST WALL : $0.7^k(0.72)(0.7)/6.5ft < 190$ plf
55 plf < 190 plf ✓ok ∴ NO COLLECTOR NEEDED

GRID 7 : $8.3^k(0.72)(0.7)/(6.5ft + 8ft + 15.25ft) < 190$ plf
141 plf < 190 plf ✓ok ∴ NO COLLECTOR NEEDED

S/W 8 : $0.8^k(0.72)(0.7)/11ft < 255$ plf
37 plf < 255 plf ✓ok ∴ NO COLLECTOR NEEDED

Project: Mercer Island Residence	Job No: 21-201
Subject: Lateral / Sheet: Diaphragms	Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland	Date: 6-10-21

DIAPHRAGMS

15/32", RATED SHT'G, w/ 10d @ 6" O.C., CASE 1 ⟶ 510 plf / 2 = 255 plf

CASE 3 ⟶ 380 plf / 2 = 190 plf

3RD FLR (E/W)

SCALE STORY FORCE FROM SHEAR MAP TO DIAPHRAGM FORCE...

$\eta = 8.4^k / 11.8^k = 0.72$

S/W 14: $1.5^k(0.72)(0.7) / 14ft < 190$ plf

40 plf < 190 plf ✓OK ∴ NO COLLECTOR NEEDED

S/W 11: $3.2^k(0.72)(0.7) / 21 ft < 190$ plf

77 plf < 190 plf ✓OK ∴ NO COLLECTOR NEEDED

S/W 12: $6.5^k(0.72)(0.7) / (12 ft + x) < 190$ plf

x = 6ft COLLECTOR NEEDED

S/W 3: $2.3^k(0.72)(0.7) / (10.25ft) < 190$ plf

113 plf < 190 plf ✓OK ∴ NO COLLECTOR NEEDED

S/W 7: ✓OK BY INSPECTION...

GRID H: COLLECTOR 2 FORCE =

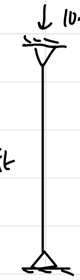
FROM ROOF

1.5^k
1.5^k
$+7.3^k$
10.3^k

SEE ENERCALC

∴ $\boxed{5\frac{1}{8} \times 12" \text{ GLB}}$ ✓OK

↓ 10.3^k



l = 19 ft

$v = 3.0^k / 24 ft = 0.13$ klf

↑ CAPACITY NEEDED FOR DIAPHRAGM NAILING

$10.3^k / 18ft = 0.573$ klf $(0.7) = 0.401$ klf

∴ USE (2) 16d @ 8" O.C.

↳ 122 plf (1.6) (2) = 585 plf > 401 plf ✓OK (12/8)

Seattle | 1011 Western Avenue, Suite 810 | Seattle, WA 98104 | 206.292.5076
Tacoma | 1250 Pacific Avenue, Suite 701 | Tacoma, WA 98402 | 253.383.2797
Portland | 101 SW Main Street, Suite 280 | Portland, OR 97204 | 503.232.3746
www.pcs-structural.com

Wood Column

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.31 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: Grid H Lvl 2 Collector

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Analysis Method	Allowable Stress Design		
End Fixities	Top & Bottom Pinned		
Overall Column Height		19 ft	
(Used for non-slender calculations)			
Wood Species	SP/SP		
Wood Grade	24F-V4		
Fb +	2,400.0 psi	Fv	210.0 psi
Fb -	1,650.0 psi	Ft	975.0 psi
Fc - Prll	1,350.0 psi	Density	26.840 pcf
Fc - Perp	650.0 psi		

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1,700.0	1,500.0	1,700.0 ksi
Minimum	900.0	790.0	

Wood Section Name	**5.125x12**
Wood Grading/Manuf.	Western
Wood Member Type	GLB
Exact Width	**5.125** in
Exact Depth	**12.0** in
Area	61.50 in^2
Ix	738.0 in^4
Iy	134.611 in^4

Allow Stress Modification Factors	
Cf or Cv for Bending	1.0
Cf or Cv for Compressio	1.0
Cf or Cv for Tension	1.0
Cm : Wet Use Factor	1.0
Ct : Temperature Fact	1.0
Cfu : Flat Use Factor	1.0
Kf : Built-up columns	1.0 *NDS 15.3.2*
Use Cr : Repetitive ?	No

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 19
Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 19

Applied Loads

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

Column self weight included : 217.795 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 19.0 ft, E = 10.30 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS	Max. Axial+Bending Stress Ratio =	**0.3297 : 1**
	Load Combination	+D+0.70E
	Governing NDS Forumla	Comp Only, fc/Fc'
	Location of max.above base	0.0 ft
	At maximum location values are .	
	Applied Axial	7.428 k
	Applied Mx	0.0 k-ft
	Applied My	0.0 k-ft
	Fc : Allowable	366.313 psi
PASS	Maximum Shear Stress Ratio =	**0.0 : 1**
	Load Combination	+0.60D+0.70E
	Location of max.above base	19.0 ft
	Applied Design Shear	0.0 psi
	Allowable Shear	336.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.0 k	Bottom along Y-Y	0.0 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .

Along Y-Y 0.0 in at 0.0 ft above base
for load combination : n/a
Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

Other Factors used to calculate allowable stresses . . .

Bending	Compression	Tension

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
D Only	0.900	0.295	0.009871	PASS	0.0 ft	0.0	PASS	19.0 ft
+D+0.70E	1.600	0.170	0.3297	PASS	0.0 ft	0.0	PASS	19.0 ft
+D+0.5250E	1.600	0.170	0.2497	PASS	0.0 ft	0.0	PASS	19.0 ft
+0.60D	1.600	0.170	0.005801	PASS	0.0 ft	0.0	PASS	19.0 ft
+0.60D+0.70E	1.600	0.170	0.3258	PASS	0.0 ft	0.0	PASS	19.0 ft

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction (k) @ Base	X-X Axis Reaction @ Top	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Axial Reaction @ Base	My - End Moments (k-ft) @ Base	My - End Moments @ Top	Mx - End Moments @ Base	Mx - End Moments @ Top
D Only					0.218				
+D+0.70E					7.428				

Wood Column

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.31 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: Grid H Lvl 2 Collector

Maximum Reactions

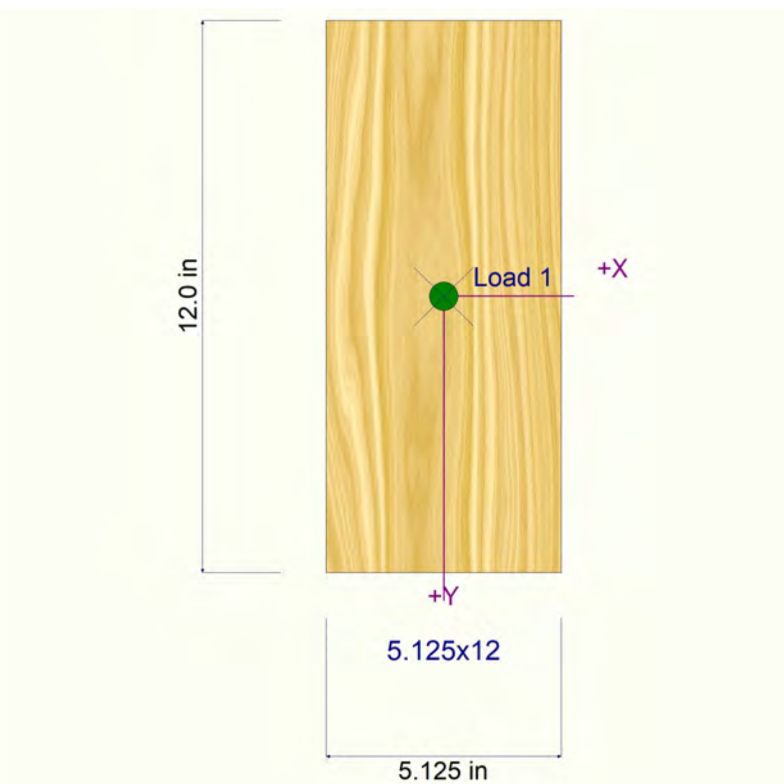
Note: Only non-zero reactions are listed.

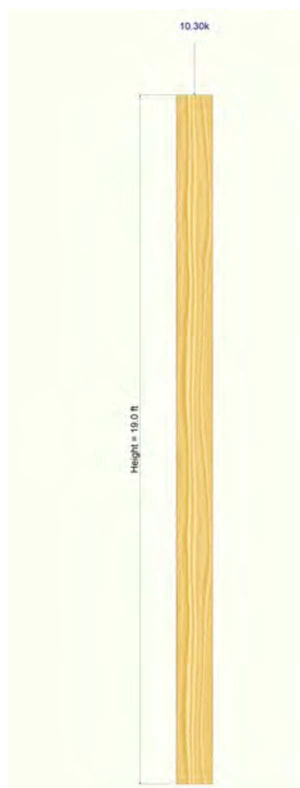
Load Combination	X-X Axis Reaction @ Base	k @ Top	Y-Y Axis Reaction @ Base	@ Top	Axial Reaction @ Base	My - End Moments @ Base	k-ft @ Top	Mx - End Moments @ Base	@ Top
+D+0.5250E					5.625				
+0.60D					0.131				
+0.60D+0.70E					7.341				
E Only					10.300				

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.70E	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.5250E	0.0000 in	0.000 ft	0.000 in	0.000 ft
+0.60D	0.0000 in	0.000 ft	0.000 in	0.000 ft
+0.60D+0.70E	0.0000 in	0.000 ft	0.000 in	0.000 ft
E Only	0.0000 in	0.000 ft	0.000 in	0.000 ft

Sketches





DIAPHRAGMS

15/32", RATED SHT'G, w/ 10d @ 6" O.C., CASE 1 ⟶ 510 plf / 2 = 255 plf
CASE 3 ⟶ 380 plf / 2 = 190 plf

2ND FLR (N/S) — SCALE STORY FORCE FROM SHEAR MAP TO DIAPHRAGM FORCE...

$\eta = 5.9^k / 15.1^k = 0.40$

S/W 5: $2.6^k(0.40)(0.7)/25ft < 190$ plf
30 plf < 190 plf ✓OK ∴ NO COLLECTOR NEEDED

West Core Wall: $2.3^k(0.40)(0.7)/6.5ft < 190$ plf
99 plf < 190 plf ✓OK ∴ NO COLLECTOR NEEDED

Grid 7: $5.6^k(0.40)(0.7)/(8ft + 6.5ft + 15ft) < 190$ plf
53 plf < 190 plf ✓OK ∴ NO COLLECTOR NEEDED

Grid 9: $6.0^k(0.72)(0.7)/(3.5ft + 3.5ft) < 255$ plf

432 plf < 255 plf ✗ N.G. ∴ COLLECTOR NEEDED

$6.0^k(0.72)(0.7)/(7ft + x) < 255$ plf ⟶ x = 4.86 ft

x2.5 (omega)

COLLECTOR FORCE $= 6.0^k(.72)\left(\frac{4.9 ft}{4.9 ft + 7 ft}\right) = 4.45^k$ (ULT.)

4.45K/3 studs = 1.5K/Stud

$1.8^k / 3.5ft = 0.52$ klf ← CAPACITY NEEDED FOR ANCHORAGE

$1.8^k / 11.5ft = 0.157$ klf ← CAPACITY NEEDED FOR SCREWS

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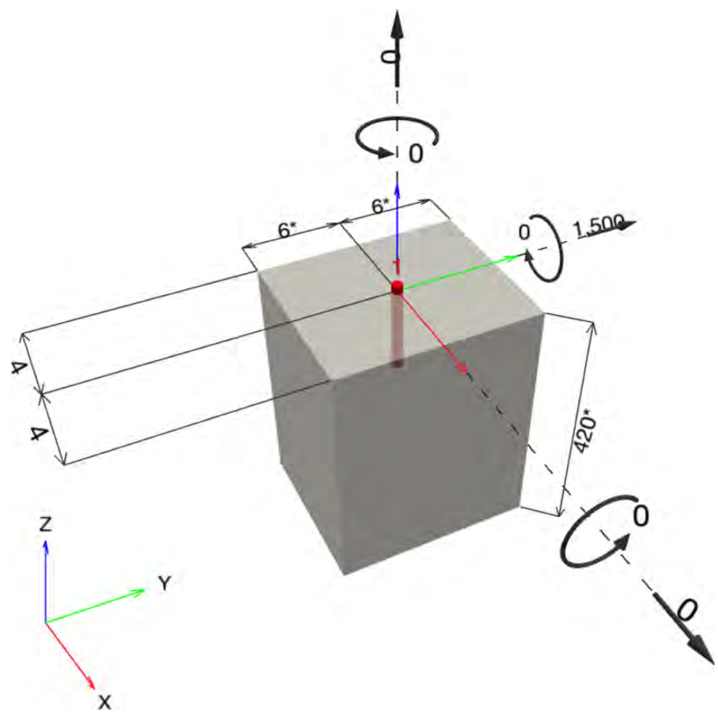
Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	MERCER ISLAND - STL BM COLLECTOR	Date:	5/4/2022
Fastening point:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**Heavy Hex Head ASTM F 1554 GR. 36 1/2**
Item number:	not available
Effective embedment depth:	h_{ef} = 4.000 in.
Material:	ASTM F 1554
Evaluation Service Report:	Hilti Technical Data
Issued I Valid:	- | -
Proof:	Design Method ACI 318-14 / CIP
Stand-off installation:	
Profile:	
Base material:	cracked concrete, 4000, f_c' = 4,000 psi; h = 420.000 in.
Reinforcement:	tension: condition B, shear: condition B;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.2.3.4.3 (d))
	Shear load: yes (17.2.3.5.3 (c))

Geometry [in.] & Loading [lb, in.lb]



1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	$N = 0; V_x = 0; V_y = 1{,}500;$ $M_x = 0; M_y = 0; M_z = 0;$	yes	83

2 Load case/Resulting anchor forces

Anchor reactions [lb]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	1,500	0	1,500

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	**Capacity ϕ N_n [lb]**	**Utilization $\beta_N = N_{ua}/\phi$ N_n**	**Status**
Steel Strength*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	N/A	N/A	N/A	N/A
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

* highest loaded anchor **anchor group (anchors in tension)

Company:		Page:	3
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	MERCER ISLAND - STL BM COLLECTOR	Date:	5/4/2022
Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	1,500	3,212	47	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	1,500	10,200	15	OK
Concrete edge failure in direction y+**	1,500	1,808	83	OK

* highest loaded anchor **anchor group (relevant anchors)

4.1 Steel Strength

V_{sa} [lb]	ϕ	ϕ V_{sa} [lb]	V_{ua} [lb]
4,942	0.650	3,212	1,500

4.2 Pryout Strength

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$c_{a,min}$ [in.]	k_{cp}	c_{ac} [in.]	$\psi_{c,N}$	h_{ef} [in.]
96.00	144.00	4.000	2	∞	1.000	4.000

$e_{c1,V}$ [in.]	$\psi_{ec1,V}$	$e_{c2,V}$ [in.]	$\psi_{ec2,V}$	$\psi_{ed,N}$	k_{cr}
0.000	1.000	0.000	1.000	0.900	24

λ_a	N_b [lb]	ϕ	$\phi_{seismic}$	ϕ V_{cpg} [lb]	V_{ua} [lb]
1.000	12,143	0.700	1.000	10,200	1,500

4.3 Concrete edge failure in direction y+

l_e [in.]	d_0 [in.]	c_1 [in.]	A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]
4.000	0.500	6.000	72.00	162.00

$\psi_{ed,V}$	$\psi_{parallel,V}$	$e_{c,V}$ [in.]	$\psi_{ec,V}$	$\psi_{c,V}$	$\psi_{h,V}$
0.833	1.000	0.000	1.000	1.000	1.000

λ_a	V_b [lb]	ϕ	$\phi_{seismic}$	ϕ V_{cbg} [lb]	V_{ua} [lb]
1.000	6,974	0.700	1.000	1,808	1,500

5 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-14, Chapter 17, Section 17.2.3.4.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.2.3.4.3 (b), Section 17.2.3.4.3 (c), or Section 17.2.3.4.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.2.3.5.3 (a), Section 17.2.3.5.3 (b), or Section 17.2.3.5.3 (c).
- Section 17.2.3.4.3 (b) / Section 17.2.3.5.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.2.3.4.3 (c) / Section 17.2.3.5.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.2.3.4.3 (d) / Section 17.2.3.5.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.

Fastening meets the design criteria!

DIAPHRAGMS

15/32", RATED SHT'G, w/ 10d @ 6" O.C., CASE 1 → 510 plf / 2 = 255 plf
CASE 3 → 380 plf / 2 = 190 plf

2ND FLR (E/W)

SCALE STORY FORCE FROM SHEAR MAP TO DIAPHRAGM FORCE...

$\eta = 5.9^k / 15.1^k = 0.40$

S/W 6 : $10.2^k(0.40)(0.7)/14\text{sft} < 255$ plf
200 plf < 255 plf ✓ok ∴ NO COLLECTOR NEEDED

S/W 4 : $8.7^k(0.40)(0.7)/15\text{ ft} < 255$ plf
163 plf < 255 plf ✓ok ∴ NO COLLECTOR NEEDED

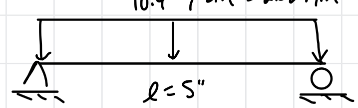
S/W 3 : $2.8^k(0.40)(0.7)/(9.83\text{ft}) < 255$ plf
80 plf < 255 plf ✓ok ∴ NO COLLECTOR NEEDED

S/W 1 : $3.0^k(0.40)(0.7)/(22\text{ ft}) < 255$ plf
39 plf < 255 plf ✓ok ∴ NO COLLECTOR NEEDED

COLLECTOR

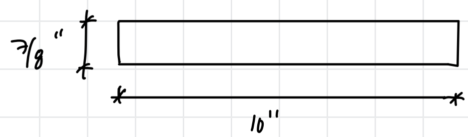
3RD FLR EAST CORE WALL:

BRG PL BENDING:



$M_{MAX} = \frac{2.08 k/in (5in)^2}{8} = 6.5$ k-in

$V_{MAX} = 2.08^k (5in)/2 = 5.2^k$



$Z_x = \frac{5 in (0.875 in)^2}{4} = 0.95 in^3$

$\phi M_n = 0.9 (0.95 in^3)(50 ksi) = \underline{\underline{43 k \cdot in}} > 6.5$ k·in ✓OK

HSS WELD:

$22.27 (20 in)(1/4) = \underline{\underline{111^k}} > 10.4^k$

$\boxed{\text{DIAPHRAGMS}}$

CHORDS:

(ROOF) CONTROLLING CHORD FORCE $= \left(\dfrac{0.08\text{klf}\,(49\text{ft})^2}{8}\right) \Big/ 20\text{ft} = \underline{\underline{1.2^k}}$

(3RD FLR) CONTROLLING CHORD FORCE $= \left(\dfrac{0.08\text{klf} \times \left(\frac{8.4^k}{11.8^k}\right)(34\text{ ft})^2}{8}\right) \Big/ 16\text{ ft} = 0.52^k$

OR $= \left(\dfrac{0.29\text{klf}\,\left(8.4^k/11.8^k\right)(23\text{ft})^2}{8}\right) \Big/ 18\text{ft} = \underline{\underline{0.76^k}}$

(2ND FLR) CONTROLLING CHORD FORCE $= \left(\dfrac{5.9^k}{15.1^k}\right)(47.0\text{k-ft}) \big/ 42.5\text{ft} = \underline{\underline{0.44^k}}$

M_{MAX} FROM ENERCALC

DBL. TOP PL LAP CAPACITY $= \underset{C_D}{1.6}\,(0.131\text{lb/nail})(20\text{ NAILS}) = 4.2^k >> 1.2^k$ ✓OK

Structural Solutions

Project: MERCER ISLAND RESIDENCE   Job Number: 21-201   Name: BRT

Originating Office: Tacoma   Sheet: ____ of ____   Date: 08/19/21

ALLOWABLE SHEAR (PLF) FOR WOOD STRUCTURAL PANEL SHEAR WALLS - RATED SHEATHING

DOUGLAS FIR-LARCH (S.G. = 0.50)

Sheathing	Edge Attachment (in. O.C.)	Field Attachment (in. O.C.)	Framing Lumber[3,4]	Sill Plate	Seismic						Wind					
					Allow (plf)	Sole Nailing[6,7]		Framing Clips[8]	5/8" A.B. (in. O.C.)	3/4" A.B. (in. O.C.)	Allow (plf)	Sole Nailing[6,7]		Framing Clips[8]	5/8" A.B. (in. O.C.)	3/4" A.B. (in. O.C.)
						Spacing	# of Rows	Spacing				Spacing	# of Rows	Spacing		
Single Sided with 10d Nails																
15/32" (1) Side	10d @ 6"	10d @ 12"	2x D.F.	2x D.F.	**310**	16d @ 8"	2	24"	48	48	**434**	16d @ 8"	2	18	32	48
15/32" (1) Side	10d @ 4"	10d @ 12"	3x D.F.	2x D.F.	**460**	16d @ 8"	2	16"	32	48	**644**	SDS @ 6"	1	12"	24	32
15/32" (1) Side	10d @ 3"	10d @ 12"	3x D.F.	2x D.F.	**600**	SDS @ 6"	1	12"	24	32	**840**	SDS @ 6"	2	9"	16	24
Double Sided with 10d Nails																
15/32" (2) Sides	10d @ 6"	10d @ 12"	2x D.F.	2x D.F.	**620**	SDS @ 6"	1	12"	24	32	**868**	SDS @ 6"	2	9"	16	24
15/32" (2) Sides	10d @ 4"	10d @ 12"	3x D.F.	3x D.F.	**920**	SDS @ 6"	2	8"	24	32	**1288**	SDS @ 6"	2	6"	16	24
15/32" (2) Sides	10d @ 3"	10d @ 12"	3x D.F.	3x D.F.	**1200**	SDS @ 6"	2	6"	16	24	**1680**	SDS @ 6"	3	4"	12	16

HEM-FIR (S.G. = 0.43)

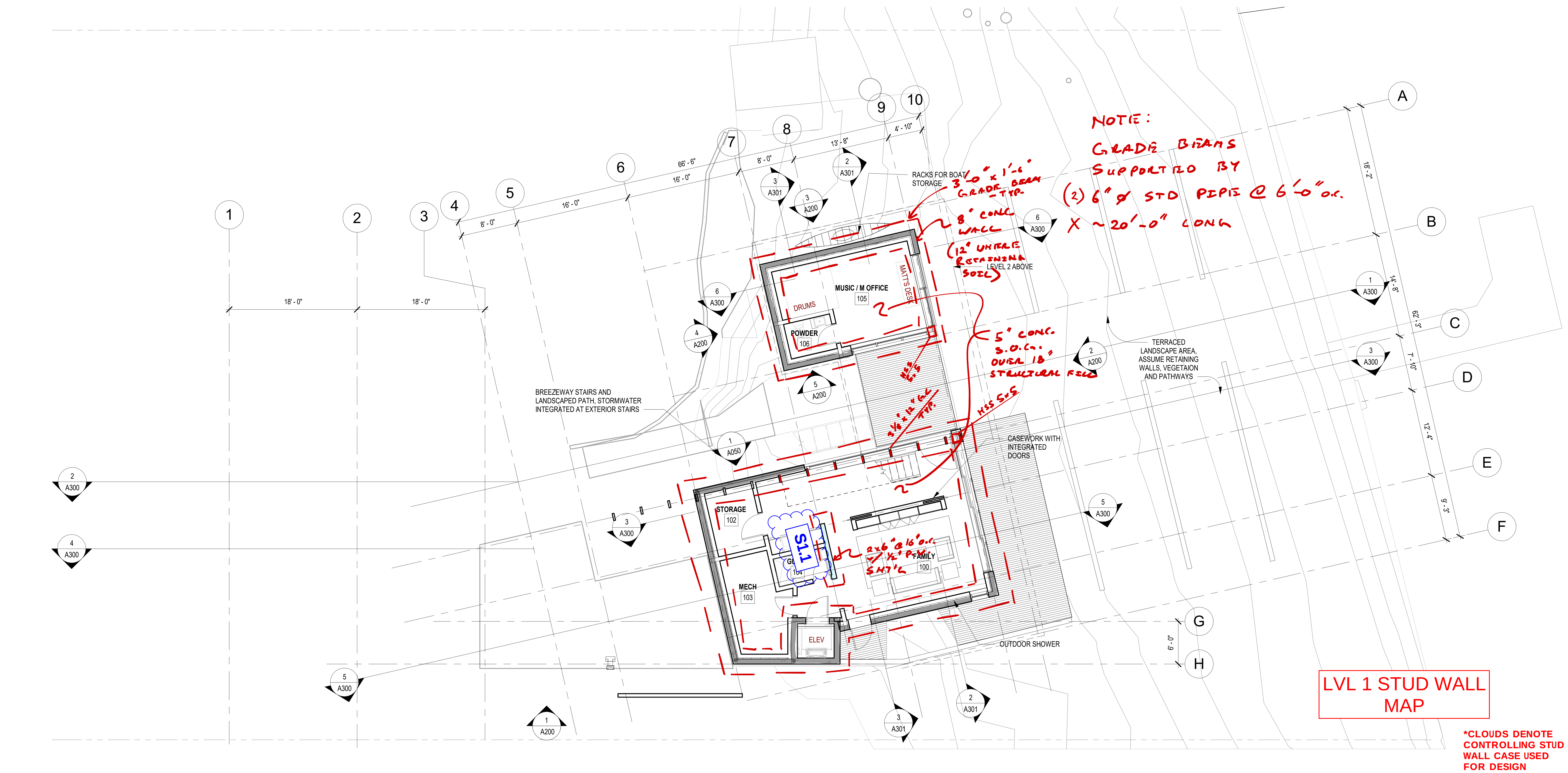
Sheathing	Edge Attachment (in. O.C.)	Field Attachment (in. O.C.)	Framing Lumber[3,4]	Sill Plate	Seismic						Wind					
					Allow (plf)	Sole Nailing[6,7]		Framing Clips[8]	5/8" A.B. (in. O.C.)	3/4" A.B. (in. O.C.)	Allow (plf)	Sole Nailing[6,7]		Framing Clips[8]	5/8" A.B. (in. O.C.)	3/4" A.B. (in. O.C.)
						Spacing	# of Rows	Spacing				Spacing	# of Rows	Spacing		
Single Sided with 10d Nails																
15/32" (1) Side	10d @ 6"	10d @ 12"	2x H.F.	2x H.F.	**288**	16d @ 8"	2	22"	48	48	**404**	16d @ 8"	2	16"	32	48
15/32" (1) Side	10d @ 4"	10d @ 12"	3x H.F.	2x H.F.	**428**	16d @ 8"	2	16"	32	48	**599**	SDS @ 6"	1	10"	24	32
15/32" (1) Side	10d @ 3"	10d @ 12"	3x H.F.	2x H.F.	**558**	SDS @ 6"	1	12"	24	32	**781**	SDS @ 6"	2	8"	16	24
Double Sided with 10d Nails																
15/32" (2) Sides	10d @ 6"	10d @ 12"	2x H.F.	2x H.F.	**577**	SDS @ 6"	1	12"	24	32	**807**	SDS @ 6"	2	8	16	24
15/32" (2) Sides	10d @ 4"	10d @ 12"	3x H.F.	3x H.F.	**856**	SDS @ 6"	2	8"	24	32	**1198**	SDS @ 6"	2	5	16	16
15/32" (2) Sides	10d @ 3"	10d @ 12"	3x H.F.	3x H.F.	**1116**	SDS @ 6"	2	6"	16	24	**1562**	SDS @ 6"	2	4	12	16

NOTES:

1. DESIGN AND CONSTRUCTION OF SHEAR WALLS PER **2018 IBC & 2018 SDPWS**
2. CAPACITIES BASED ON SDPWS TABLE 4.3A.
3. 3x OR (2) 2x MEMBERS ARE REQUIRED AT ABUTTING PANEL EDGES WHERE SEISMIC LOAD EXCEEDS 350 PLF/SIDE. (SDPWS 4.3.7.1.5c)
4. 3x OR (2) 2x MEMBERS ARE REQUIRED WHERE NAILING IS LESS THAN 6" FROM BOTH SIDES INTO COMMON MEMBER. (NOTE 6 OF SDPWS TABLE 4.3A)
5. SHEAR WALLS ARE BLOCKED AT ALL PANEL EDGES
6. STAGGER SOLE NAIL ROWS 1/2"
7. SDS SCREWS ARE 1/4"x4 1/2" MINIMUM (ASD CAPACITY 350# DF/ 250# HF). 16d COMMON NAILS ARE 0.148"x3.5" (ASD CAPACITY 100# DF/86# HF).
8. FRAMING CLIPS ARE SIMPSON A35 OR LTP5. (ASD CAPACITY A35-670#DF/575#HF LTP5-620#DF/535# HF). CONSIDER CLIP LENGTH & OPTIONS AT TIGHT SPACING.
9. SDPWS 4.3.6.4.3 - SILL PLATE WITH 0.229x3"x3" PLATE WASHER ON AB's 1/2" MAX FROM SHEATHED EDGE. PCS STANDARD USES SIMPSON SLOTTED WASHER.
10. ANCHOR BOLTS BASED ON NDS TABLE 12E. 5/8" ASD CAPACITY 930# 2xDF/1180# 3xDF/860# 2xHF/1070#3xHF. 3/4" ASD CAPACITY 1270#/1540#/1200#/1400#.
11. REQUIRES 3x or (2) 2x RIMBOARD AND/OR BLOCKING - DISCUSS WITH PM.

GRAVITY

GENERAL FLOOR PLAN NOTES



1 LEVEL 1 FLOOR PLAN
A111 1/8" = 1'-0"

MILLER HULL
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71 Columbia, Sixth Floor
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PCS Structural Solutions

STAMP

NOT FOR CONSTRUCTION

MERCER ISLAND HOUSE

6838 96TH AVE SE
MERCER ISLAND, WA 98040

SUBMITTAL

100% SCHEMATIC DESIGN

MAY 21, 2021

REVISIONS

No.	Description	Date

Drawn: Author
Checked: Checker
M|H Proj No.: A20.0085.00

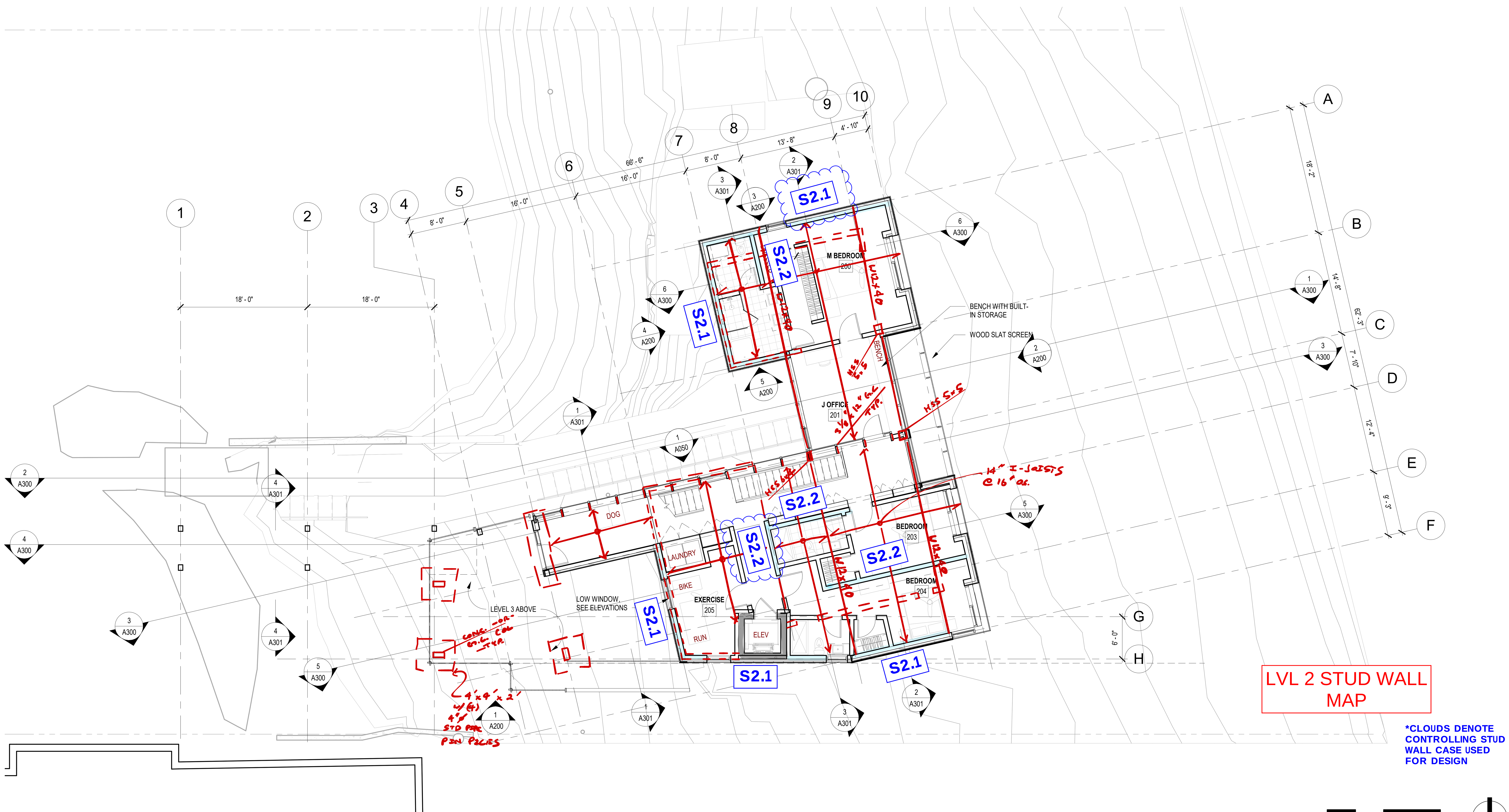
Issue Date: MAY 21, 2021

SHEET

LEVEL 1 - FLOOR PLAN

S111

GENERAL FLOOR PLAN NOTES



1 A121 **LEVEL 2 FLOOR PLAN**
1/8" = 1'-0"

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Drawn: Author
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M|H Proj No.: A20.0085.00
Issue Date: MAY 21, 2021

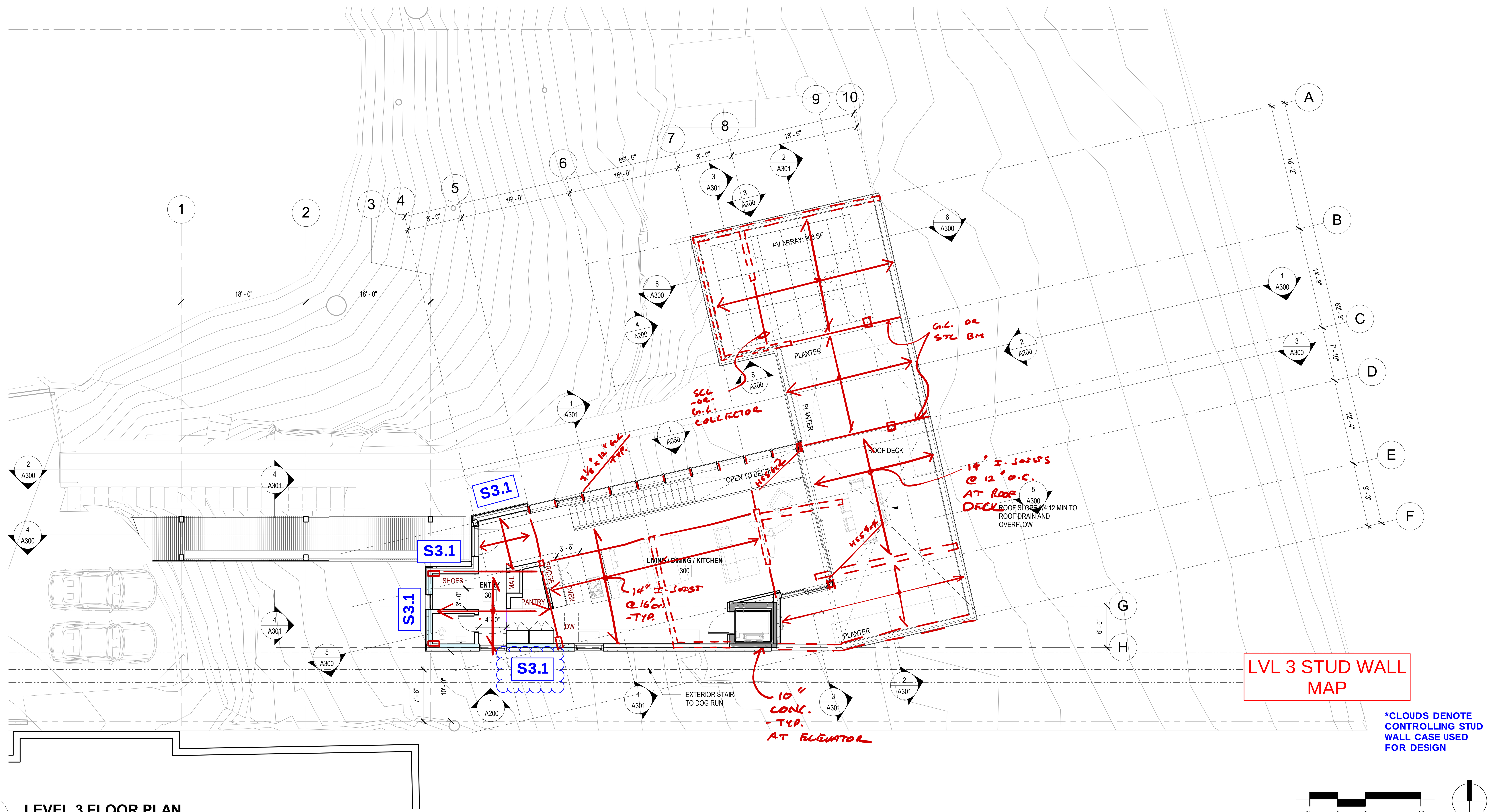
SHEET

LEVEL 2 - FLOOR PLAN

S121

AREA SCHEDULE (GSF)	
Name	Area
LEVEL 1 / OFFICE	343.00 SF
LEVEL 1	867.35 SF
LEVEL 2	2097.90 SF
LEVEL 3	1130.79 SF
GARAGE	572.78 SF
	5011.81 SF

GENERAL FLOOR PLAN NOTES



1 LEVEL 3 FLOOR PLAN

A131

1/8" = 1'-0"

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Issue Date: MAY 21, 2021

SHEET

LEVEL 3 - FLOOR PLAN

S131

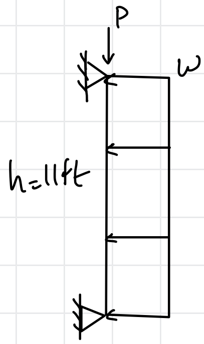
PCS Structural Solutions

Project: Mercer Island Residence | Job No: 21-201
Subject: Gravity | Sheet: Stud Walls | Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland | Date: 6-10-21

Stud Walls

*SEE SPREADSHEETS FOR CALCS

S3.1



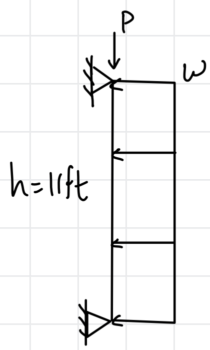
W = 34.5 PSF

P_D = 1140 lb

P_S = **1210 lb**

USE 2x6 @ 16" O.C.

S2.1



W = 34.5 PSF

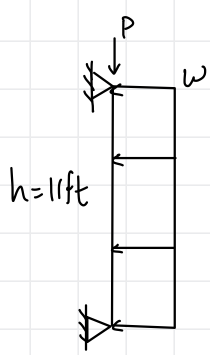
P_D = 705 lb

P_L = 485 lb

USE 2x6 @ 16" O.C.

P_S = 230 lb

S2.2



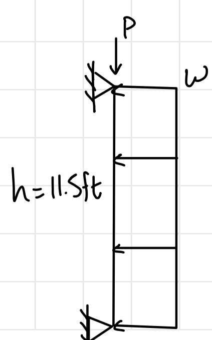
W = 5 PSF

P_D = 230 lb

P_S = 460 lb

USE 2x6 @ 16" O.C.

S1.1



W = 5 PSF

USE 2x6 @ 16" O.C.

P_D = 230 lb + 320 lb = 660 lb
+ 11ft (10 psf)

P_L = 460 lb + 640 lb = 1100 lb

Project: MERCER ISLAND RESIDENCE | Job Number: 21-201
Sheet: ____ of ____ | Name: BRT
PCS Structural Solutions | Originating Office: Tacoma | Date: 11/18/21

STUD WALL DESIGN - S3.1

2018 NDS/2018 IBC

WALL DATA

LUMBER TYPE: DF#2/HF#1

F_b =	900	PSI	
F_c =	1350	PSI	
$F_{c\perp}$ =	405	PSI	
E =	1.50E+06	PSI	

APPLIED LOADS:

W_{WIND} =	34.5 PSF	P_{DEAD} =	1210	LBS
$W_{SEISMIC}$ =	0.0 PSF	P_{LIVE} =	0	LBS
		P_{SNOW} =	1140	LBS
		P_{WIND} =	0	LBS
		$P_{SEISMIC}$ =	0	LBS

STUD SIZE: (1) 2x6

A_X =	8.25	IN^2	
S_X =	7.56	IN^3	
I_X =	20.80	IN^4	
$C_{F(BENDING)}$ =	1.3		(NDS 4.3.6)
F_{cE} =	781.3	PSI	
C_b =	1.25		(NDS 3.10.4)

MISCELLANEOUS:

HEIGHT =	11	FT		
SPACING =	16	IN		
ECCENTRICITY =	0.1	IN		
$C_{F(COMPRESSION)}$ =	1.10		(NDS 4.3.6)	
		APPLY?		
$C_{SYS(BENDING)}$ =	1.35	YES	(SDPWS T3.1.1.1)	
$C_{r(BENDING)}$ =	1.15	YES	(NDS 4.3.9)	

LOAD CASES - IBC 1605.3.1

CASE 1	DEAD + LIVE + 5 PSF LAT.	CASE 4	DEAD + 0.45WIND + 0.75LIVE + 0.75SNOW
CASE 2	DEAD + SNOW + 5 PSF LAT.	CASE 5	DEAD + 0.60WIND
CASE 3	DEAD + 0.75LIVE + 0.75SNOW + 5 PSF LAT.	CASE 6	DEAD + 0.75SEISMIC
		CASE 7	DEAD + 0.53SEISMIC + 0.75LIVE + 0.75SNOW

ALLOWABLE STRESSES - Cd PER NDS T2.3.2, Cp PER NDS 3.7.1, ASSUME Cm, Ct, Ci, CL = 1.0

CASE	C_D	F_c^*	F_{cE}/F_c^*	C_P	F_c'	F_b'	$F_{c\perp}$
1	1.00	1485	0.53	0.452	671	1346	506
2 & 3	1.15	1708	0.46	0.403	688	1547	506
4 & 5	1.60	2376	0.33	0.303	719	2527	506
6 & 7	1.60	2376	0.33	0.303	719	2153	506

APPLIED STRESSES - NDS CHAPTER 3 DESIGN EQUATIONS

CASE	$P_{APPLIED}$	f_c	$M_{LAT. LOAD}$	$M_{ECC.}$	M_{TOTAL}	f_b
1	1210	147	101	10	107	170
2	2350	285	101	20	113	179
3	2065	250	101	17	112	177
4	2065	250	313	17	324	514
5	1210	147	417	10	424	672
6	1210	147	0	10	6	10
7	2065	250	0	17	11	17

DESIGN CHECKS - COMBINED STRESS CHECK PER NDS EQN 3.9-3

CASE	f_c/F_c'	f_b/F_b'	$f_c/F_{c\perp}$	Combined	f_c/F_{cE}	Deflection	L/?
1	0.22	0.13	0.29	0.20	0.19	0.07	L/1765
2	0.41	0.12	0.56	0.35	0.36	0.08	L/1672
3	0.36	0.11	0.49	0.30	0.32	0.08	L/1694
4*	0.35	0.20	0.49	0.42	0.32	0.12	L/1126
5*	0.20	0.27	0.29	0.37	0.19	0.15	L/860
6	0.20	0.00	0.29	0.05	0.19	0.00	L/30000
7	0.35	0.01	0.49	0.13	0.32	0.01	L/17579
MAX. --->	0.41	0.27	0.56	0.42	0.36	0.15	L/860
	O.K.	O.K.	O.K.	O.K.	O.K.		

* Deflections reduced by 0.42 per IBC Table 1604.3 footnote f. Increase deflection by 1.4 for jambs supporting glass.

PLATE BENDING - *ALIGN STUDS WITH JOISTS WHERE POSSIBLE*

MISCELLANEOUS:

C_{Fu} =	1.15		(NDS 4.3.7)
F_V =	150	PSI	

ALLOWABLE STRESSES:

F_V' =	173	PSI
F_b' =	1547	PSI

STUD REACTIONS (OUT - OF - PLANE)

253 LB

DBL TOP PLATE PROPERTIES:

A_X =	16.50	IN^2
S_X =	4.13	IN^3
I_X =	3.09	IN^4

APPLIED STRESSES:

f_v =	142	PSI	<--- O.K.
f_b =	2279	PSI	<--- N.G.
Δ_{MAX} =	0.043	IN	

ok b/c jst is aligned w/ stud

Project:	MERCER ISLAND RESIDENCE	Job Number:	21-201
Sheet:	of	Name:	BRT
Originating Office:	Tacoma	Date:	08/19/21

PCS Structural Solutions

STUD WALL DESIGN - S2.1

2018 NDS/2018 IBC

WALL DATA

LUMBER TYPE:	DF#2/HF#1		APPLIED LOADS:				
F_b =	900 PSI		W_{WIND} =	34.5 PSF	P_{DEAD} =	705	LBS
F_c =	1350 PSI		$W_{SEISMIC}$ =	0.0 PSF	P_{LIVE} =	485	LBS
$F_{c\perp}$ =	405 PSI				P_{SNOW} =	230	LBS
E =	1.50E+06 PSI				P_{WIND} =	0	LBS
					$P_{SEISMIC}$ =	0	LBS

STUD SIZE:	(1) 2x6	MISCELLANEOUS:			
A_X =	8.25 IN^2	HEIGHT =	11 FT		
S_X =	7.56 IN^3	SPACING =	16 IN		
I_X =	20.80 IN^4	ECCENTRICITY =	0.1 IN		
$C_{F(BENDING)}$ =	1.3 (NDS 4.3.6)	$C_{F(COMPRESSION)}$ =	1.10		(NDS 4.3.6)
				APPLY?	
F_{cE} =	781.3 PSI	$C_{SYS(BENDING)}$ =	1.35	YES	(SDPWS T3.1.1.1)
C_b =	1.25 (NDS 3.10.4)	$C_{r(BENDING)}$ =	1.15	YES	(NDS 4.3.9)

LOAD CASES - IBC 1605.3.1

CASE 1	DEAD + LIVE + 5 PSF LAT.	CASE 4	DEAD + 0.45WIND + 0.75LIVE + 0.75SNOW
CASE 2	DEAD + SNOW + 5 PSF LAT.	CASE 5	DEAD + 0.60WIND
CASE 3	DEAD + 0.75LIVE + 0.75SNOW + 5 PSF LAT.	CASE 6	DEAD + 0.75EISMIC
		CASE 7	DEAD + 0.53SEISMIC + 0.75LIVE + 0.75SNOW

ALLOWABLE STRESSES - Cd PER NDS T2.3.2, Cp PER NDS 3.7.1, ASSUME Cm, Ct, Ci, CL = 1.0

CASE	C_D	F_c*	F_{cE}/F_c*	C_P	F_c'	F_b'	$F_{c\perp}$
1	1.00	1485	0.53	0.452	671	1346	506
2 & 3	1.15	1708	0.46	0.403	688	1547	506
4 & 5	1.60	2376	0.33	0.303	719	2527	506
6 & 7	1.60	2376	0.33	0.303	719	2153	506

APPLIED STRESSES - NDS CHAPTER 3 DESIGN EQUATIONS

CASE	$P_{APPLIED}$	f_c	$M_{LAT. LOAD}$	$M_{ECC.}$	M_{TOTAL}	f_b
1	1190	144	101	10	107	170
2	935	113	101	8	106	168
3	1241	150	101	10	107	170
4	1241	150	313	10	320	507
5	705	85	417	6	421	668
6	705	85	0	6	4	6
7	1241	150	0	10	6	10

DESIGN CHECKS - COMBINED STRESS CHECK PER NDS EQN 3.9-3

CASE	f_c/F_c'	f_b/F_b'	$f_c/F_{c\perp}$	Combined	f_c/F_{cE}	Deflection	L/?
1	0.22	0.13	0.28	0.20	0.18	0.07	L/1766
2	0.16	0.11	0.22	0.15	0.15	0.07	L/1789
3	0.22	0.11	0.30	0.18	0.19	0.07	L/1762
4*	0.21	0.20	0.30	0.29	0.19	0.12	L/1141
5*	0.12	0.26	0.17	0.31	0.11	0.15	L/866
6	0.12	0.00	0.17	0.02	0.11	0.00	L/51489
7	0.21	0.00	0.30	0.05	0.19	0.00	L/29245
MAX. --->	0.22	0.26	0.30	0.31	0.19	0.15	L/866
	O.K.	O.K.	O.K.	O.K.	O.K.		

* Deflections reduced by 0.42 per IBC Table 1604.3 footnote f. Increase deflection by 1.4 for jambs supporting glass.

PLATE BENDING - *ALIGN STUDS WITH JOISTS WHERE POSSIBLE*

MISCELLANEOUS:		ALLOWABLE STRESSES:		STUD REACTIONS (OUT - OF - PLANE)
C_{fu} =	1.15 (NDS 4.3.7)	F_v' =	173 PSI	
F_v =	150 PSI	F_b' =	1547 PSI	253 LB

DBL TOP PLATE PROPERTIES:		APPLIED STRESSES:		
A_X =	16.50 IN^2	f_v =	57 PSI	<--- O.K.
S_X =	4.13 IN^3	f_b =	907 PSI	<--- O.K.
I_X =	3.09 IN^4	Δ_{MAX} =	0.017 IN	

Project: MERCER ISLAND RESIDENCE Job Number: 21-201

Sheet: ____ of ____ Name: BRT

PCS Structural Solutions Originating Office: Tacoma Date: 08/19/21

STUD WALL DESIGN - S2.2

2018 NDS/2018 IBC

WALL DATA

LUMBER TYPE: DF#2/HF#1

F_b = 900 PSI
F_c = 1350 PSI
$F_{c\perp}$ = 405 PSI
E = 1.50E+06 PSI

APPLIED LOADS:

W_{WIND} = 5.0 PSF
$W_{SEISMIC}$ = 0.0 PSF

P_{DEAD} = 230 LBS
P_{LIVE} = 460 LBS
P_{SNOW} = 0 LBS
P_{WIND} = 0 LBS
$P_{SEISMIC}$ = 0 LBS

STUD SIZE: (1) 2x6

A_X = 8.25 IN^2
S_X = 7.56 IN^3
I_X = 20.80 IN^4
$C_{F(BENDING)}$ = 1.3 (NDS 4.3.6)
F_{cE} = 781.3 PSI
C_b = 1.25 (NDS 3.10.4)

MISCELLANEOUS:

HEIGHT = 11 FT
SPACING = 16 IN
ECCENTRICITY = 0.1 IN
$C_{F(COMPRESSION)}$ = 1.10 (NDS 4.3.6)

		APPLY?	
$C_{SYS(BENDING)}$ =	1.35	YES	(SDPWS T3.1.1.1)
$C_{r(BENDING)}$ =	1.15	YES	(NDS 4.3.9)

LOAD CASES - IBC 1605.3.1

CASE 1	DEAD + LIVE + 5 PSF LAT.	CASE 4	DEAD + 0.45WIND + 0.75LIVE + 0.75SNOW
CASE 2	DEAD + SNOW + 5 PSF LAT.	CASE 5	DEAD + 0.60WIND
CASE 3	DEAD + 0.75LIVE + 0.75SNOW + 5 PSF LAT.	CASE 6	DEAD + 0.75EISMIC
		CASE 7	DEAD + 0.53SEISMIC + 0.75LIVE + 0.75SNOW

ALLOWABLE STRESSES - Cd PER NDS T2.3.2, Cp PER NDS 3.7.1, ASSUME Cm, Ct, Ci, CL = 1.0

CASE	C_D	F_c*	F_{cE}/F_c*	C_P	F_c'	F_b'	$F_{c\perp}$
1	1.00	1485	0.53	0.452	671	1346	506
2 & 3	1.15	1708	0.46	0.403	688	1547	506
4 & 5	1.60	2376	0.33	0.303	719	2527	506
6 & 7	1.60	2376	0.33	0.303	719	2153	506

APPLIED STRESSES - NDS CHAPTER 3 DESIGN EQUATIONS

CASE	$P_{APPLIED}$	f_c	$M_{LAT.\ LOAD}$	$M_{ECC.}$	M_{TOTAL}	f_b
1	690	84	101	6	104	166
2	230	28	101	2	102	162
3	575	70	101	5	104	165
4	575	70	45	5	48	77
5	230	28	61	2	62	98
6	230	28	0	2	1	2
7	575	70	0	5	3	5

DESIGN CHECKS - COMBINED STRESS CHECK PER NDS EQN 3.9-3

CASE	f_c/F_c'	f_b/F_b'	$f_c/F_{c\perp}$	Combined	f_c/F_{cE}	Deflection	L/?
1	0.12	0.12	0.17	0.15	0.11	0.07	L/1810
2	0.04	0.10	0.06	0.11	0.04	0.07	L/1853
3	0.10	0.11	0.14	0.13	0.09	0.07	L/1821
4*	0.10	0.03	0.14	0.04	0.09	0.02	L/7538
5*	0.04	0.04	0.06	0.04	0.04	0.02	L/5910
6	0.04	0.00	0.06	0.00	0.04	0.00	L/157826
7	0.10	0.00	0.14	0.01	0.09	0.00	L/63130
MAX. --->	0.12	0.12	0.17	0.15	0.11	0.07	L/1810
	O.K.	O.K.	O.K.	O.K.	O.K.		

* Deflections reduced by 0.42 per IBC Table 1604.3 footnote f. Increase deflection by 1.4 for jambs supporting glass.

PLATE BENDING - *ALIGN STUDS WITH JOISTS WHERE POSSIBLE*

MISCELLANEOUS:

C_{Fu} = 1.15 (NDS 4.3.7)
F_V = 150 PSI

ALLOWABLE STRESSES:

F_V' = 150 PSI
F_b' = 1346 PSI

STUD REACTIONS (OUT - OF - PLANE)
37 LB

DBL TOP PLATE PROPERTIES:

A_X = 16.50 IN^2
S_X = 4.13 IN^3
I_X = 3.09 IN^4

APPLIED STRESSES:

f_v = 14 PSI <--- O.K.
f_b = 223 PSI <--- O.K.
Δ_{MAX} = 0.004 IN

PCS Structural Solutions

Project: MERCER ISLAND RESIDENCE — Job Number: 21-201

Sheet: ____ of ____ — Name: BRT

Originating Office: Tacoma — Date: 08/19/21

STUD WALL DESIGN - S1.1

2018 NDS/2018 IBC

WALL DATA

LUMBER TYPE: DF#2/HF#1

F_b =	900 PSI	W_{WIND} =	5.0 PSF	P_{DEAD} =	660 LBS
F_c =	1350 PSI	$W_{SEISMIC}$ =	0.0 PSF	P_{LIVE} =	1100 LBS
$F_{c\perp}$ =	405 PSI			P_{SNOW} =	0 LBS
E =	1.50E+06 PSI			P_{WIND} =	0 LBS
				$P_{SEISMIC}$ =	0 LBS

APPLIED LOADS: (above)

STUD SIZE: (1) 2x6

MISCELLANEOUS:

A_X =	8.25 IN^2	HEIGHT =	11.5 FT	
S_X =	7.56 IN^3	SPACING =	16 IN	
I_X =	20.80 IN^4	ECCENTRICITY =	0.1 IN	
$C_{F(BENDING)}$ =	1.3 (NDS 4.3.6)	$C_{F(COMPRESSION)}$ =	1.10 (NDS 4.3.6)	
				APPLY?
F_{cE} =	714.8 PSI	$C_{SYS(BENDING)}$ =	1.35	YES (SDPWS T3.1.1.1)
C_b =	1.25 (NDS 3.10.4)	$C_{r(BENDING)}$ =	1.15	YES (NDS 4.3.9)

LOAD CASES - IBC 1605.3.1

CASE 1	DEAD + LIVE + 5 PSF LAT.
CASE 2	DEAD + SNOW + 5 PSF LAT.
CASE 3	DEAD + 0.75LIVE + 0.75SNOW + 5 PSF LAT.
CASE 4	DEAD + 0.45WIND + 0.75LIVE + 0.75SNOW
CASE 5	DEAD + 0.60WIND
CASE 6	DEAD + 0.7SEISMIC
CASE 7	DEAD + 0.53SEISMIC + 0.75LIVE + 0.75SNOW

ALLOWABLE STRESSES - Cd PER NDS T2.3.2, Cp PER NDS 3.7.1, ASSUME Cm, Ct, Ci, CL = 1.0

CASE	C_D	F_c*	F_{cE}/F_c*	C_P	F_c'	F_b'	$F_{c\perp}$
1	1.00	1485	0.48	0.420	624	1346	506
2 & 3	1.15	1708	0.42	0.374	639	1547	506
4 & 5	1.60	2376	0.30	0.279	663	2527	506
6 & 7	1.60	2376	0.30	0.279	663	2153	506

APPLIED STRESSES - NDS CHAPTER 3 DESIGN EQUATIONS

CASE	$P_{APPLIED}$	f_c	$M_{LAT. LOAD}$	$M_{ECC.}$	M_{TOTAL}	f_b
1	1760	213	110	15	119	189
2	660	80	110	6	114	180
3	1485	180	110	12	118	187
4	1485	180	50	12	57	91
5	660	80	66	6	70	110
6	660	80	0	6	3	5
7	1485	180	0	12	8	12

DESIGN CHECKS - COMBINED STRESS CHECK PER NDS EQN 3.9-3

CASE	f_c/F_c'	f_b/F_b'	$f_c/F_{c\perp}$	Combined	f_c/F_{cE}	Deflection	L/?
1	0.34	0.14	0.42	0.32	0.30	0.09	L/1515
2	0.13	0.12	0.16	0.15	0.11	0.09	L/1591
3	0.28	0.12	0.36	0.24	0.25	0.09	L/1533
4*	0.27	0.04	0.36	0.12	0.25	0.02	L/6084
5*	0.12	0.04	0.16	0.06	0.11	0.03	L/5014
6	0.12	0.00	0.16	0.02	0.11	0.00	L/52609
7	0.27	0.01	0.36	0.08	0.25	0.01	L/23382
MAX. --->	0.34	0.14	0.42	0.32	0.30	0.09	L/1515
	O.K.	O.K.	O.K.	O.K.	O.K.		

* Deflections reduced by 0.42 per IBC Table 1604.3 footnote f. Increase deflection by 1.4 for jambs supporting glass.

PLATE BENDING - *ALIGN STUDS WITH JOISTS WHERE POSSIBLE*

MISCELLANEOUS:

C_{fu} = 1.15 (NDS 4.3.7)

F_V = 150 PSI

ALLOWABLE STRESSES:

F_V' = 150 PSI

F_b' = 1346 PSI

STUD REACTIONS (OUT - OF - PLANE): 38 LB

DBL TOP PLATE PROPERTIES:

A_X = 16.50 IN^2

S_X = 4.13 IN^3

I_X = 3.09 IN^4

APPLIED STRESSES:

f_v = 40 PSI <--- O.K.

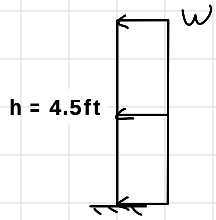
f_b = 640 PSI <--- O.K.

Δ_{MAX} = 0.012 IN

Project: MERCER ISLAND RESIDENCE | Job No: 21-201
Subject: PARAPETS | Sheet
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland | Name: BRT | Date: 10-25-21

PARAPETS

STEEL TUBE -

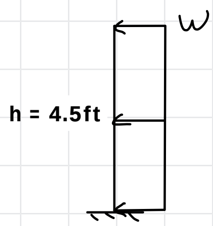


W = 27.1 psf − (−36.2 psf) = 63.3 psf

TRIB WIDTH = 4 psf

$\boxed{\text{USE HSS } 4\times2\times\frac{1}{4}}$

STEEL CHNL -

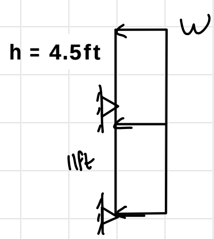


W = 27.1 psf − (−36.2 psf) = 63.3 psf

TRIB WIDTH = 4 psf

$\boxed{\text{USE C}4\times5.4}$

FULL-HT STEEL CHNL. -



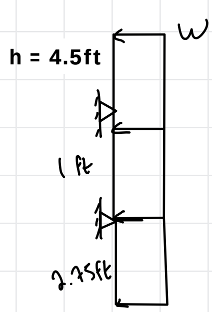
NOT A SOLID WALL

W = 25 psf − (−32.2 psf) = 57.2 psf / 2 = 28.6 psf

TRIB WIDTH = 4 psf

$\boxed{\text{USE C}4\times5.4}$

WINDOW STEEL CHNL. -



NOT A SOLID WALL

W = 25 psf − (−32.2 psf) = 57.2 psf / 2 = 28.6 psf

TRIB WIDTH = 4 psf

$\boxed{\text{USE C}4\times5.4}$

Steel Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.22.1.12 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

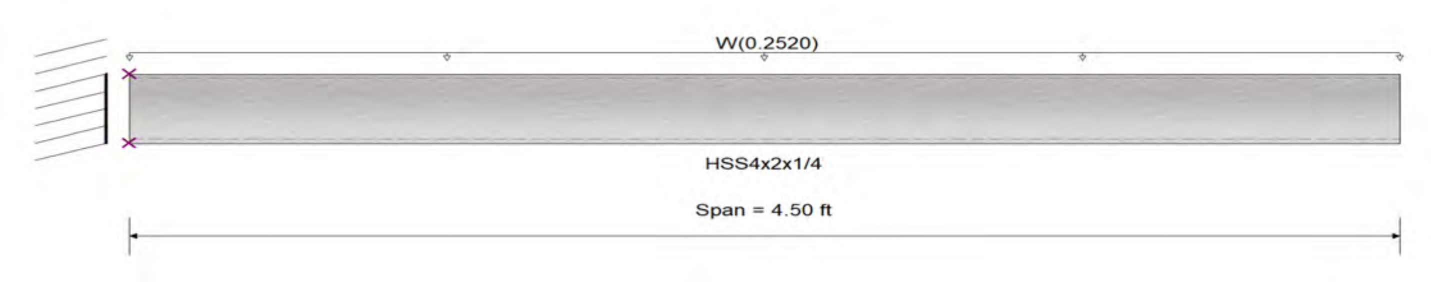
DESCRIPTION: Parapet - steel TUBE

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	36.0 ksi
Beam Bracing :	Completely Unbraced	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

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

Beam self weight NOT internally calculated and added
Uniform Load : W = 0.0630 ksf, Tributary Width = 4.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.321** : 1	Maximum Shear Stress Ratio =	**0.038** : 1
Section used for this span	**HSS4x2x1/4**	Section used for this span	**HSS4x2x1/4**
Mu : Applied	2.552 k-ft	Vu : Applied	1.134 k
Mn * Phi : Allowable	7.938 k-ft	Vn * Phi : Allowable	29.904 k
Load Combination	W Only	Load Combination	W Only
		Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.072 in	Ratio =	1,502	>=360	
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360	Span: 1 : +0.420W
Max Downward Total Deflection	0.043 in	Ratio =	2505	>=240.	Span: 1 : +0.2520W
Max Upward Total Deflection	0.000 in	Ratio =	0	<240.0	

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	Summary of Moment Values max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	Summary of Shear Values VuMax	Vnx	Phi*Vnx
Dsgn. L = 4.50 ft	1		0.000				8.82	7.94	1.00	1.00	-0.00	33.23	29.90
+0.50W													
Dsgn. L = 4.50 ft	1	0.161	0.019		-1.28	1.28	8.82	7.94	1.00	1.00	0.57	33.23	29.90
W Only													
Dsgn. L = 4.50 ft	1	0.321	0.038		-2.55	2.55	8.82	7.94	1.00	1.00	1.13	33.23	29.90

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+0.420W	1	0.0719	4.500		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.134	
Overall MINimum	0.510	
+0.60W	0.680	
+0.450W	0.510	
W Only	1.134	

Steel Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.22.1.12 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

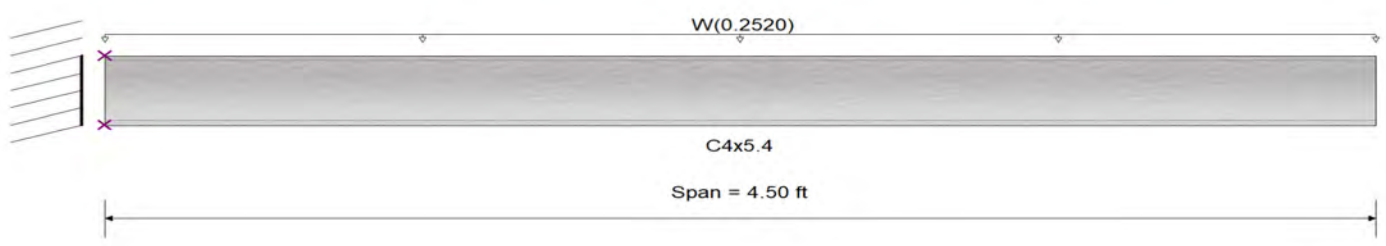
DESCRIPTION: Parapet - steel CHANNEL CANT.

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	36.0 ksi
Beam Bracing :	Completely Unbraced	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

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

Beam self weight NOT internally calculated and added
Uniform Load : W = 0.0630 ksf, Tributary Width = 4.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.471** : 1	Maximum Shear Stress Ratio =	**0.079** : 1
Section used for this span	**C4x5.4**	Section used for this span	**C4x5.4**
Mu : Applied	2.552 k-ft	Vu : Applied	1.134 k
Mn * Phi : Allowable	5.415 k-ft	Vn * Phi : Allowable	14.308 k
Load Combination	W Only	Load Combination	W Only
		Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.200 in	Ratio =	541	>=360	
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360	Span: 1 : W Only
Max Downward Total Deflection	0.120 in	Ratio =	902	>=240.	Span: 1 : +0.60W
Max Upward Total Deflection	0.000 in	Ratio =	0	<240.0	

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	VuMax	Vnx	Phi*Vnx
Dsgn. L = 4.50 ft	1		0.000				6.02	5.42	1.00	1.00	-0.00	15.90	14.31
+0.50W													
Dsgn. L = 4.50 ft	1	0.236	0.040		-1.28	1.28	6.02	5.42	1.00	1.00	0.57	15.90	14.31
W Only													
Dsgn. L = 4.50 ft	1	0.471	0.079		-2.55	2.55	6.02	5.42	1.00	1.00	1.13	15.90	14.31

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
W Only	1	0.1995	4.500		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.134	
Overall MINimum	0.510	
+0.60W	0.680	
+0.450W	0.510	
W Only	1.134	

Steel Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.22.1.12   PCS STRUCTURAL SOLUTIONS   (c) ENERCALC INC 1983-2021

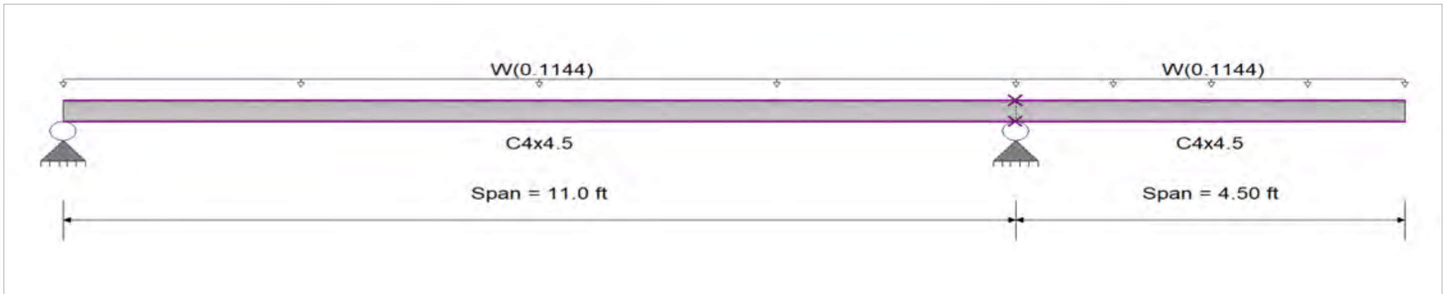
DESCRIPTION: Parapet - channel - full ht

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	36.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

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

Beam self weight NOT internally calculated and added
Load for Span Number 1
Uniform Load : W = 0.02860 ksf, Tributary Width = 4.0 ft

Load for Span Number 2
Uniform Load : W = 0.02860 ksf, Tributary Width = 4.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.210** : 1	Maximum Shear Stress Ratio =	**0.076** : 1
Section used for this span	**C4x4.5**	Section used for this span	**C4x4.5**
Mu : Applied	1.200 k-ft	Vu : Applied	0.7345 k
Mn * Phi : Allowable	5.724 k-ft	Vn * Phi : Allowable	9.720 k
Load Combination	W Only	Load Combination	W Only
		Location of maximum on span	11.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.091 in	Ratio =	1,451	>=360	Span: 2 : +0.420W
Max Upward Transient Deflection	-0.025 in	Ratio =	4,387	>=360	Span: 2 : +0.420W
Max Downward Total Deflection	0.055 in	Ratio =	2419	>=240.	Span: 2 : +0.2520W
Max Upward Total Deflection	-0.015 in	Ratio =	7313	>=240.	Span: 2 : +0.2520W

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	VuMax	Vnx	Phi*Vnx
Dsgn. L = 11.00 ft	1		0.000				6.36	5.72	1.00	1.00	-0.00	10.80	9.72
Dsgn. L = 4.50 ft	2		0.000				6.36	5.72	1.00	1.00	-0.00	10.80	9.72
+0.50W													
Dsgn. L = 11.00 ft	1	0.105	0.038	0.60	-0.58	0.60	6.36	5.72	1.00	1.00	0.37	10.80	9.72
Dsgn. L = 4.50 ft	2	0.101	0.026		-0.58	0.58	6.36	5.72	1.00	1.00	0.26	10.80	9.72
W Only													
Dsgn. L = 11.00 ft	1	0.210	0.076	1.20	-1.16	1.20	6.36	5.72	1.00	1.00	0.73	10.80	9.72
Dsgn. L = 4.50 ft	2	0.202	0.053		-1.16	1.16	6.36	5.72	1.00	1.00	0.51	10.80	9.72

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+0.420W	1	0.0909	5.060		0.0000	0.000
	2	0.0000	5.060	+0.420W	-0.0246	4.500

Vertical Reactions

Support notation : Far left is #1   Values in KIPS

Load Combination	Support 1	Support 2	Support 3

Steel Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.22.1.12 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: Parapet - channel - full ht

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MINimum	0.236	0.562	
+0.60W	0.314	0.750	
+0.450W	0.236	0.562	
W Only	0.524	1.249	

Project Title:
Engineer:
Project ID:
Project Descr:

Steel Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.22.1.12 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

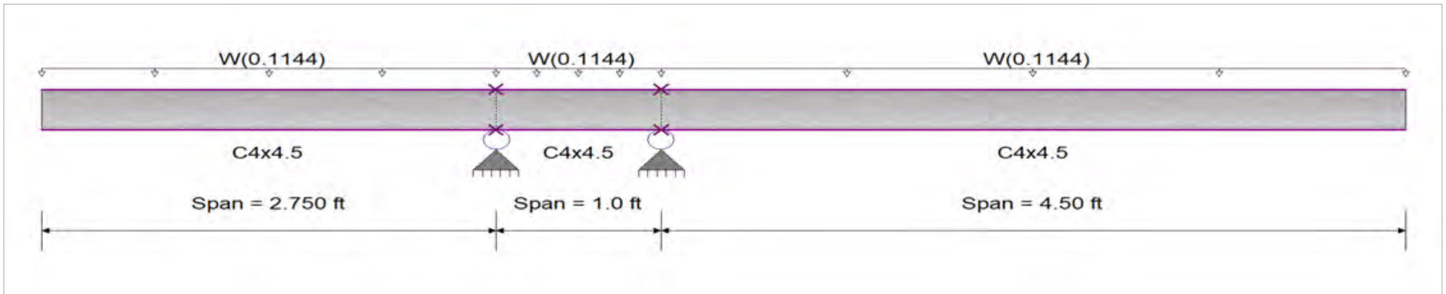
DESCRIPTION: Parapet - channel - window

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	36.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

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

Beam self weight NOT internally calculated and added
Load for Span Number 1
Uniform Load : W = 0.02860 ksf, Tributary Width = 4.0 ft

Load for Span Number 2
Uniform Load : W = 0.02860 ksf, Tributary Width = 4.0 ft

Load for Span Number 3
Uniform Load : W = 0.02860 ksf, Tributary Width = 4.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.202** : 1	Maximum Shear Stress Ratio =	**0.081** : 1
Section used for this span	**C4x4.5**	Section used for this span	**C4x4.5**
Mu : Applied	1.158 k-ft	Vu : Applied	0.7829 k
Mn * Phi : Allowable	5.724 k-ft	Vn * Phi : Allowable	9.720 k
Load Combination	W Only	Load Combination	W Only
		Location of maximum on span	1.000 ft
Span # where maximum occurs	Span # 2	Span # where maximum occurs	Span # 2

Maximum Deflection

Max Downward Transient Deflection	0.054 in	Ratio =	1,999	>=360	Span: 3 : +0.420W
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360	Span: 3 : +0.420W
Max Downward Total Deflection	0.032 in	Ratio =	3332	>=240.	Span: 3 : +0.2520W
Max Upward Total Deflection	-0.000 in	Ratio =	29278	>=240.	Span: 3 : +0.2520W

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	VuMax	Vnx	Phi*Vnx
Dsgn. L = 2.75 ft	1		0.000				6.36	5.72	1.00	1.00	-0.00	10.80	9.72
Dsgn. L = 1.00 ft	2		0.000				6.36	5.72	1.00	1.00	-0.00	10.80	9.72
Dsgn. L = 4.50 ft	3		0.000				6.36	5.72	1.00	1.00	-0.00	10.80	9.72
+0.50W													
Dsgn. L = 2.75 ft	1	0.038	0.034		-0.22	0.22	6.36	5.72	1.00	1.00	0.33	10.80	9.72
Dsgn. L = 1.00 ft	2	0.101	0.040	-0.00	-0.58	0.58	6.36	5.72	1.00	1.00	0.39	10.80	9.72
Dsgn. L = 4.50 ft	3	0.101	0.026		-0.58	0.58	6.36	5.72	1.00	1.00	0.26	10.80	9.72
W Only													
Dsgn. L = 2.75 ft	1	0.076	0.069		-0.43	0.43	6.36	5.72	1.00	1.00	0.67	10.80	9.72
Dsgn. L = 1.00 ft	2	0.202	0.081	-0.00	-1.16	1.16	6.36	5.72	1.00	1.00	0.78	10.80	9.72
Dsgn. L = 4.50 ft	3	0.202	0.053		-1.16	1.16	6.36	5.72	1.00	1.00	0.51	10.80	9.72

Steel Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.22.1.12 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: Parapet - channel - window

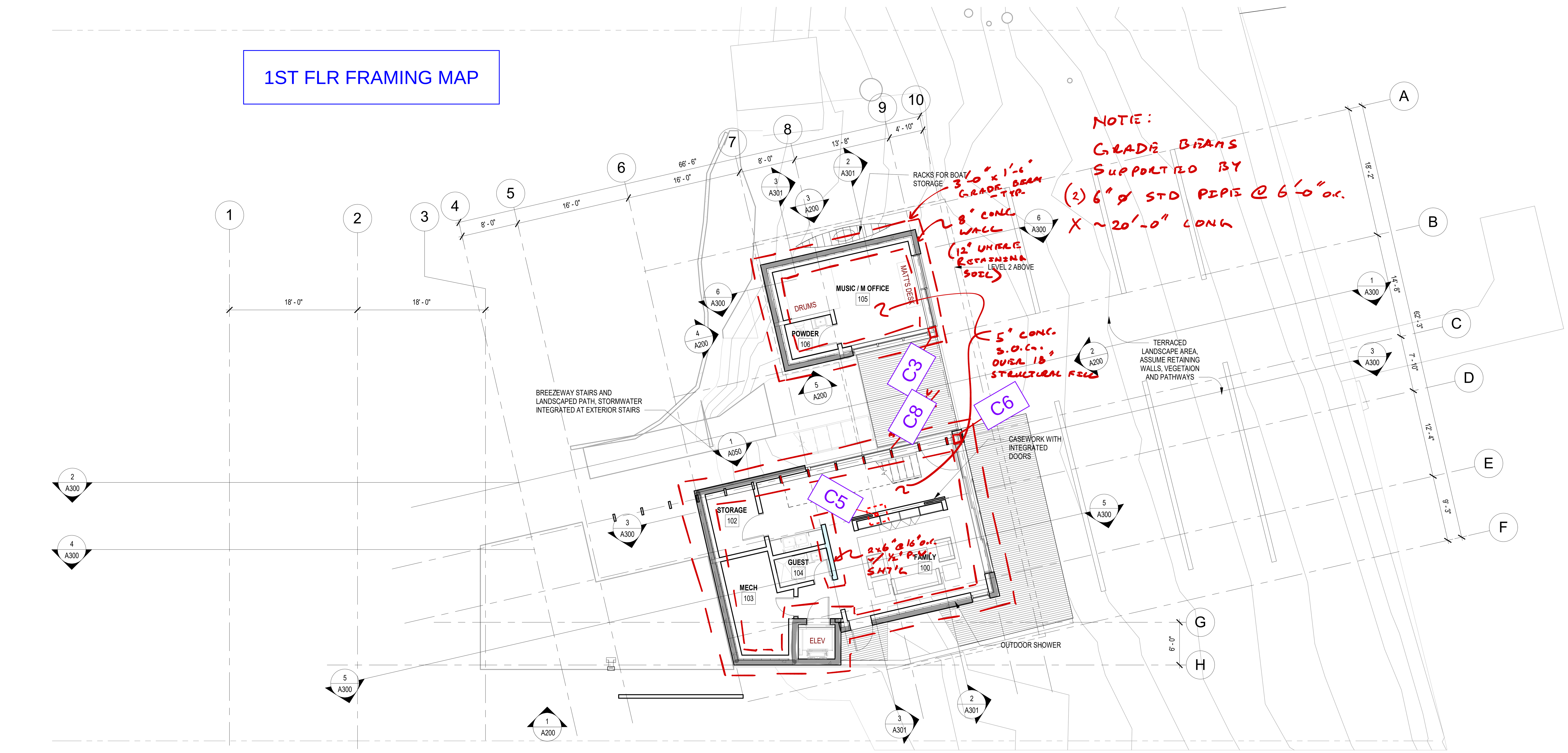
Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+0.420W	1	0.0119	0.000		0.0000	0.000
	2	0.0000	0.000	+0.420W	-0.0007	0.540
+0.420W	3	0.0540	4.500		0.0000	0.540

Vertical Reactions

Support notation : Far left is #´ Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4
Overall MAXimum		-0.354	1.298	
Overall MINimum		-0.159	0.584	
+0.60W		-0.212	0.779	
+0.450W		-0.159	0.584	
W Only		-0.354	1.298	



GENERAL FLOOR PLAN NOTES

1 LEVEL 1 FLOOR PLAN
A111 1/8" = 1'-0"

MILLER HULL
The Miller Hull Partnership, LLP
Architecture and Planning
Polson Building
71 Columbia, Sixth Floor
Seattle, WA 98104
Phone: 206.682.6837
Contact: Name

PCS Structural Solutions

STAMP

NOT FOR CONSTRUCTION

MERCER ISLAND HOUSE

6838 96TH AVE SE
MERCER ISLAND, WA 98040

SUBMITTAL

100% SCHEMATIC DESIGN

MAY 21, 2021

REVISIONS

No.	Description	Date

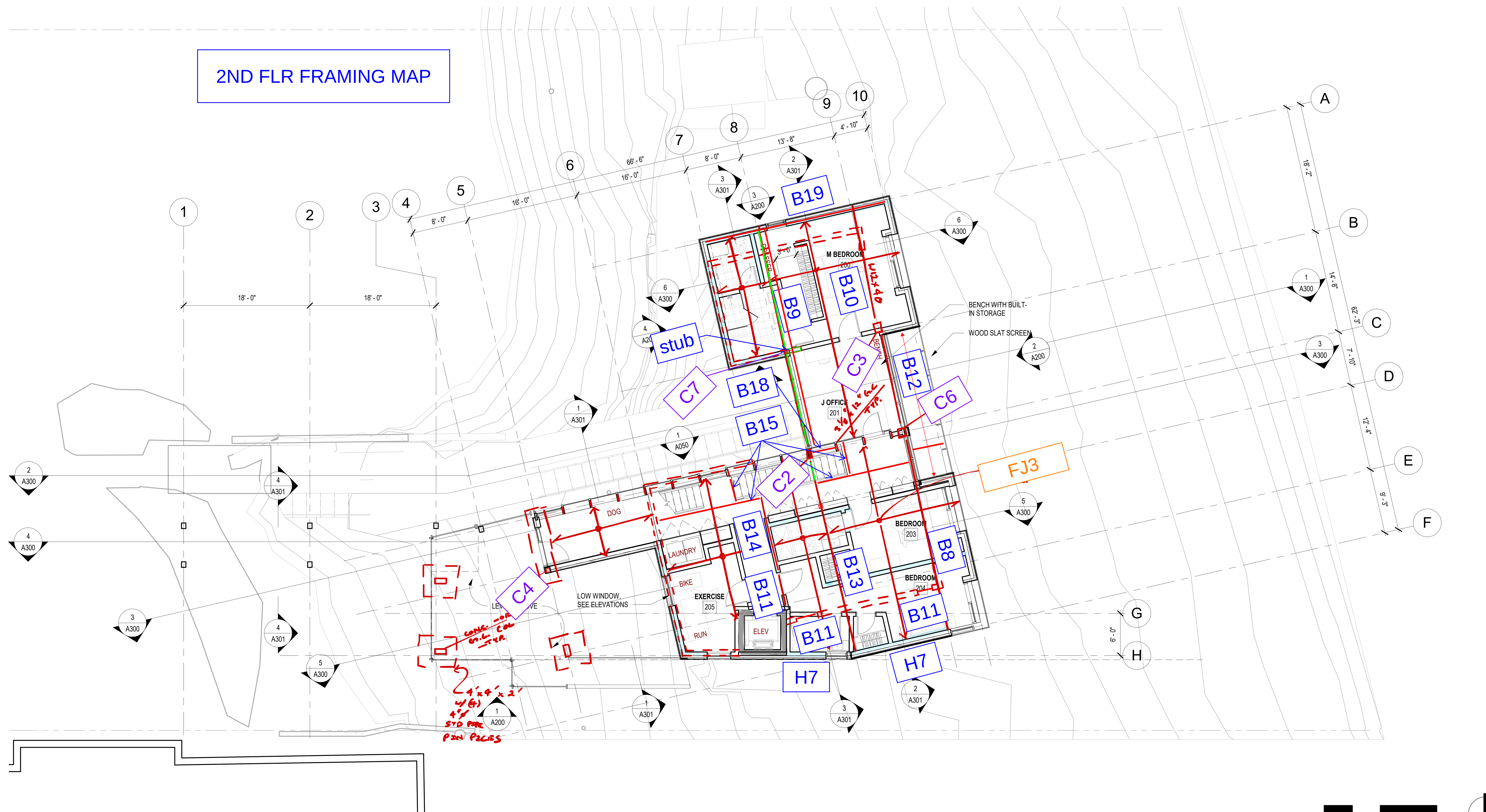
Drawn: Author
Checked: Checker
M|H Proj No.: A20.0085.00
Issue Date: MAY 21, 2021

SHEET

LEVEL 1 - FLOOR PLAN

S111

GENERAL FLOOR PLAN NOTES



1 A121 **LEVEL 2 FLOOR PLAN**
1/8" = 1'-0"

MILLER | HULL
The Miller Hull Partnership, LLP
Architecture and Planning
Polson Building
71 Columbia, Sixth Floor
Seattle, WA 98104

Phone: 206.682.6837
Contact: Name

PCS Structural Solutions

STAMP

NOT FOR CONSTRUCTION

MERCER ISLAND HOUSE

6838 96TH AVE SE
MERCER ISLAND, WA 98040

SUBMITTAL

100% SCHEMATIC DESIGN

MAY 21, 2021

REVISIONS

No.	Description	Date

Drawn: Author
Checked: Checker
M|H Proj No.: A20.0085.00

Issue Date: MAY 21, 2021

SHEET

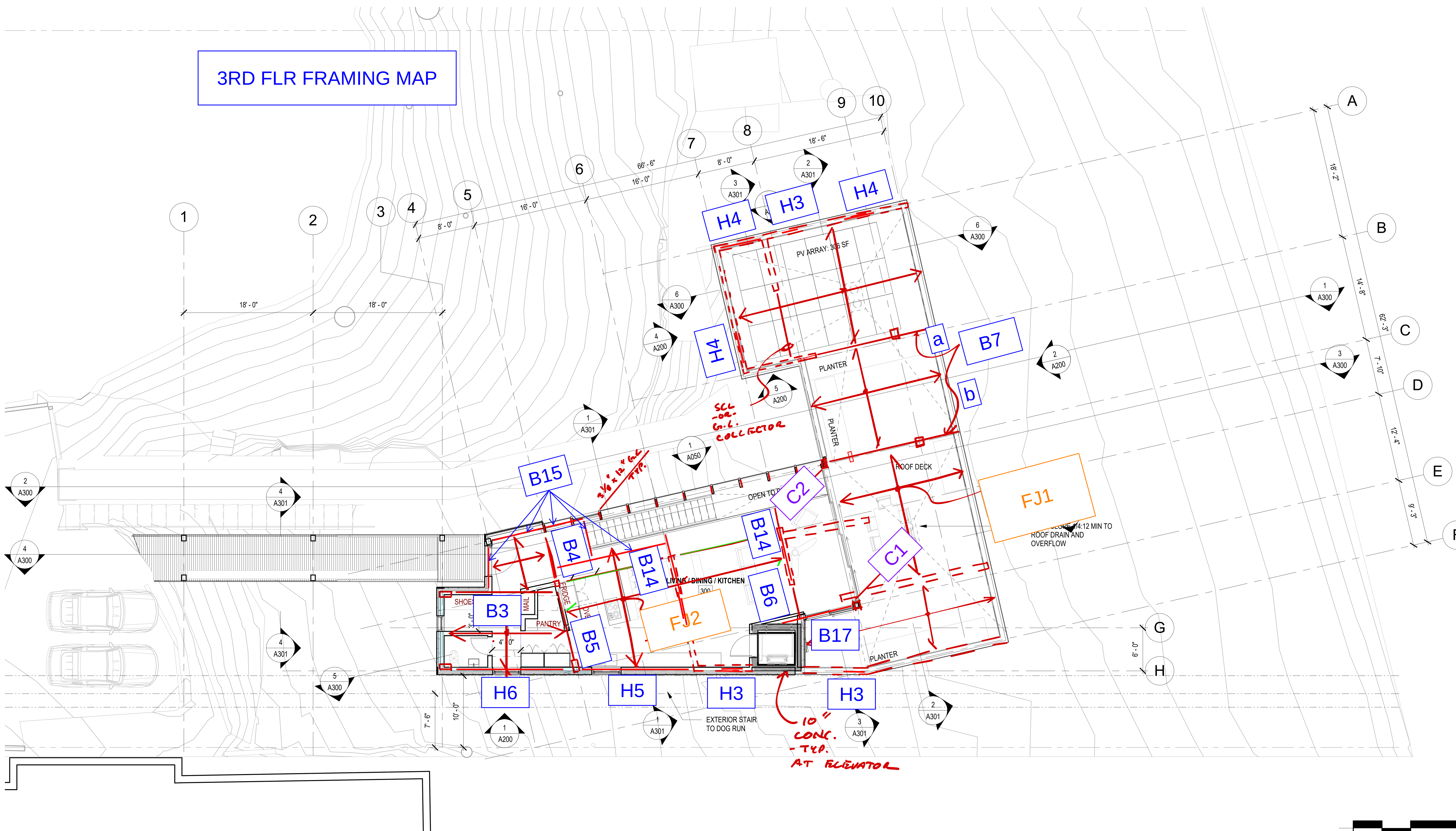
LEVEL 2 - FLOOR PLAN

S121

AREA SCHEDULE (GSF)

Name	Area
LEVEL 1 / OFFICE	343.00 SF
LEVEL 1	867.35 SF
LEVEL 2	2097.90 SF
LEVEL 3	1130.79 SF
GARAGE	572.78 SF
	5011.81 SF

GENERAL FLOOR PLAN NOTES



1 A131 LEVEL 3 FLOOR PLAN

1/8" = 1'-0"

MILLER HULL

The Miller Hull Partnership, LLP
Architecture and Planning
Polson Building
71 Columbia, Sixth Floor
Seattle, WA 98104

Phone: 206.682.6837
Contact: Name

PCS Structural Solutions

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SHEET

LEVEL 3 - FLOOR PLAN

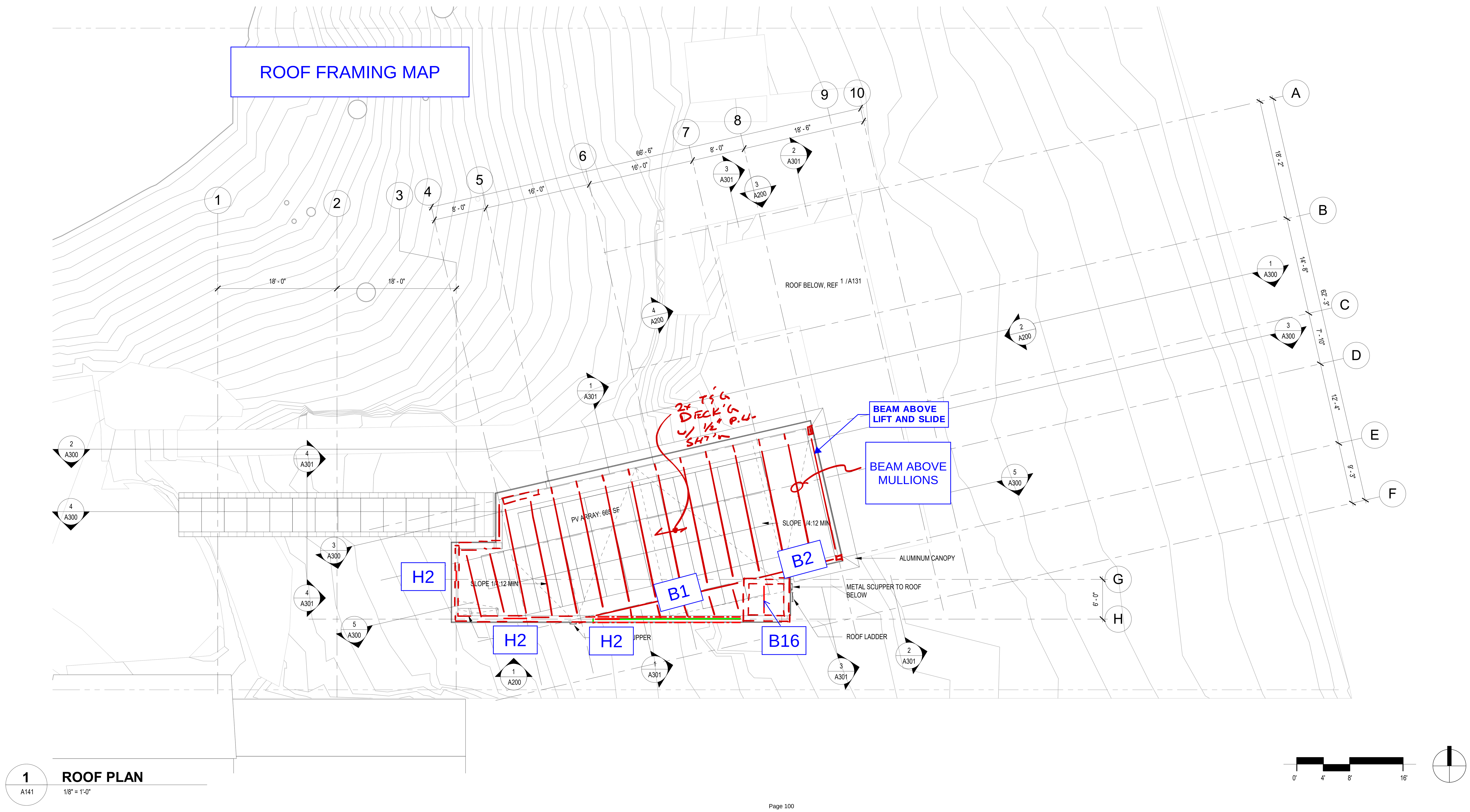
S131

GENERAL ROOF PLAN NOTES

1. SEE SECTIONS AND DETAILS FOR ROOF TYPE CALL OUTS.

SEC C411 RENEWABLES
   - A. QUANTITY OF RENEWABLES REQUIRED IS [put calculation here]. [XX] kW PROVIDED.
   - B. REFER TO SHEETS E[xxx] FOR ADDITIONAL PV INFORMATION.

SEC C412 SOLAR READINESS
   - A. THE SOLAR ZONE WHICH COMPLIES WITH REQUIREMENTS FOR UNSHADED AREA WITHIN THIS SECTION IS AS SHOWN IN THE TABULATION ABOVE. THE PORTION OF THE ROOF AREA PROVIDED IN SOLAR ZONE IS [xx% (xxx SF/Roof area minus skylight area)].
   - B. REFER TO SHEETS E[xxx] FOR FUTURE PV INTERCONNECTION PROVISIONS.



1 ROOF PLAN
A141
1/8" = 1'-0"

MILLER HULL
The Miller Hull Partnership, LLP
Architecture and Planning
Polson Building
71 Columbia, Sixth Floor
Seattle, WA 98104
Phone: 206.682.6837
Contact: Name

PCS Structural Solutions

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MERCER ISLAND HOUSE

6838 96TH AVE SE
MERCER ISLAND, WA 98040

SUBMITTAL

100% SCHEMATIC DESIGN

MAY 21, 2021

REVISIONS

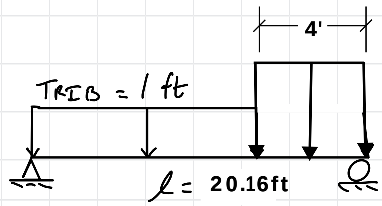
No.	Description	Date

Drawn: Author
Checked: Checker
M|H Proj No.: A20.0085.00
Issue Date: MAY 21, 2021

SHEET

ROOF PLAN
S141

JOISTS AT PLANTERS

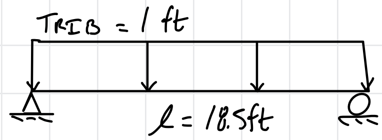


D = 187 PSF or 38 psf
S = 25 PSF
L = 40 PSF

USE 14" TJI 560

JOISTS

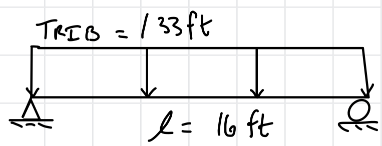
FJ1



worst case (@ vegetated roof)
D = 78 PSF
S = 25 PSF
L = 40 PSF

USE 14" TJI 560

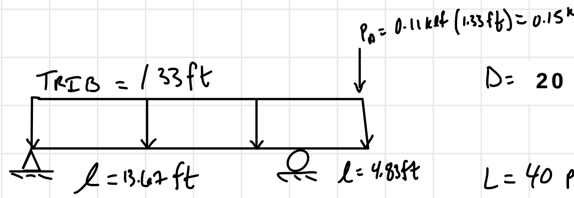
FJ2



D = 20 PSF
L = 40 PSF

USE 14" TJI 560

FJ3

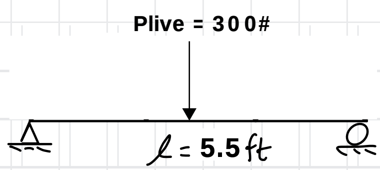


D = 20 PSF
L = 40 PSF

USE 14" TJI 210

* SEE ENERCALC FOR RESULTS

SUN-SHADE FRAMING



USE 2X8 P.O.C.

SUN-SHADE FRAMING IS NOT OCCUPIABLE SO DESIGN IS FOR POTENTIAL OF WINDOW WASHING ONLY

FORTE WEB

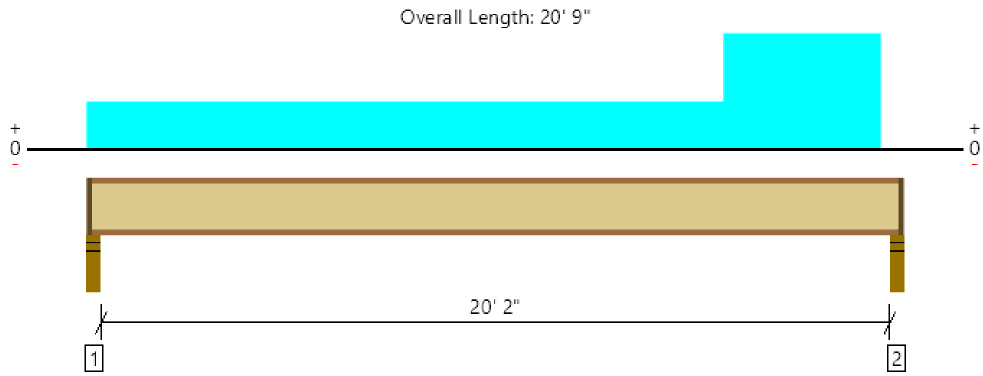
MEMBER REPORT

FLOOR JOISTS, FJ1

1 piece(s) 14" TJI® 560 @ 12" OC

FAILED

OK, SEE BELOW



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1290 @ 20' 6 1/2"	1396 (2.25")	Passed (92%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1290 @ 20' 5 1/2"	2390	Passed (54%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	4767 @ 11' 3 3/16"	11275	Passed (42%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.217 @ 10' 4 7/16"	0.508	Passed (L/999+)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.456 @ 10' 6 15/16"	0.678	Passed (L/536)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
TJ-Pro™ Rating	53	55	Failed	--	--

System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/360).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Weyerhaeuser Edge™ Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: None.

BY ENGINEERING JUDGEMENT, THIS IS ACCEPTABLE

Supports	Bearing Length: Total	Available	Required	Loads to Supports (lbs): Dead	Floor Live	Snow	Total	Accessories
1 - Stud wall - HF	3.50"	2.25"	1.75"	464	415	259	1138	1 1/4" Rim Board
2 - Stud wall - HF	3.50"	2.25"	1.85"	899	392	245	1536	1 1/4" Rim Board

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	8' 6" o/c	
Bottom Edge (Lu)	20' 7" o/c	

- TJI joists are only analyzed using Maximum Allowable bracing solutions.
- Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
1 - Uniform (PSF)	0 to 16' 2"	12"	38.0	40.0	25.0	ROOF PAVER SYSTEM
2 - Uniform (PLF)	16' 2" to 20' 2"	N/A	187.0	40.0	25.0	PLANTERS

Weyerhaeuser Notes

ForteWEB Software Operator	Job Notes
Bradly Taylor PCS Structural Solutions (253) 383-2797 btaylor@pcs-structural.com	

Weyerhaeuser

3/10/2022 10:18:22 PM UTC

ForteWEB v3.2, Engine: V8.2.0.17, Data: V8.1.0.16

File Name: 21201 Mercer Island Residence

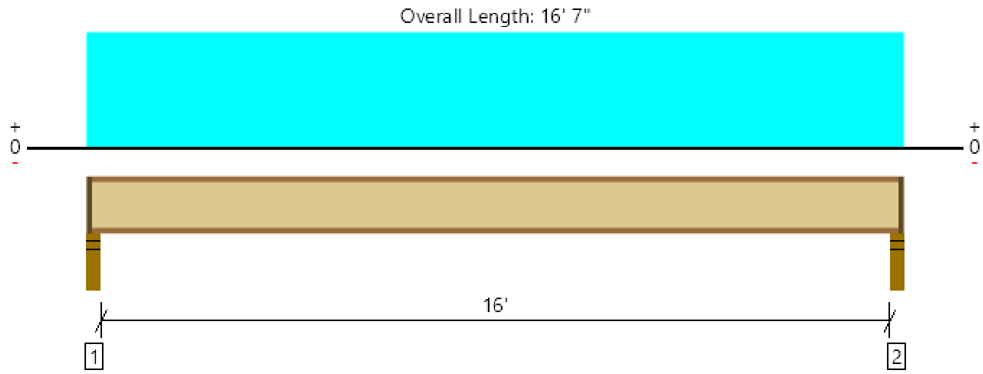
FORTE WEB

MEMBER REPORT

PASSED

FLOOR JOISTS, FJ2

1 piece(s) 14" TJI® 560 @ 16" OC



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	655 @ 2 1/2"	1396 (2.25")	Passed (47%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	640 @ 3 1/2"	2390	Passed (27%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	2614 @ 8' 3 1/2"	11275	Passed (23%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.101 @ 8' 3 1/2"	0.404	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.152 @ 8' 3 1/2"	0.539	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	59	55	Passed	--	--

System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/360).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Weyerhaeuser Edge™ Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: None.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Total	
1 - Stud wall - HF	3.50"	2.25"	1.75"	221	442	663	1 1/4" Rim Board
2 - Stud wall - HF	3.50"	2.25"	1.75"	221	442	663	1 1/4" Rim Board

• Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	12' 2" o/c	
Bottom Edge (Lu)	16' 5" o/c	

•TJI joists are only analyzed using Maximum Allowable bracing solutions.
•Maximum allowable bracing intervals based on applied load.

Vertical Load	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 16' 7"	16"	20.0	40.0	ROOF PAVER SYSTEM

Weyerhaeuser Notes

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

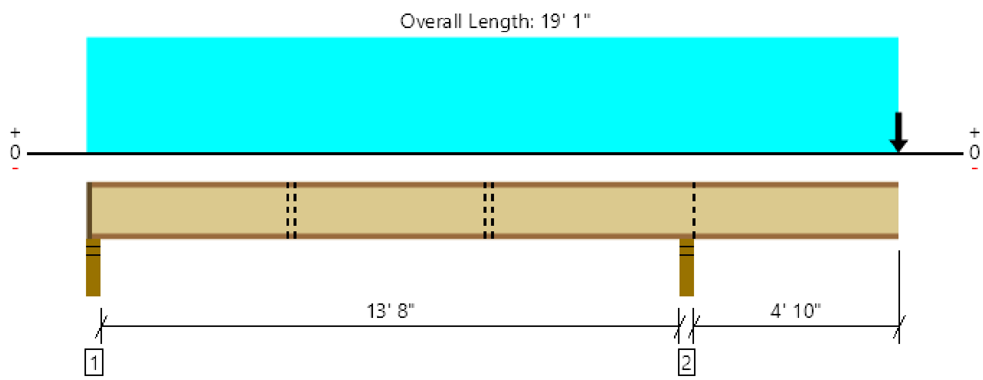
ForteWEB Software Operator	Job Notes
Bradly Taylor PCS Structural Solutions (253) 383-2797 btaylor@pcs-structural.com	

Weyerhaeuser

3/10/2022 10:20:59 PM UTC
ForteWEB v3.2, Engine: V8.2.0.17, Data: V8.1.0.16
File Name: 21201 Mercer Island Residence

FLOOR JOISTS, FJ3

1 piece(s) 14" TJI® 210 @ 16" OC



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1297 @ 14' 1 1/4"	2145 (3.50")	Passed (60%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	654 @ 13' 11 1/2"	1945	Passed (34%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	-1988 @ 14' 1 1/4"	3368	Passed (59%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.099 @ 7' 1 7/8"	0.347	Passed (L/999+)	--	1.0 D + 1.0 L (Alt Spans)
Total Load Defl. (in)	0.170 @ 19' 1"	0.332	Passed (2L/704)	--	1.0 D + 1.0 L (Alt Spans)
TJ-Pro™ Rating	57	55	Passed	--	--

System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/360).
- Overhang deflection criteria: LL (2L/480) and TL (2L/360).
- Moment capacity over cantilever support 2 has been reduced by 25% to lessen the effects of buckling.
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Weyerhaeuser Edge™ Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: None.
- Permanent bracing at third points In the back span or a direct applied ceiling over the entire back span length is required at the Right end of the member. See literature detail (PB1) For clarification.

	Bearing Length			Loads to Supports (lbs)			
Supports	Total	Available	Required	Dead	Floor Live	Total	Accessories
1 - Stud wall - HF	3.50"	2.25"	1.75"	95	382/-42	477/-42	1 1/4" Rim Board
2 - Stud wall - HF	3.50"	3.50"	3.50"	614	684	1298	Blocking

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.
- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	7' 1" o/c	
Bottom Edge (Lu)	5' 9" o/c	

- TJI joists are only analyzed using Maximum Allowable bracing solutions.
- Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 19' 1"	16"	20.0	40.0	ROOF PAVER SYSTEM
2 - Point (lb)	19' 1"	N/A	200	-	Wall Weight

Weyerhaeuser Notes

ForteWEB Software Operator	Job Notes
Bradly Taylor PCS Structural Solutions (253) 383-2797 btaylor@pcs-structural.com	

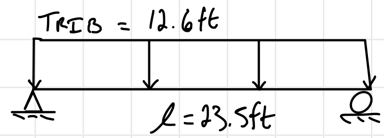
PCS Structural Solutions

Project: Mercer Island Residence | Job No: 21-201
Subject: Gravity | Sheet: Beams | Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland | Date: 6-10-21

* **BEAMS**

* SEE ENERCALC FOR RESULTS...

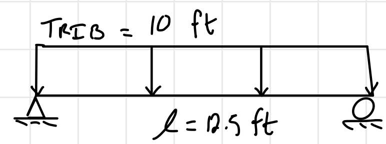
B1



D = 30 PSF
S = 25 PSF

USE 5 1/8" x 18" GLB

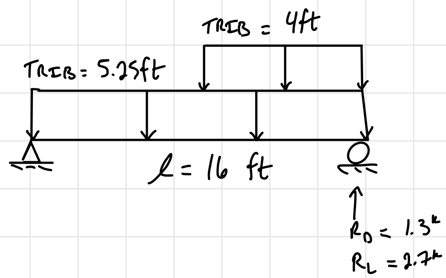
B2



D = 30 PSF
S = 25 PSF

USE 5 1/8" x 15" GLB

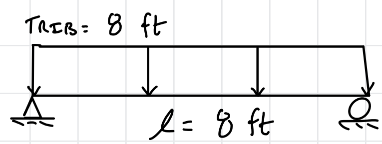
B3



D = 20 PSF
L = 40 PSF

USE 5 1/8" x 12" GLB

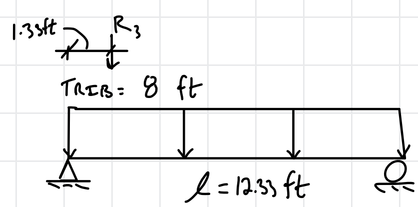
B4



D = 20 PSF
L = 40 PSF

USE DF 6x10

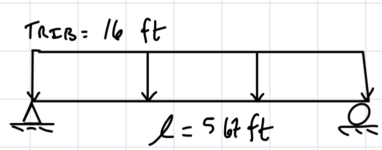
B5



D = 20 PSF
L = 40 PSF

USE 5 1/8" x 10 1/2" GLB

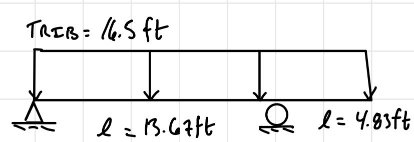
B6



D = 20 PSF
L = 40 PSF

USE DF 6x10

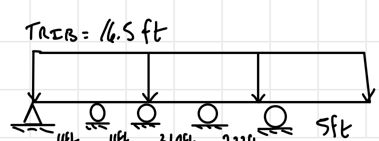
B7a



D = 78 PSF
L = 40 PSF
S = 25 PSF

W 10x19

B7b



P
16.2k (D)
6.6k (L)
4.1k (S)

D = 97.6 PSF
L = 40 PSF
S = 25 PSF

AVERAGE OF PLANTER AND PAVER FLOOR SYSTEM WEIGHTS

W 10x19

Seattle | 1011 Western Avenue, Suite 810 | Seattle, WA 98104 | 206.292.5076
Tacoma | 1250 Pacific Avenue, Suite 701 | Tacoma, WA 98402 | 253.383.2797
Portland | 101 SW Main Street, Suite 280 | Portland, OR 97204 | 503.232.3746
www.pcs-structural.com

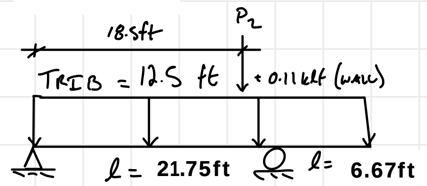
Structural Solutions

Project: Mercer Island Residence | Job No: 21-201
Subject: Gravity | Sheet: Beams | Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland | Date: 6-10-21

includes omega = 2.5

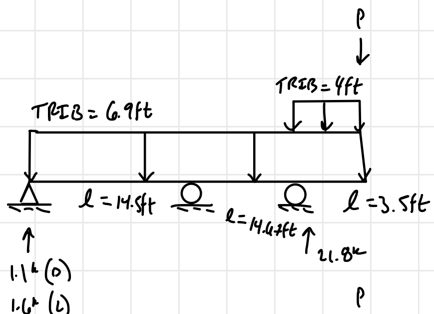
* Beams

B8



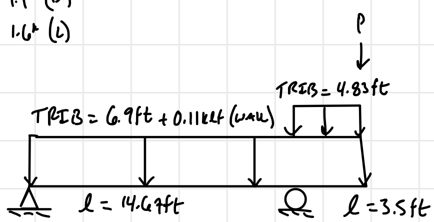
$P_{D_1} = 0.65^k$ $P_{E_1} = 5.4^k$
$P_{S_2} = 0.4^k$ $P_{L_2} = 0.6^k$
$P_{D_2} = 1.2^k + 0.9^k$ = 2.1k
D = 20 PSF
L = 40 PSF
USE W12x40

B9



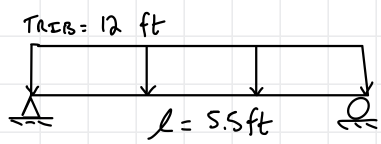
0.2 k +
$P_D = 8.1^k$ $P_S = 3.4^k$ $P_L = 5.4^k$
D = 20 PSF
L = 40 PSF
USE W12 x 40

B10



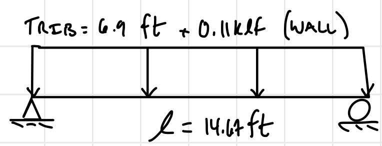
0.2 k
$P_D = 6.4^k$ $P_S = 2.7^k$ $P_L = 4.3^k$
D = 20 PSF
L = 40 PSF
USE W12 x 40

B11



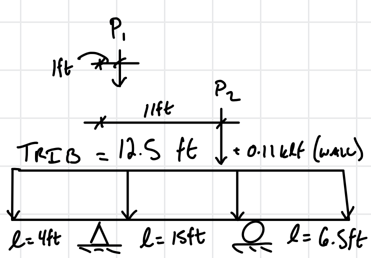
D = 20 PSF
L = 40 PSF
USE DF 6x10

B12



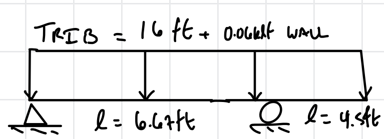
D = 20 PSF
L = 40 PSF
USE 5¼" x 14" SCL

B13



$P_{D_1} = 0.65^k$ $P_{E_1} = 5.4^k$
$P_{S_2} = 0.4^k$ $P_{L_2} = 0.6^k$
$P_{E_2} = 1.5^k$ $P_{D_2} = 1.2^k + 0.9^k$
includes omega = 2.5
D = 20 PSF
L = 40 PSF
USE W12x40

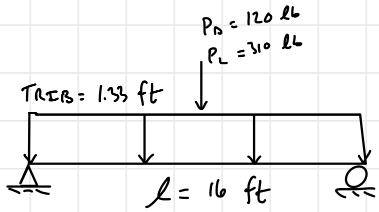
B14



D = 20 PSF
L = 40 PSF
USE 5¼ x 14 SCL

* BEAMS

B15

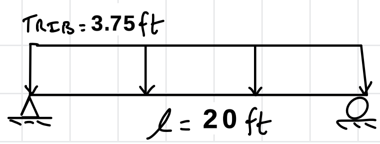


D = 20 PSF
L = 40 PSF

USE 3 1/2 x 14" SCL

CANOPY LOADING:
D = 6 PSF
S = 25 PSF
TRIB = 3FT, ECC = 1.5FT

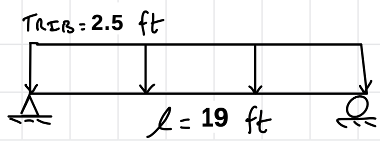
BEAM ABOVE LIFT AND SLIDE



D = 30 PSF
S = 25 PSF

USE HSS12x4x1/2

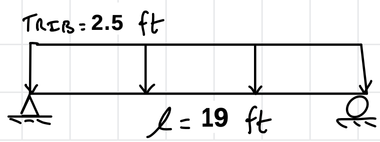
STAIR STRINGERS



D = 20 PSF
L = 40 PSF

USE C12x20.7

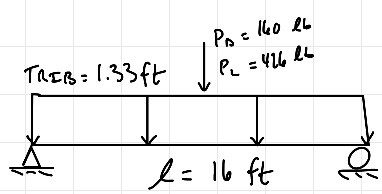
STAIR STRINGERS - EXT. SIDE



D = 20 PSF
L = 40 PSF

USE W6X15

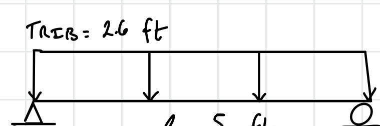
* SCL @ EXERCISE RM SHAFT



D = 20 PSF
L = 40 PSF

USE 3 1/2 x 14" SCL

B16



D = 10 PSF
S = 25 PSF

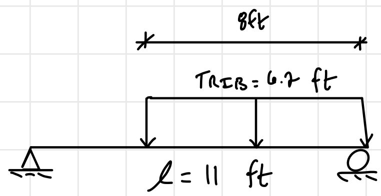
USE 2x6

PCS Structural Solutions

Project: Mercer Island Residence | Job No: 21-201
Subject: Gravity | Sheet Beams | Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland | Date: 6-10-21

Beams

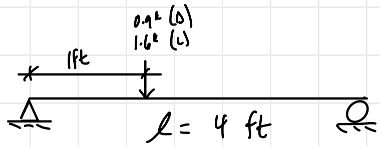
B17



D = 20 PSF
L = 40 PSF

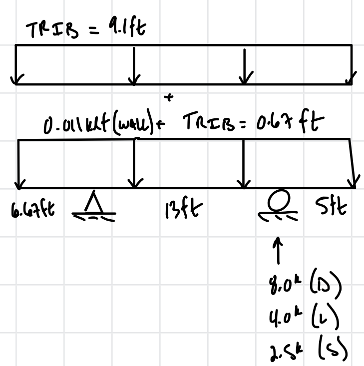
USE 5 1/4 x 14" SCL

B18



USE 5 1/4 x 14" SCL

B19

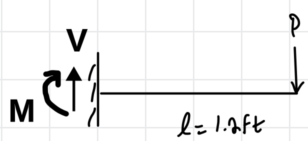


D = 78 PSF ; L = 40 PSF ; S = 25 PSF

D = 20 PSF
L = 40 PSF

USE 5 1/4 x 14" SCL

PL STUB SUPPORTING WF



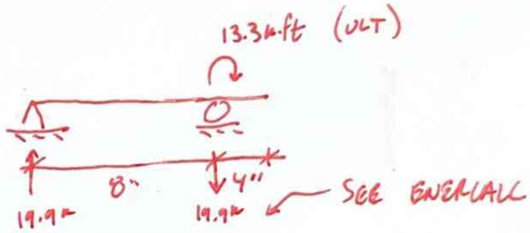
$P_D = 2.8^k$
$P_L = 4.8^k$

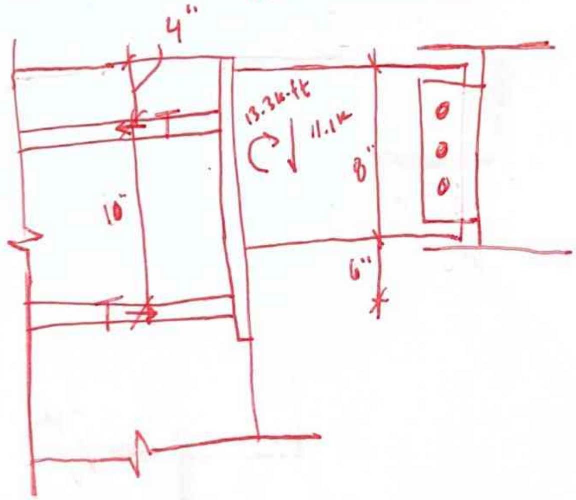
USE HSS 6x4x3/8

Vult = 11.1k
Mult = 13.3k*ft

SEE CONNECTION CALCS ON NEXT PAGES...

CHECK PL STUB TO LONG. WALL CONNECTION





CHECK REBAR: $\phi T_n = 0.9\,(60ksi)\,(0.44 in^2) = \underline{\underline{23.7^k}} > 19.9^k$ ✓OK

CHECK PL BENDING:

$M_u = 13.3\ k\cdot ft$
$V_u = 19.9^k$
} SEE ENERCALC

$\phi M_n = 0.9\,(36ksi)\,(4")\left(\frac{(7/8")^2}{4}\right) = \underline{\underline{24.8k\cdot ft}} > 13.3k\cdot ft$ ✓OK

$\phi V_n = 0.6\,(36ksi)\,(4")\,(7/8") = \underline{\underline{75.6^k}} > 19.9^k$ ✓OK

General Beam Analysis

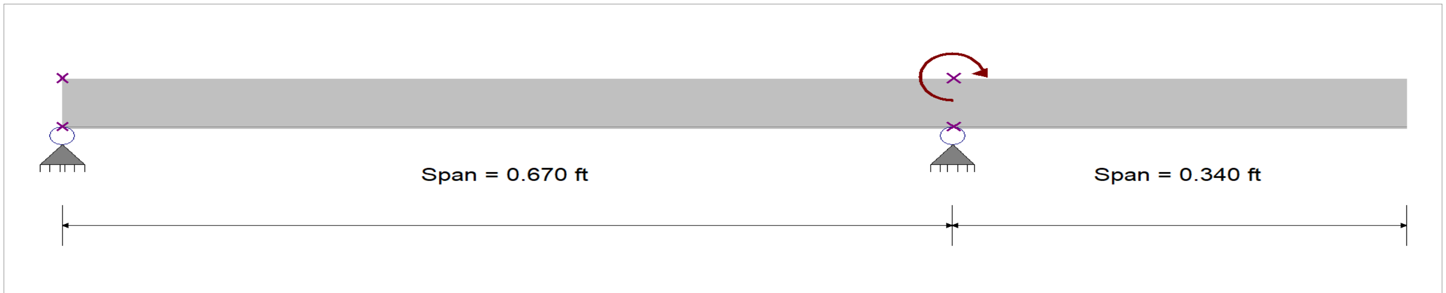
Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.22.3.16 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: PL STUB TO BEAM CONNECTION

General Beam Properties

Elastic Modulus	29,000.0 ksi					
Span #1	Span Length =	0.670 ft	Area =	10.0 in^2	Moment of Inertia =	100.0 in^4
Span #2	Span Length =	0.340 ft	Area =	10.0 in^2	Moment of Inertia =	100.0 in^4



Applied Loads

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

Load(s) for Span Number 1
Moment : D = 13.30 k-ft, Loc = 0.670 ft in span

DESIGN SUMMARY

Maximum Bending =	13.300 k-ft	Maximum Shear =	19.851 k
Load Combination	D Only	Load Combination	D Only
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1
Location of maximum on span	0.670 ft	Location of maximum on span	0.000 ft

Maximum Deflection		
Max Downward Transient Deflection	0.000 in	0
Max Upward Transient Deflection	0.000 in	0
Max Downward Total Deflection	0.001 in	13560
Max Upward Total Deflection	-0.000 in	34882

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values (k-ft)							Shear Values (k)	
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma - Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	VnxVnx/Omega
Overall MAXimum Envelope												
Dsgn. L = 0.67 ft	1				-13.30	13.30					19.85	
Dsgn. L = 0.34 ft	2										-0.00	
D Only												
Dsgn. L = 0.67 ft	1				-13.30	13.30					19.85	
Dsgn. L = 0.34 ft	2										-0.00	
+0.60D												
Dsgn. L = 0.67 ft	1				-7.98	7.98					11.91	
Dsgn. L = 0.34 ft	2										-0.00	

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
	1	0.0000	0.000	D Only	-0.0002	0.392
D Only	2	0.0006	0.340		0.0000	0.392

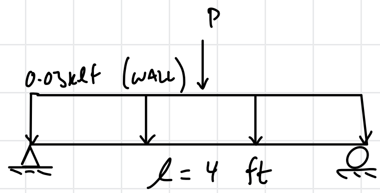
Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum	-19.851	19.851	
Overall MINimum	-11.910		
D Only	-19.851	19.851	
+0.60D	-11.910	11.910	

* HEADERS

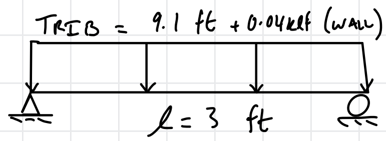
H2



P_D = 630 lb
P_S = 525 lb

4x10 DF #2

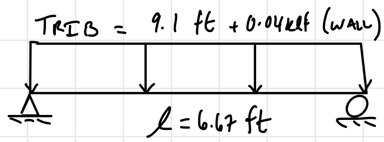
H3



D = 80 PSF
L = 40 PSF
S = 25 PSF

4x10 DF #2

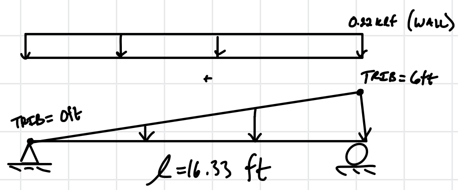
H4



D = 80 PSF
L = 40 PSF
S = 25 PSF

4x10 DF #2

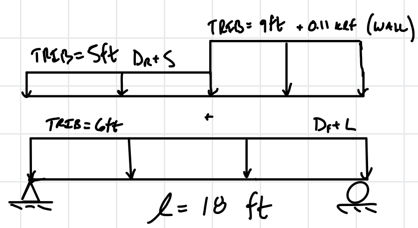
H5



D = 30 PSF
S = 25 PSF

5 1/8" x 12" GLB

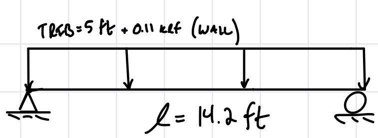
H6



D_R = 30 PSF
S = 25 PSF
L = 40 PSF
D_f = 20 PSF

5 1/8" x 16.5" GLB

H7

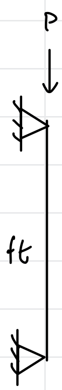


D_R = 80 PSF
L = 40 PSF

5 1/8" x 12" GLB

* COLUMN

C1



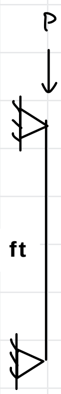
h= 11ft

P_S = 505 lb + 1563 lb = 2070 lb

P_D = 606 lb + 1948 lb = 2560 lb

USE HSS 4x4x1/4

C2



H = 22 ft

P_S = 0.5k + 0.61k = 1.11k

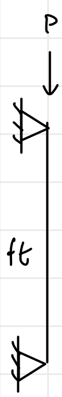
P_D = 0.6k + 2.0k + 1.1k = 3.7k

P_L = 1.3k + 1.6k = 2.9k

3 1/8" x 12" GL

Lbx = 10ft

C3



h= 11ft

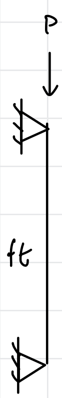
P_S = $\underbrace{5.2^k}_{\text{NO ECC.}}$

P_D = 16.4^k + $\underbrace{1.8^k}_{\text{ECC. -X}}$ + $\underbrace{1.6^k}_{\text{ECC. +X}}$

P_L = 8.3^k + 1.9^k + 3.11^k

USE HSS 4x4x3/8

C4



h= 11ft

P_D = 0.6^k + 1.8^k = 2.4^k

P_L = 1.3^k + 4.4^k = 5.7^k

USE HSS 4x4x1/4

Project: Mercer Island Residence			Job No: 21-201
Subject: Gravity	Sheet Column		Name: BRT
Originating Office: ☐ Seattle	☒ Tacoma	☐ Portland	Date: 6-10-21

* $\boxed{\text{Column}}$

C5

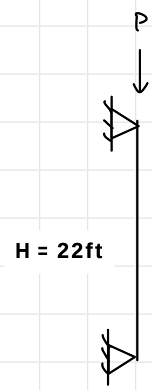
$P_L = 7.9^k$ $P_E = 1.5^k$

$P_S = 0.3^k$

$P_D = 5.2^k$

$\boxed{\text{USE HSS 4x4x1/4}}$

C6



P_L = 6.6k + 2.1k + 2.1k = 10.8k $P_E = 3.9^k$

P_S = 4.07k

P_D = 16.2k + 2.0k + 4.0k = 19.0k Lbx = 10 ft

$\boxed{\text{USE HSS 5x5x3/8}}$

$\boxed{\text{C7}}$

P_L = 4.6k

P_S = 2.9k

P_D = 9.0k

$\boxed{\text{USE HSS 5x5x3/8}}$

Seattle | 1011 Western Avenue, Suite 810 | Seattle, WA 98104 | 206.292.5076
Tacoma | 1250 Pacific Avenue, Suite 701 | Tacoma, WA 98402 | 253.383.2797
Portland | 101 SW Main Street, Suite 280 | Portland, OR 97204 | 503.232.3746
www.pcs-structural.com

* Column

C8

H = 22ft

FROM B7b

P_L = 4.3k

P_S = 2.2k

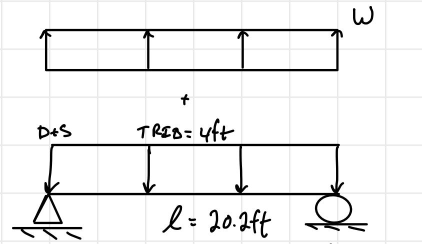
P_D = 8.5k

Lbx = 10 ft

USE 3-1/8"x12" GL

Curtain Wall Mullion

Beam Above:

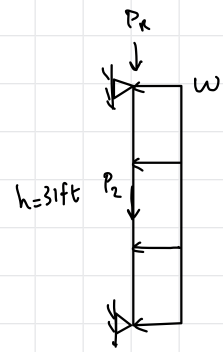


D = 30 psf
S = 25 psf
W = 48.7 psf

P_{DR} = 1.3k
P_{SR} = 1.1k
P_{WR} = -0.4k

USE 3 1/8" x 13 1/2" GLB

Mullion:



P_{DR} = 1.3k
P_{SR} = 1.1k

W = 26 psf

P_{D2} = 0.7k

L/240 → 1.55 in
6" Eccentricity

WEAK-AXIS UNBRACED LENGTH = 11 FT

USE 3 1/8" x 12" GLB

See Enercalc for calcs...

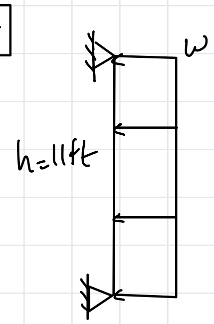
PCS Structural Solutions

Project: Mercer Island Residence Job No: 21-201
Subject: Gravity Sheet: Header Studs Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland Date: 6-10-21

Header Studs

*SEE SPREADSHEETS FOR CALCS

H4 - FULL-HT



$W = 34.5$ psf
$S = 48''$

$\boxed{\text{USE (2) 2x6}}$

↑ BY ENGINEERING JUDGEMENT, (1) 2x6 o.k. @ H2 + H3

H4 CONTROLS FOR H2 + H3 AS WELL

H4 - BRG

$P_D = 2{,}000$ lb $P_S = 760$ lb

$P_L = 1{,}220$ lb

$\boxed{\text{USE (2) 2x6}}$

PCS Structural Solutions

Project: MERCER ISLAND RESIDENCE
Job Number: 21-201
Sheet: ____ of ____
Name: BRT
Originating Office: Tacoma
Date: 08/23/21

BEARING STUD DESIGN - H4 BRG

2018 NDS/2018 IBC

WALL DATA

LUMBER TYPE: DF#2/HF#1

F_b = 900 PSI
F_c = 1350 PSI
$F_{c\perp}$ = 405 PSI
E = 1.50E+06 PSI

APPLIED LOADS:

W_{WIND} = 0.0 PSF
$W_{SEISMIC}$ = 0.0 PSF

P_{DEAD} = 2000 LBS
P_{LIVE} = 1220 LBS
P_{SNOW} = 760 LBS
P_{WIND} = 0 LBS
$P_{SEISMIC}$ = 0 LBS

STUD SIZE: (2) 2x6

A_X = 16.50 IN^2
S_X = 15.13 IN^3
I_X = 41.59 IN^4
$C_{F(BENDING)}$ = 1.3 (NDS 4.3.6)
F_{cE} = 781.3 PSI
C_b = 1.13 (NDS 3.10.4)

MISCELLANEOUS:

HEIGHT = 11 FT
SPACING = 0 IN
ECCENTRICITY = 0.1 IN
$C_{F(COMPRESSION)}$ = 1.10 (NDS 4.3.6)

		APPLY?	
$C_{SYS(BENDING)}$ =	1.00	NO	(SDPWS T3.1.1.1)
$C_{r(BENDING)}$ =	1.00	NO	(NDS 4.3.9)

LOAD CASES - IBC 1605.3.1

CASE 1	DEAD + LIVE + 5 PSF LAT.
CASE 2	DEAD + SNOW + 5 PSF LAT.
CASE 3	DEAD + 0.75LIVE + 0.75SNOW + 5 PSF LAT.
CASE 4	DEAD + 0.45WIND + 0.75LIVE + 0.75SNOW
CASE 5	DEAD + 0.60WIND
CASE 6	DEAD + 0.75EISMIC
CASE 7	DEAD + 0.53SEISMIC + 0.75LIVE + 0.75SNOW

ALLOWABLE STRESSES - Cd PER NDS T2.3.2, Cp PER NDS 3.7.1, ASSUME Cm, Ct, Ci, CL = 1.0

CASE	C_D	F_c*	F_{cE}/F_c*	C_P	F_c'	F_b'	$F_{c\perp}$
1	1.00	1485	0.53	0.452	671	1170	456
2 & 3	1.15	1708	0.46	0.403	688	1346	456
4 & 5	1.60	2376	0.33	0.303	719	1872	456
6 & 7	1.60	2376	0.33	0.303	719	1872	456

APPLIED STRESSES - NDS CHAPTER 3 DESIGN EQUATIONS

CASE	$P_{APPLIED}$	f_c	$M_{LAT. LOAD}$	$M_{ECC.}$	M_{TOTAL}	f_b
1	3220	195	0	27	17	13
2	2760	167	0	23	14	11
3	3485	211	0	29	18	14
4	3485	211	0	29	18	14
5	2000	121	0	17	10	8
6	2000	121	0	17	10	8
7	3485	211	0	29	18	14

DESIGN CHECKS - COMBINED STRESS CHECK PER NDS EQN 3.9-3

CASE	f_c/F_c'	f_b/F_b'	$f_c/F_{c\perp}$	Combined	f_c/F_{cE}	Deflection	L/?
1	0.29	0.01	0.43	0.10	0.25	0.01	L/22547
2	0.24	0.01	0.37	0.07	0.21	0.01	L/26304
3	0.31	0.01	0.46	0.11	0.27	0.01	L/20832
4*	0.29	0.01	0.46	0.10	0.27	0.00	L/29760
5*	0.17	0.00	0.27	0.03	0.16	0.00	L/51857
6	0.17	0.00	0.27	0.03	0.16	0.00	L/36300
7	0.29	0.01	0.46	0.10	0.27	0.01	L/20832
MAX. --->	0.31	0.01	0.46	0.11	0.27	0.01	L/20832
	O.K.	O.K.	O.K.	O.K.	O.K.		

* Deflections reduced by 0.42 per IBC Table 1604.3 footnote f. Increase deflection by 1.4 for jambs supporting glass.

PLATE BENDING - *ALIGN STUDS WITH JOISTS WHERE POSSIBLE*

MISCELLANEOUS:

C_{Fu} = 1.15 (NDS 4.3.7)
F_v = 150 PSI

ALLOWABLE STRESSES:

F_v' = 173 PSI
F_b' = 1547 PSI

STUD REACTIONS (OUT - OF - PLANE)
0 LB

DBL TOP PLATE PROPERTIES:

A_X = 16.50 IN^2
S_X = 4.13 IN^3
I_X = 3.09 IN^4

APPLIED STRESSES:

f_v = 167 PSI <--- O.K.
f_b = 0 PSI <--- O.K.
Δ_{MAX} = 0.000 IN

PCS Structural Solutions

Project: MERCER ISLAND RESIDENCE | Job Number: 21-201

Sheet: ____ of ____ | Name: BRT

Originating Office: Tacoma | Date: 08/23/21

FULL HT STUD DESIGN - H4 FULL-HT

2018 NDS/2018 IBC

WALL DATA

LUMBER TYPE: DF#2/HF#1

F_b = 900 PSI
F_c = 1350 PSI
$F_{c\perp}$ = 405 PSI
E = 1.50E+06 PSI

APPLIED LOADS:

W_{WIND} = 34.5 PSF
$W_{SEISMIC}$ = 0.0 PSF

P_{DEAD} = 0 LBS
P_{LIVE} = 0 LBS
P_{SNOW} = 0 LBS
P_{WIND} = 0 LBS
$P_{SEISMIC}$ = 0 LBS

STUD SIZE: (2) 2x6

A_X = 16.50 IN^2
S_X = 15.13 IN^3
I_X = 41.59 IN^4
$C_{F(BENDING)}$ = 1.3 (NDS 4.3.6)
F_{cE} = 781.3 PSI
C_b = 1.13 (NDS 3.10.4)

MISCELLANEOUS:

HEIGHT = 11 FT
SPACING = 48 IN
ECCENTRICITY = 0.1 IN
$C_{F(COMPRESSION)}$ = 1.10 (NDS 4.3.6)

		APPLY?	
$C_{SYS(BENDING)}$ =	1.00	NO	(SDPWS T3.1.1.1)
$C_{r(BENDING)}$ =	1.00	NO	(NDS 4.3.9)

LOAD CASES - IBC 1605.3.1

CASE 1	DEAD + LIVE + 5 PSF LAT.
CASE 2	DEAD + SNOW + 5 PSF LAT.
CASE 3	DEAD + 0.75LIVE + 0.75SNOW + 5 PSF LAT.
CASE 4	DEAD + 0.45WIND + 0.75LIVE + 0.75SNOW
CASE 5	DEAD + 0.60WIND
CASE 6	DEAD + 0.7SEISMIC
CASE 7	DEAD + 0.53SEISMIC + 0.75LIVE + 0.75SNOW

ALLOWABLE STRESSES - Cd PER NDS T2.3.2, Cp PER NDS 3.7.1, ASSUME Cm, Ct, Ci, CL = 1.0

CASE	C_D	F_c*	F_{cE}/F_c*	C_P	F_c'	F_b'	$F_{c\perp}$
1	1.00	1485	0.53	0.452	671	1170	456
2 & 3	1.15	1708	0.46	0.403	688	1346	456
4 & 5	1.60	2376	0.33	0.303	719	1872	456
6 & 7	1.60	2376	0.33	0.303	719	1872	456

APPLIED STRESSES - NDS CHAPTER 3 DESIGN EQUATIONS

CASE	$P_{APPLIED}$	f_c	$M_{LAT.\ LOAD}$	$M_{ECC.}$	M_{TOTAL}	f_b
1	0	0	303	0	303	240
2	0	0	303	0	303	240
3	0	0	303	0	303	240
4	0	0	939	0	939	745
5	0	0	1252	0	1252	994
6	0	0	0	0	0	0
7	0	0	0	0	0	0

DESIGN CHECKS - COMBINED STRESS CHECK PER NDS EQN 3.9-3

CASE	f_c/F_c'	f_b/F_b'	$f_c/F_{c\perp}$	Combined	f_c/F_{cE}	Deflection	L/?
1	0.00	0.21	0.00	0.21	0.00	0.11	L/1250
2	0.00	0.18	0.00	0.18	0.00	0.11	L/1250
3	0.00	0.18	0.00	0.18	0.00	0.11	L/1250
4*	0.00	0.40	0.00	0.40	0.00	0.23	L/575
5*	0.00	0.53	0.00	0.53	0.00	0.31	L/431
6	0.00	0.00	0.00	0.00	0.00	0.00	#DIV/0!
7	0.00	0.00	0.00	0.00	0.00	0.00	#DIV/0!
MAX. --->	0.00	0.53	0.00	0.53	0.00	0.31	#DIV/0!
	O.K.	O.K.	O.K.	O.K.	O.K.		

* Deflections reduced by 0.42 per IBC Table 1604.3 footnote f. Increase deflection by 1.4 for jambs supporting glass.

PLATE BENDING - *ALIGN STUDS WITH JOISTS WHERE POSSIBLE*

MISCELLANEOUS:

C_{Fu} = 1.15 (NDS 4.3.7)
F_V = 150 PSI

ALLOWABLE STRESSES:

F_V' = 150 PSI
F_b' = 1346 PSI

STUD REACTIONS (OUT - OF - PLANE): 759 LB

DBL TOP PLATE PROPERTIES:

A_X = 16.50 IN^2
S_X = 4.13 IN^3
I_X = 3.09 IN^4

APPLIED STRESSES:

f_v = 0 PSI <--- O.K.
f_b = 0 PSI <--- O.K.
Δ_{MAX} = 0.000 IN

Project:	MERCER ISLAND RESIDENCE
Job Number:	21-201
Sheet:	of
Name:	BRT
Originating Office:	Tacoma
Date:	08/23/21

PCS Structural Solutions

BEARING STUD DESIGN - Garage Brg

2018 NDS/2018 IBC

WALL DATA

LUMBER TYPE: DF#2/HF#1

F_b =	900	PSI
F_c =	1350	PSI
$F_{c\perp}$ =	405	PSI
E =	1.50E+06	PSI

APPLIED LOADS:

W_{WIND} =	0.0 PSF	P_{DEAD} =	500	LBS
$W_{SEISMIC}$ =	0.0 PSF	P_{LIVE} =	0	LBS
		P_{SNOW} =	400	LBS
		P_{WIND} =	0	LBS
		$P_{SEISMIC}$ =	0	LBS

STUD SIZE: (1) 2x6

A_X =	8.25	IN^2
S_X =	7.56	IN^3
I_X =	20.80	IN^4
$C_{F(BENDING)}$ =	1.3	(NDS 4.3.6)
F_{cE} =	656.5	PSI
C_b =	1.25	(NDS 3.10.4)

MISCELLANEOUS:

HEIGHT =	12	FT	
SPACING =	0	IN	
ECCENTRICITY =	0.1	IN	
$C_{F(COMPRESSION)}$ =	1.10	(NDS 4.3.6)	
		APPLY?	
$C_{SYS(BENDING)}$ =	1.00	NO	(SDPWS T3.1.1.1)
$C_{r(BENDING)}$ =	1.00	NO	(NDS 4.3.9)

LOAD CASES - IBC 1605.3.1

CASE 1	DEAD + LIVE + 5 PSF LAT.
CASE 2	DEAD + SNOW + 5 PSF LAT.
CASE 3	DEAD + 0.75LIVE + 0.75SNOW + 5 PSF LAT.
CASE 4	DEAD + 0.45WIND + 0.75LIVE + 0.75SNOW
CASE 5	DEAD + 0.60WIND
CASE 6	DEAD + 0.75SEISMIC
CASE 7	DEAD + 0.53SEISMIC + 0.75LIVE + 0.75SNOW

ALLOWABLE STRESSES - Cd PER NDS T2.3.2, Cp PER NDS 3.7.1, ASSUME Cm, Ct, Ci, CL = 1.0

CASE	C_D	F_c*	F_{cE}/F_c*	C_P	F_c'	F_b'	$F_{c\perp}$
1	1.00	1485	0.44	0.392	582	1170	506
2 & 3	1.15	1708	0.38	0.347	593	1346	506
4 & 5	1.60	2376	0.28	0.258	614	1872	506
6 & 7	1.60	2376	0.28	0.258	614	1872	506

APPLIED STRESSES - NDS CHAPTER 3 DESIGN EQUATIONS

CASE	$P_{APPLIED}$	f_c	$M_{LAT. LOAD}$	$M_{ECC.}$	M_{TOTAL}	f_b
1	500	61	0	4	3	4
2	900	109	0	8	5	7
3	800	97	0	7	4	7
4	800	97	0	7	4	7
5	500	61	0	4	3	4
6	500	61	0	4	3	4
7	800	97	0	7	4	7

DESIGN CHECKS - COMBINED STRESS CHECK PER NDS EQN 3.9-3

CASE	f_c/F_c'	f_b/F_b'	$f_c/F_{c\perp}$	Combined	f_c/F_{cE}	Deflection	L/?
1	0.10	0.00	0.12	0.01	0.09	0.00	L/66550
2	0.18	0.01	0.22	0.04	0.17	0.00	L/36972
3	0.16	0.00	0.19	0.03	0.15	0.00	L/41594
4*	0.16	0.00	0.19	0.03	0.15	0.00	L/59420
5*	0.10	0.00	0.12	0.01	0.09	0.00	L/95071
6	0.10	0.00	0.12	0.01	0.09	0.00	L/66550
7	0.16	0.00	0.19	0.03	0.15	0.00	L/41594
MAX. --->	0.18	0.01	0.22	0.04	0.17	0.00	L/36972
	O.K.	O.K.	O.K.	O.K.	O.K.		

* Deflections reduced by 0.42 per IBC Table 1604.3 footnote f. Increase deflection by 1.4 for jambs supporting glass.

PLATE BENDING - *ALIGN STUDS WITH JOISTS WHERE POSSIBLE*

MISCELLANEOUS:

C_{Fu} =	1.15	(NDS 4.3.7)
F_V =	150	PSI

ALLOWABLE STRESSES:

F_V' =	173	PSI
F_b' =	1547	PSI

STUD REACTIONS (OUT - OF - PLANE)
0 LB

DBL TOP PLATE PROPERTIES:

A_X =	16.50	IN^2
S_X =	4.13	IN^3
I_X =	3.09	IN^4

APPLIED STRESSES:

f_v =	55	PSI	<--- O.K.
f_b =	0	PSI	<--- O.K.
Δ_{MAX} =	0.000	IN	

Project: MERCER ISLAND RESIDENCE | Job Number: 21-201
Sheet: ____ of ____ | Name: BRT
Originating Office: Tacoma | Date: 08/23/21

PCS Structural Solutions

FULL HT STUD DESIGN - Garage Full Ht

2018 NDS/2018 IBC

WALL DATA

LUMBER TYPE:	DF#2/HF#1		APPLIED LOADS:		P_{DEAD} =	0 LBS
F_b =	900 PSI		W_{WIND} =	29.0 PSF	P_{LIVE} =	0 LBS
F_c =	1350 PSI		$W_{SEISMIC}$ =	5.0 PSF	P_{SNOW} =	0 LBS
$F_{c\perp}$ =	405 PSI				P_{WIND} =	0 LBS
E =	1.50E+06 PSI				$P_{SEISMIC}$ =	0 LBS

STUD SIZE:	(2) 2x6	MISCELLANEOUS:	HEIGHT =	12 FT
A_X =	16.50 IN^2		SPACING =	56 IN
S_X =	15.13 IN^3		ECCENTRICITY =	0.1 IN
I_X =	41.59 IN^4		$C_{F(COMPRESSION)}$ =	1.10 (NDS 4.3.6)
$C_{F(BENDING)}$ =	1.3 (NDS 4.3.6)			APPLY?
F_{cE} =	656.5 PSI		$C_{SYS(BENDING)}$ = 1.00	NO (SDPWS T3.1.1.1)
C_b =	1.13 (NDS 3.10.4)		$C_{r(BENDING)}$ = 1.00	NO (NDS 4.3.9)

LOAD CASES - IBC 1605.3.1

CASE 1	DEAD + LIVE + 5 PSF LAT.	CASE 4	DEAD + 0.45WIND + 0.75LIVE + 0.75SNOW
CASE 2	DEAD + SNOW + 5 PSF LAT.	CASE 5	DEAD + 0.60WIND
CASE 3	DEAD + 0.75LIVE + 0.75SNOW + 5 PSF LAT.	CASE 6	DEAD + 0.75EISMIC
		CASE 7	DEAD + 0.53SEISMIC + 0.75LIVE + 0.75SNOW

ALLOWABLE STRESSES - Cd PER NDS T2.3.2, Cp PER NDS 3.7.1, ASSUME Cm, Ct, Ci, CL = 1.0

CASE	C_D	F_c*	F_{cE}/F_c*	C_P	F_c'	F_b'	$F_{c\perp}$
1	1.00	1485	0.44	0.392	582	1170	456
2 & 3	1.15	1708	0.38	0.347	593	1346	456
4 & 5	1.60	2376	0.28	0.258	614	1872	456
6 & 7	1.60	2376	0.28	0.258	614	1872	456

APPLIED STRESSES - NDS CHAPTER 3 DESIGN EQUATIONS

CASE	$P_{APPLIED}$	f_c	$M_{LAT.\ LOAD}$	$M_{ECC.}$	M_{TOTAL}	f_b
1	0	0	420	0	420	333
2	0	0	420	0	420	333
3	0	0	420	0	420	333
4	0	0	1096	0	1096	870
5	0	0	1462	0	1462	1160
6	0	0	294	0	294	233
7	0	0	223	0	223	177

DESIGN CHECKS - COMBINED STRESS CHECK PER NDS EQN 3.9-3

CASE	f_c/F_c'	f_b/F_b'	$f_c/F_{c\perp}$	Combined	f_c/F_{cE}	Deflection	L/?
1	0.00	0.28	0.00	0.28	0.00	0.17	L/825
2	0.00	0.25	0.00	0.25	0.00	0.17	L/825
3	0.00	0.25	0.00	0.25	0.00	0.17	L/825
4*	0.00	0.46	0.00	0.46	0.00	0.32	L/452
5*	0.00	0.62	0.00	0.62	0.00	0.43	L/339
6	0.00	0.12	0.00	0.12	0.00	0.12	L/1179
7	0.00	0.09	0.00	0.09	0.00	0.09	L/1557
MAX. --->	0.00	0.62	0.00	0.62	0.00	0.43	L/339
	O.K.	O.K.	O.K.	O.K.	O.K.		

* Deflections reduced by 0.42 per IBC Table 1604.3 footnote f. Increase deflection by 1.4 for jambs supporting glass.

PLATE BENDING - *ALIGN STUDS WITH JOISTS WHERE POSSIBLE*

MISCELLANEOUS:		ALLOWABLE STRESSES:		STUD REACTIONS (OUT - OF - PLANE)
C_{Fu} =	1.15 (NDS 4.3.7)	F_V' =	150 PSI	
F_V =	150 PSI	F_b' =	1346 PSI	812 LB

DBL TOP PLATE PROPERTIES:		APPLIED STRESSES:		
A_X =	16.50 IN^2	f_v =	0 PSI	<--- O.K.
S_X =	4.13 IN^3	f_b =	0 PSI	<--- O.K.
I_X =	3.09 IN^4	Δ_{MAX} =	0.000 IN	

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

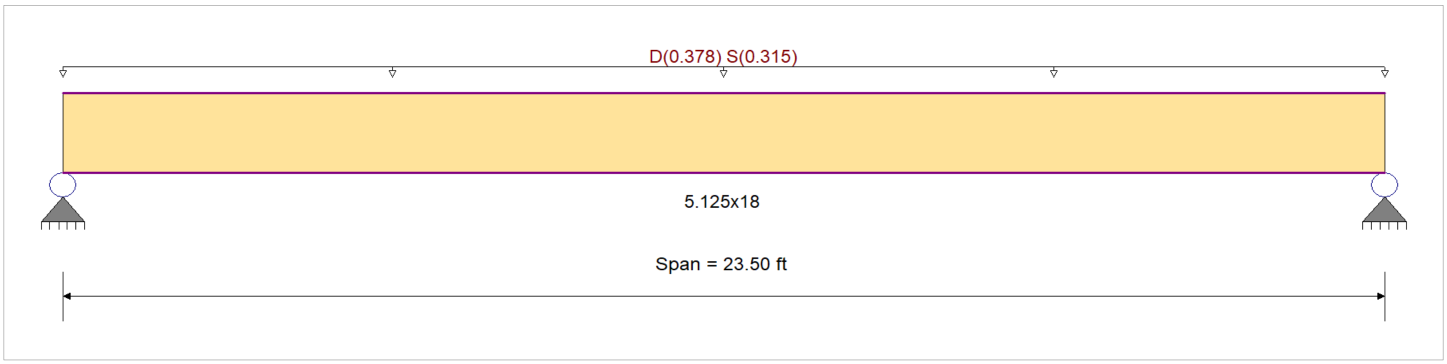
DESCRIPTION: B1

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,400.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	1,850.0 psi	Ebend- xx	1,800.0 ksi
		Fc - Prll	1,650.0 psi	Eminbend - xx	950.0 ksi
Wood Species	DF/DF	Fc - Perp	650.0 psi	Ebend- yy	1,600.0 ksi
Wood Grade	24F-V4	Fv	265.0 psi	Eminbend - yy	850.0 ksi
		Ft	1,100.0 psi	Density	31.210 pcf
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 loads
Uniform Load : D = 0.030, S = 0.0250 ksf, Tributary Width = 12.60 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.814** : 1	Maximum Shear Stress Ratio	=	**0.392** : 1
Section used for this span		**5.125x18**	Section used for this span		**5.125x18**
fb: Actual	=	2,134.15 psi	fv: Actual	=	119.32 psi
Fb: Allowable	=	2,620.69 psi	Fv: Allowable	=	304.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	11.750 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.485 in	Ratio =	581 >=360	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	1.098 in	Ratio =	256 >=240	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 23.50 ft	**1**	0.581	0.279	0.90	0.950	1.00	1.00	1.00	1.00	1.00	27.47	1,191.29	2050.97	4.10	66.60	238.50
+D+S					0.950	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 23.50 ft	**1**	0.814	0.392	1.15	0.950	1.00	1.00	1.00	1.00	1.00	49.22	2,134.15	2620.69	7.34	119.32	304.75
+D+0.750S					0.950	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 23.50 ft	**1**	0.724	0.348	1.15	0.950	1.00	1.00	1.00	1.00	1.00	43.78	1,898.43	2620.69	6.53	106.14	304.75
+0.60D					0.950	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 23.50 ft	**1**	0.196	0.094	1.60	0.950	1.00	1.00	1.00	1.00	1.00	16.48	714.77	3646.17	2.46	39.96	424.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	1.0977	11.836		0.0000	0.000

Wood Beam

DESCRIPTION: B1

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	8.378	8.378
Overall MINimum	3.701	3.701
D Only	4.676	4.676
+D+S	8.378	8.378
+D+0.750S	7.452	7.452
+0.60D	2.806	2.806
S Only	3.701	3.701

Project Title: MERCER ISLAND RESIDENCE
Engineer: BRT
Project ID: 21-201
Project Descr:

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

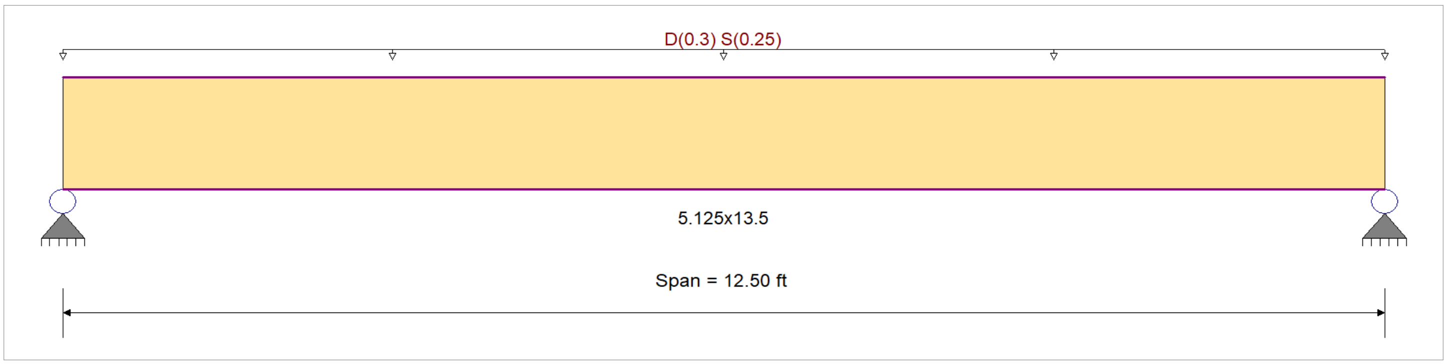
DESCRIPTION: B2

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,400.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	1,850.0 psi	Ebend- xx	1,800.0 ksi
		Fc - Prll	1,650.0 psi	Eminbend - xx	950.0 ksi
Wood Species	DF/DF	Fc - Perp	650.0 psi	Ebend- yy	1,600.0 ksi
Wood Grade	24F-V4	Fv	265.0 psi	Eminbend - yy	850.0 ksi
		Ft	1,100.0 psi	Density	31.210 pcf
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 loads
Uniform Load : D = 0.030, S = 0.0250 ksf, Tributary Width = 10.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.308** : 1	Maximum Shear Stress Ratio	=	**0.207** : 1
Section used for this span		**5.125x13.5**	Section used for this span		**5.125x13.5**
fb: Actual	=	850.64 psi	fv: Actual	=	63.15 psi
Fb: Allowable	=	2,760.00 psi	Fv: Allowable	=	304.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	6.250 ft	Location of maximum on span	=	11.405 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.073 in	Ratio =	2053 >=360	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.165 in	Ratio =	908 >=240	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 12.50 ft	1	0.220	0.148	0.90	1.000	1.00	1.00	1.00	1.00	1.00	6.15	474.25	2160.00	1.62	35.21	238.50
+D+S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 12.50 ft	1	0.308	0.207	1.15	1.000	1.00	1.00	1.00	1.00	1.00	11.04	850.64	2760.00	2.91	63.15	304.75
+D+0.750S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 12.50 ft	1	0.274	0.184	1.15	1.000	1.00	1.00	1.00	1.00	1.00	9.81	756.54	2760.00	2.59	56.16	304.75
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 12.50 ft	1	0.074	0.050	1.60	1.000	1.00	1.00	1.00	1.00	1.00	3.69	284.55	3840.00	0.97	21.12	424.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.1650	6.296		0.0000	0.000

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: B2

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	3.531	3.531
Overall MINimum	1.563	1.563
D Only	1.969	1.969
+D+S	3.531	3.531
+D+0.750S	3.141	3.141
+0.60D	1.181	1.181
S Only	1.563	1.563

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

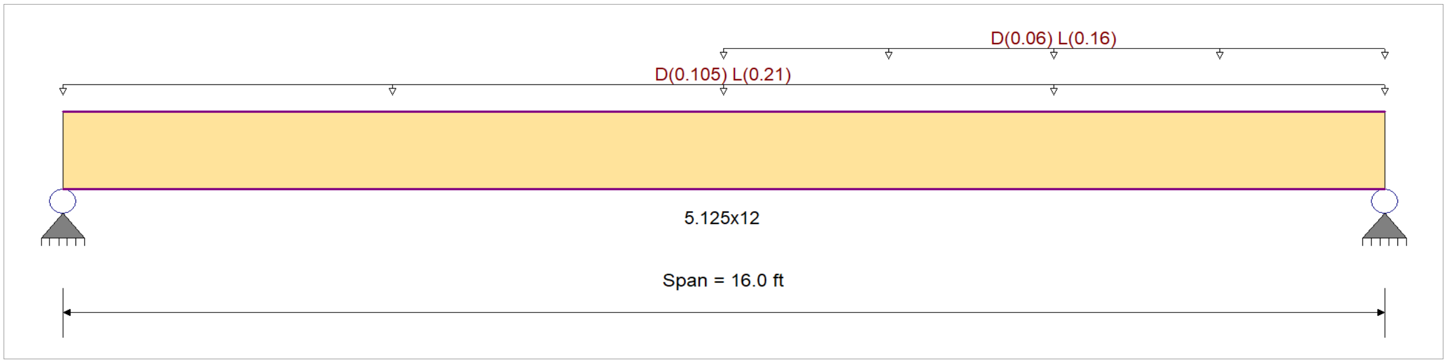
DESCRIPTION: B3

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,400.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	1,850.0 psi	Ebend- xx	1,800.0 ksi
		Fc - Prll	1,650.0 psi	Eminbend - xx	950.0 ksi
Wood Species	DF/DF	Fc - Perp	650.0 psi	Ebend- yy	1,600.0 ksi
Wood Grade	24F-V4	Fv	265.0 psi	Eminbend - yy	850.0 ksi
		Ft	1,100.0 psi	Density	31.210 pcf
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 loads
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 5.250 ft
Uniform Load : D = 0.0150, L = 0.040 ksf, Extent = 8.0 -->> 16.0 ft, Tributary Width = 4.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.577** : 1	Maximum Shear Stress Ratio	=	**0.313** : 1
Section used for this span		**5.125x12**	Section used for this span		**5.125x12**
fb: Actual	=	1,385.66 psi	fv: Actual	=	82.98 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	=	8.818 ft	Location of maximum on span	=	15.007 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.324 in	Ratio =	592 >=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <480	n/a
Max Downward Total Deflection	0.490 in	Ratio =	392 >=360	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0 <360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 16.0 ft	**1**	0.216	0.116	0.90	1.000	1.00	1.00	1.00	1.00	1.00	4.79	467.01	2160.00	1.13	27.55	238.50
+D+L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 16.0 ft	**1**	0.577	0.313	1.00	1.000	1.00	1.00	1.00	1.00	1.00	14.20	1,385.66	2400.00	3.40	82.98	265.00
+D+0.750L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 16.0 ft	**1**	0.385	0.209	1.25	1.000	1.00	1.00	1.00	1.00	1.00	11.85	1,155.95	3000.00	2.83	69.13	331.25
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 16.0 ft	**1**	0.073	0.039	1.60	1.000	1.00	1.00	1.00	1.00	1.00	2.87	280.21	3840.00	0.68	16.53	424.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.4896	8.175		0.0000	0.000

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: B3

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	3.067	3.947
Overall MINimum	2.000	2.640
D Only	1.067	1.307
+D+L	3.067	3.947
+D+0.750L	2.567	3.287
+0.60D	0.640	0.784
L Only	2.000	2.640

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

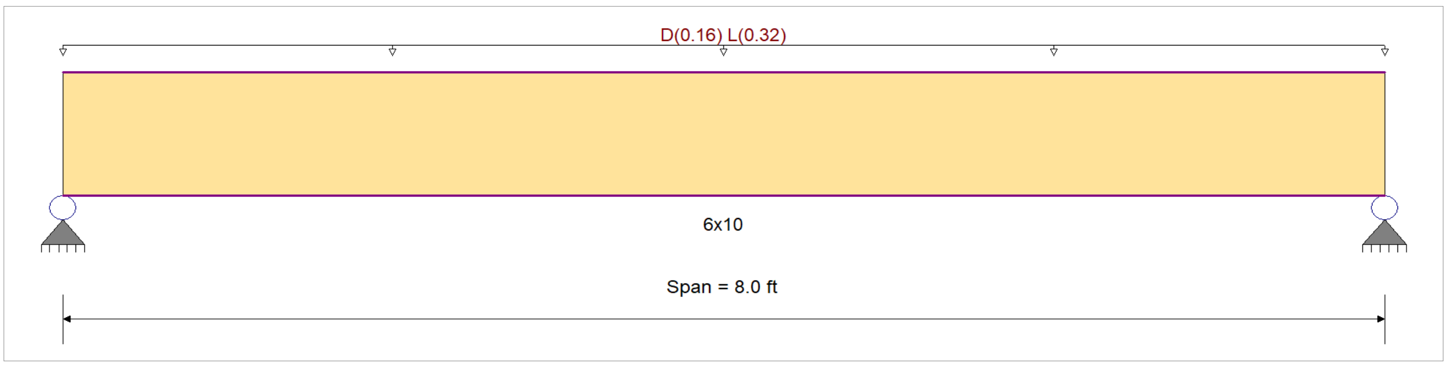
DESCRIPTION: B4

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	750.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	750.0 psi	Ebend- xx	1,300.0 ksi
		Fc - Prll	700.0 psi	Eminbend - xx	470.0 ksi
Wood Species	Douglas Fir-Larch	Fc - Perp	625.0 psi		
Wood Grade	No.2	Fv	170.0 psi		
		Ft	475.0 psi	Density	31.210 pcf
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 loads
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 8.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.760** : 1	Maximum Shear Stress Ratio	=	**0.266** : 1
Section used for this span		**6x10**	Section used for this span		**6x10**
fb: Actual	=	570.14 psi	fv: Actual	=	45.30 psi
Fb: Allowable	=	750.00 psi	Fv: Allowable	=	170.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	4.000 ft	Location of maximum on span	=	7.212 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.058 in	Ratio =	1653 >=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <480	n/a
Max Downward Total Deflection	0.089 in	Ratio =	1076 >=360	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0 <360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 8.0 ft	1	0.295	0.103	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.37	198.81	675.00	0.55	15.80	153.00
+D+L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 8.0 ft	1	0.760	0.266	1.00	1.000	1.00	1.00	1.00	1.00	1.00	3.93	570.14	750.00	1.58	45.30	170.00
+D+0.750L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 8.0 ft	1	0.509	0.178	1.25	1.000	1.00	1.00	1.00	1.00	1.00	3.29	477.31	937.50	1.32	37.92	212.50
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 8.0 ft	1	0.099	0.035	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.82	119.28	1200.00	0.33	9.48	272.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0892	4.029		0.0000	0.000

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: B4

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.965	1.965
Overall MINimum	1.280	1.280
D Only	0.685	0.685
+D+L	1.965	1.965
+D+0.750L	1.645	1.645
+0.60D	0.411	0.411
L Only	1.280	1.280

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: B5

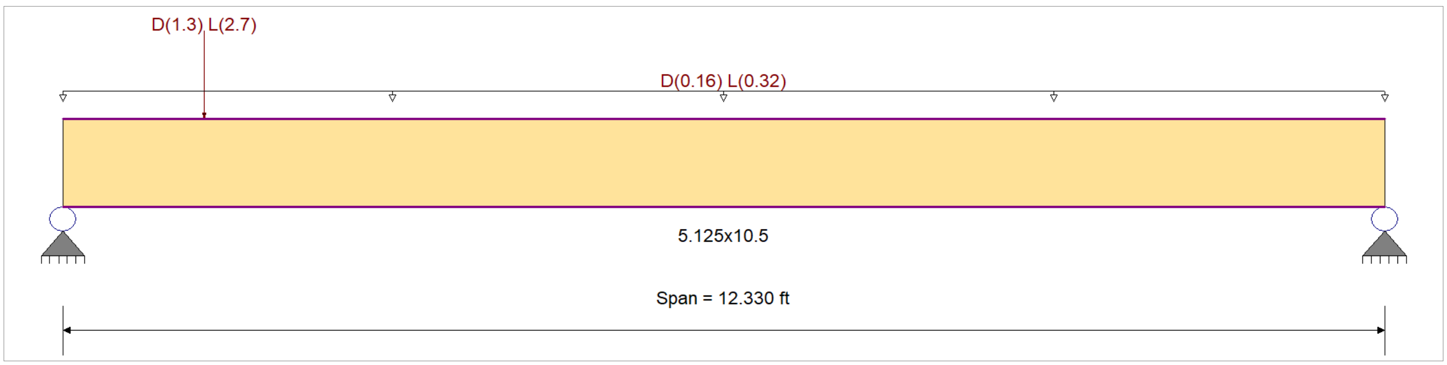
CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,400.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	1,850.0 psi	Ebend- xx	1,800.0 ksi
		Fc - Prll	1,650.0 psi	Eminbend - xx	950.0 ksi
Wood Species	DF/DF	Fc - Perp	650.0 psi	Ebend- yy	1,600.0 ksi
Wood Grade	24F-V4	Fv	265.0 psi	Eminbend - yy	850.0 ksi
		Ft	1,100.0 psi	Density	31.210 pcf

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 loads
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 8.0 ft
Point Load : D = 1.30, L = 2.70 k @ 1.330 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.647**: 1	Maximum Shear Stress Ratio	=	**0.650** : 1
Section used for this span		**5.125x10.5**	Section used for this span		**5.125x10.5**
fb: Actual	=	1,553.66 psi	fv: Actual	=	172.24 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	=	5.265 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.254 in	Ratio =	581	>=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0	<480	n/a
Max Downward Total Deflection	0.387 in	Ratio =	382	>=360	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0	<360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 12.330 ft	1	0.247	0.242	0.90	1.000	1.00	1.00	1.00	1.00	1.00	4.18	533.15	2160.00	2.07	57.74	238.50
+D+L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 12.330 ft	1	0.647	0.650	1.00	1.000	1.00	1.00	1.00	1.00	1.00	12.19	1,553.66	2400.00	6.18	172.24	265.00
+D+0.750L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 12.330 ft	1	0.433	0.434	1.25	1.000	1.00	1.00	1.00	1.00	1.00	10.19	1,298.53	3000.00	5.15	143.62	331.25
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 12.330 ft	1	0.083	0.082	1.60	1.000	1.00	1.00	1.00	1.00	1.00	2.51	319.89	3840.00	1.24	34.64	424.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.3870	5.985		0.0000	0.000

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: B5

Vertical Reactions

Support notation : Far left is #· Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	6.600	3.463
Overall MINimum	4.382	2.264
D Only	2.218	1.199
+D+L	6.600	3.463
+D+0.750L	5.504	2.897
+0.60D	1.331	0.719
L Only	4.382	2.264

Project Title: MERCER ISLAND RESIDENCE
Engineer: BRT
Project ID: 21-201
Project Descr:

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

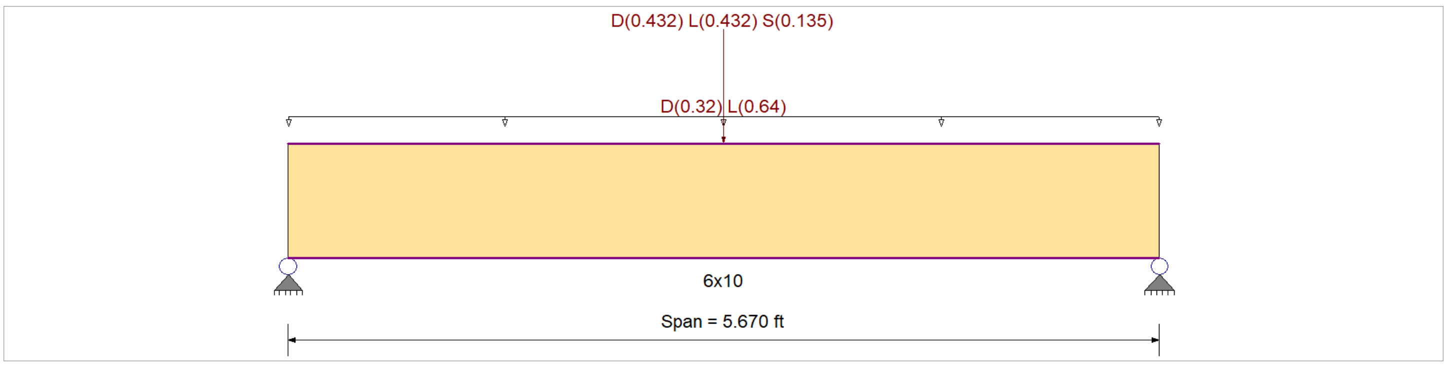
DESCRIPTION: B6

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	1,200.0 psi	*E : Modulus of Elasticit*		
Load Combination	IBC 2018	Fb -	1,200.0 psi	Ebend- xx	1,600.0 ksi	
		Fc - Prll	1,000.0 psi	Eminbend - xx	580.0 ksi	
Wood Species	Douglas Fir-Larch	Fc - Perp	625.0 psi			
Wood Grade	No.1	Fv	170.0 psi			
		Ft	825.0 psi	Density	31.210 pcf	
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 loads
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 16.0 ft
Point Load : D = 0.4320, L = 0.4320, S = 0.1350 k @ 2.835 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.620**: 1	Maximum Shear Stress Ratio	=	**0.409** : 1
Section used for this span		**6x10**	Section used for this span		**6x10**
fb: Actual	=	743.84 psi	fv: Actual	=	69.53 psi
Fb: Allowable	=	1,200.00 psi	Fv: Allowable	=	170.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	2.835 ft	Location of maximum on span	=	4.884 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.028 in	Ratio =	2400 >=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <480	n/a
Max Downward Total Deflection	0.045 in	Ratio =	1505 >=360	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0 <360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 5.670 ft	1	0.261	0.168	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.94	281.95	1080.00	0.89	25.69	153.00
+D+L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 5.670 ft	1	0.620	0.409	1.00	1.000	1.00	1.00	1.00	1.00	1.00	5.13	743.84	1200.00	2.42	69.53	170.00
+D+S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 5.670 ft	1	0.224	0.141	1.15	1.000	1.00	1.00	1.00	1.00	1.00	2.14	309.71	1380.00	0.96	27.62	195.50
+D+0.750L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 5.670 ft	1	0.419	0.276	1.25	1.000	1.00	1.00	1.00	1.00	1.00	4.33	628.37	1500.00	2.04	58.57	212.50
+D+0.750L+0.750S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 5.670 ft	1	0.470	0.307	1.15	1.000	1.00	1.00	1.00	1.00	1.00	4.48	649.19	1380.00	2.09	60.02	195.50
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 5.670 ft	1	0.088	0.057	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.17	169.17	1920.00	0.54	15.41	272.00

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: B6

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0452	2.856		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	3.186	3.186
Overall MINimum	0.068	0.068
D Only	1.155	1.155
+D+L	3.186	3.186
+D+S	1.223	1.223
+D+0.750L	2.678	2.678
+D+0.750L+0.750S	2.729	2.729
+0.60D	0.693	0.693
L Only	2.030	2.030
S Only	0.068	0.068

Steel Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.31 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

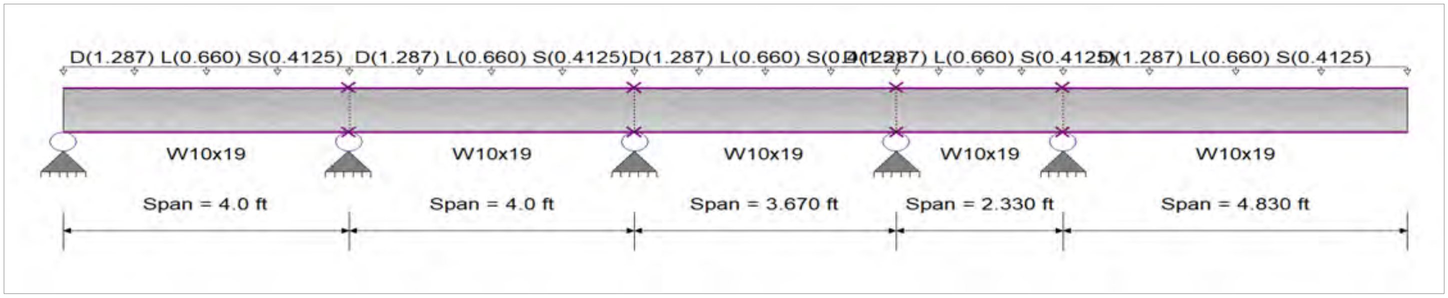
DESCRIPTION: Copy of B7b

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

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

Beam self weight calculated and added to loading

Load for Span Number 1
Uniform Load : D = 0.0780, L = 0.040, S = 0.0250 ksf, Tributary Width = 16.50 ft

Load for Span Number 2
Uniform Load : D = 0.0780, L = 0.040, S = 0.0250 ksf, Tributary Width = 16.50 ft

Load for Span Number 3
Uniform Load : D = 0.0780, L = 0.040, S = 0.0250 ksf, Tributary Width = 16.50 ft

Load for Span Number 4
Uniform Load : D = 0.0780, L = 0.040, S = 0.0250 ksf, Tributary Width = 16.50 ft

Load for Span Number 5
Uniform Load : D = 0.0780, L = 0.040, S = 0.0250 ksf, Tributary Width = 16.50 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.407** : 1	Maximum Shear Stress Ratio =	**0.252** : 1
Section used for this span	**W10x19**	Section used for this span	**W10x19**
Mu : Applied	33.004 k-ft	Vu : Applied	19.313 k
Mn * Phi : Allowable	81.000 k-ft	Vn * Phi : Allowable	76.50 k
Load Combination	+1.20D+1.60L+0.50S	Load Combination	+1.20D+1.60L+0.50S
Location of maximum on span	2.330 ft	Location of maximum on span	2.330 ft
Span # where maximum occurs	Span # 4	Span # where maximum occurs	Span # 4

Maximum Deflection

Max Downward Transient Deflection	0.043 in	Ratio =	2,677	>=480.	Span: 5 : L Only
Max Upward Transient Deflection	-0.001 in	Ratio =	21,054	>=480.	Span: 5 : L Only
Max Downward Total Deflection	0.138 in	Ratio =	837	>=360.	Span: 5 : +D+0.750L+0.750S
Max Upward Total Deflection	-0.004 in	Ratio =	6585	>=360.	Span: 5 : +D+0.750L+0.750S

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	VuMax	Vnx	Phi*Vnx
+1.40D													
Dsgn. L = 4.00 ft	1	0.035	0.057	2.38	-2.83	2.83	90.00	81.00	1.00	1.00	4.36	76.50	76.50
Dsgn. L = 4.00 ft	2	0.041	0.066	0.59	-3.31	3.31	90.00	81.00	1.00	1.00	5.02	76.50	76.50
Dsgn. L = 3.67 ft	3	0.044	0.107	3.57	-3.31	3.57	90.00	81.00	1.00	1.00	8.22	76.50	76.50
Dsgn. L = 2.33 ft	4	0.263	0.163	2.79	-21.33	21.33	90.00	81.00	1.00	1.00	12.48	76.50	76.50
Dsgn. L = 4.83 ft	5	0.263	0.115		-21.33	21.33	90.00	81.00	1.00	1.00	8.83	76.50	76.50
+1.20D+1.60L													

Steel Beam

DESCRIPTION: Copy of B7b

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	VuMax	Vnx	Phi*Vnx
Dsgn. L = 4.00 ft	1	0.050	0.082	3.41	-4.06	4.06	90.00	81.00	1.00	1.00	6.26	76.50	76.50
Dsgn. L = 4.00 ft	2	0.059	0.094	0.85	-4.75	4.75	90.00	81.00	1.00	1.00	7.20	76.50	76.50
Dsgn. L = 3.67 ft	3	0.063	0.154	5.13	-4.75	5.13	90.00	81.00	1.00	1.00	11.79	76.50	76.50
Dsgn. L = 2.33 ft	4	0.378	0.234	4.00	-30.60	30.60	90.00	81.00	1.00	1.00	17.91	76.50	76.50
Dsgn. L = 4.83 ft	5	0.378	0.166		-30.60	30.60	90.00	81.00	1.00	1.00	12.67	76.50	76.50
+1.20D+1.60L+0.50S													
Dsgn. L = 4.00 ft	1	0.054	0.088	3.68	-4.38	4.38	90.00	81.00	1.00	1.00	6.75	76.50	76.50
Dsgn. L = 4.00 ft	2	0.063	0.101	0.92	-5.12	5.12	90.00	81.00	1.00	1.00	7.76	76.50	76.50
Dsgn. L = 3.67 ft	3	0.068	0.166	5.53	-5.12	5.53	90.00	81.00	1.00	1.00	12.72	76.50	76.50
Dsgn. L = 2.33 ft	4	0.407	0.252	4.32	-33.00	33.00	90.00	81.00	1.00	1.00	19.31	76.50	76.50
Dsgn. L = 4.83 ft	5	0.407	0.179		-33.00	33.00	90.00	81.00	1.00	1.00	13.67	76.50	76.50
+1.20D+0.50L													
Dsgn. L = 4.00 ft	1	0.036	0.059	2.47	-2.94	2.94	90.00	81.00	1.00	1.00	4.53	76.50	76.50
Dsgn. L = 4.00 ft	2	0.042	0.068	0.61	-3.43	3.43	90.00	81.00	1.00	1.00	5.21	76.50	76.50
Dsgn. L = 3.67 ft	3	0.046	0.111	3.71	-3.43	3.71	90.00	81.00	1.00	1.00	8.53	76.50	76.50
Dsgn. L = 2.33 ft	4	0.273	0.169	2.89	-22.13	22.13	90.00	81.00	1.00	1.00	12.95	76.50	76.50
Dsgn. L = 4.83 ft	5	0.273	0.120		-22.13	22.13	90.00	81.00	1.00	1.00	9.16	76.50	76.50
+1.20D													
Dsgn. L = 4.00 ft	1	0.030	0.049	2.04	-2.43	2.43	90.00	81.00	1.00	1.00	3.74	76.50	76.50
Dsgn. L = 4.00 ft	2	0.035	0.056	0.51	-2.84	2.84	90.00	81.00	1.00	1.00	4.30	76.50	76.50
Dsgn. L = 3.67 ft	3	0.038	0.092	3.06	-2.84	3.06	90.00	81.00	1.00	1.00	7.05	76.50	76.50
Dsgn. L = 2.33 ft	4	0.226	0.140	2.39	-18.28	18.28	90.00	81.00	1.00	1.00	10.70	76.50	76.50
Dsgn. L = 4.83 ft	5	0.226	0.099		-18.28	18.28	90.00	81.00	1.00	1.00	7.57	76.50	76.50
+1.20D+0.50L+1.60S													
Dsgn. L = 4.00 ft	1	0.049	0.080	3.33	-3.96	3.96	90.00	81.00	1.00	1.00	6.10	76.50	76.50
Dsgn. L = 4.00 ft	2	0.057	0.092	0.83	-4.63	4.63	90.00	81.00	1.00	1.00	7.02	76.50	76.50
Dsgn. L = 3.67 ft	3	0.062	0.150	5.00	-4.63	5.00	90.00	81.00	1.00	1.00	11.50	76.50	76.50
Dsgn. L = 2.33 ft	4	0.368	0.228	3.90	-29.83	29.83	90.00	81.00	1.00	1.00	17.45	76.50	76.50
Dsgn. L = 4.83 ft	5	0.368	0.161		-29.83	29.83	90.00	81.00	1.00	1.00	12.35	76.50	76.50
+1.20D+1.60S													
Dsgn. L = 4.00 ft	1	0.043	0.069	2.90	-3.45	3.45	90.00	81.00	1.00	1.00	5.32	76.50	76.50
Dsgn. L = 4.00 ft	2	0.050	0.080	0.72	-4.03	4.03	90.00	81.00	1.00	1.00	6.11	76.50	76.50
Dsgn. L = 3.67 ft	3	0.054	0.131	4.35	-4.03	4.35	90.00	81.00	1.00	1.00	10.01	76.50	76.50
Dsgn. L = 2.33 ft	4	0.321	0.199	3.40	-25.98	25.98	90.00	81.00	1.00	1.00	15.20	76.50	76.50
Dsgn. L = 4.83 ft	5	0.321	0.141		-25.98	25.98	90.00	81.00	1.00	1.00	10.76	76.50	76.50
+1.20D+0.50L+0.50S													
Dsgn. L = 4.00 ft	1	0.040	0.066	2.74	-3.26	3.26	90.00	81.00	1.00	1.00	5.02	76.50	76.50
Dsgn. L = 4.00 ft	2	0.047	0.075	0.68	-3.81	3.81	90.00	81.00	1.00	1.00	5.77	76.50	76.50
Dsgn. L = 3.67 ft	3	0.051	0.124	4.11	-3.81	4.11	90.00	81.00	1.00	1.00	9.46	76.50	76.50
Dsgn. L = 2.33 ft	4	0.303	0.188	3.21	-24.54	24.54	90.00	81.00	1.00	1.00	14.36	76.50	76.50
Dsgn. L = 4.83 ft	5	0.303	0.133		-24.54	24.54	90.00	81.00	1.00	1.00	10.16	76.50	76.50
+1.20D+0.50L+0.70S													
Dsgn. L = 4.00 ft	1	0.042	0.068	2.84	-3.38	3.38	90.00	81.00	1.00	1.00	5.22	76.50	76.50
Dsgn. L = 4.00 ft	2	0.049	0.078	0.71	-3.96	3.96	90.00	81.00	1.00	1.00	6.00	76.50	76.50
Dsgn. L = 3.67 ft	3	0.053	0.128	4.27	-3.96	4.27	90.00	81.00	1.00	1.00	9.83	76.50	76.50
Dsgn. L = 2.33 ft	4	0.315	0.195	3.33	-25.50	25.50	90.00	81.00	1.00	1.00	14.92	76.50	76.50
Dsgn. L = 4.83 ft	5	0.315	0.138		-25.50	25.50	90.00	81.00	1.00	1.00	10.56	76.50	76.50
+0.90D													
Dsgn. L = 4.00 ft	1	0.022	0.037	1.53	-1.82	1.82	90.00	81.00	1.00	1.00	2.81	76.50	76.50
Dsgn. L = 4.00 ft	2	0.026	0.042	0.38	-2.13	2.13	90.00	81.00	1.00	1.00	3.22	76.50	76.50
Dsgn. L = 3.67 ft	3	0.028	0.069	2.30	-2.13	2.30	90.00	81.00	1.00	1.00	5.28	76.50	76.50
Dsgn. L = 2.33 ft	4	0.169	0.105	1.79	-13.71	13.71	90.00	81.00	1.00	1.00	8.02	76.50	76.50
Dsgn. L = 4.83 ft	5	0.169	0.074		-13.71	13.71	90.00	81.00	1.00	1.00	5.68	76.50	76.50

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.0024	1.800		0.0000	0.000
	2	0.0000	1.800	+D+0.750L+0.750S	-0.0003	3.367
+D+0.750L+0.750S	3	0.0029	2.171		0.0000	3.367
	4	0.0000	2.171	+D+0.750L+0.750S	-0.0042	1.417
+D+0.750L+0.750S	5	0.1384	4.830		0.0000	1.417

Steel Beam

Project File: 21201 enercalc - brt.ec6

DESCRIPTION: Copy of B7b

Vertical Reactions

Support notation : Far left is #´ Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4	Support 5	Support 6
Overall MAXimum	3.404	9.119	10.149	-7.533	24.598	
Overall MINimum	-0.665	-1.783	-1.984	1.472	-4.808	
D Only	2.107	5.644	6.281	-4.662	15.222	
+D+L	3.171	8.496	9.455	-7.018	22.915	
+D+S	2.772	7.426	8.265	-6.134	20.030	
+D+0.750L	2.905	7.783	8.662	-6.429	20.992	
+D+0.750L+0.750S	3.404	9.119	10.149	-7.533	24.598	
+0.60D	1.264	3.386	3.769	-2.797	9.133	
L Only	1.065	2.852	3.174	-2.356	7.693	
S Only	0.665	1.783	1.984	-1.472	4.808	

Steel Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.31 PCS STRUCTURAL SOLUTIONS

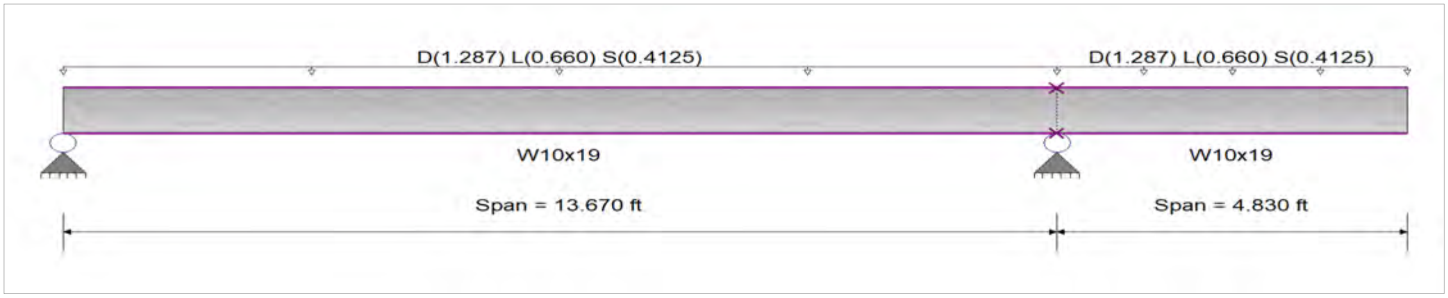
DESCRIPTION: B7a

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

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

Beam self weight calculated and added to loading
Load for Span Number 1
Uniform Load : D = 0.0780, L = 0.040, S = 0.0250 ksf, Tributary Width = 16.50 ft

Load for Span Number 2
Uniform Load : D = 0.0780, L = 0.040, S = 0.0250 ksf, Tributary Width = 16.50 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.625** : 1	Maximum Shear Stress Ratio =	**0.284** : 1
Section used for this span	**W10x19**	Section used for this span	**W10x19**
Mu : Applied	50.619 k-ft	Vu : Applied	21.754 k
Mn * Phi : Allowable	81.000 k-ft	Vn * Phi : Allowable	76.50 k
Load Combination	+1.20D+1.60L+0.50S	Load Combination	+1.20D+1.60L+0.50S
Location of maximum on span	5.960 ft	Location of maximum on span	13.670 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.131 in	Ratio =	1,247	>=480.	Span: 2 : L Only
Max Upward Transient Deflection	-0.077 in	Ratio =	1,497	>=480.	Span: 2 : L Only
Max Downward Total Deflection	0.420 in	Ratio =	390	>=360.	Span: 2 : +D+0.750L+0.750S
Max Upward Total Deflection	-0.247 in	Ratio =	468	>=360.	Span: 2 : +D+0.750L+0.750S

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	VuMax	Vnx	Phi*Vnx
+1.40D													
Dsgn. L = 13.67 ft	1	0.404	0.184	32.71	-21.33	32.71	90.00	81.00	1.00	1.00	14.06	76.50	76.50
Dsgn. L = 4.83 ft	2	0.263	0.115		-21.33	21.33	90.00	81.00	1.00	1.00	8.83	76.50	76.50
+1.20D+1.60L													
Dsgn. L = 13.67 ft	1	0.579	0.264	46.93	-30.60	46.93	90.00	81.00	1.00	1.00	20.17	76.50	76.50
Dsgn. L = 4.83 ft	2	0.378	0.166		-30.60	30.60	90.00	81.00	1.00	1.00	12.67	76.50	76.50
+1.20D+1.60L+0.50S													
Dsgn. L = 13.67 ft	1	0.625	0.284	50.62	-33.00	50.62	90.00	81.00	1.00	1.00	21.75	76.50	76.50
Dsgn. L = 4.83 ft	2	0.407	0.179		-33.00	33.00	90.00	81.00	1.00	1.00	13.67	76.50	76.50
+1.20D+0.50L													
Dsgn. L = 13.67 ft	1	0.419	0.191	33.94	-22.13	33.94	90.00	81.00	1.00	1.00	14.59	76.50	76.50
Dsgn. L = 4.83 ft	2	0.273	0.120		-22.13	22.13	90.00	81.00	1.00	1.00	9.16	76.50	76.50
+1.20D													
Dsgn. L = 13.67 ft	1	0.346	0.158	28.04	-18.28	28.04	90.00	81.00	1.00	1.00	12.05	76.50	76.50
Dsgn. L = 4.83 ft	2	0.226	0.099		-18.28	18.28	90.00	81.00	1.00	1.00	7.57	76.50	76.50
+1.20D+0.50L+1.60S													
Dsgn. L = 13.67 ft	1	0.565	0.257	45.75	-29.83	45.75	90.00	81.00	1.00	1.00	19.66	76.50	76.50

Steel Beam

DESCRIPTION: B7a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	Summary of Moment Values max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	Summary of Shear Values VuMax	Vnx	Phi*Vnx
Dsgn. L = 4.83 ft	2	0.368	0.161		-29.83	29.83	90.00	81.00	1.00	1.00	12.35	76.50	76.50
+1.20D+1.60S													
Dsgn. L = 13.67 ft	1	0.492	0.224	39.85	-25.98	39.85	90.00	81.00	1.00	1.00	17.12	76.50	76.50
Dsgn. L = 4.83 ft	2	0.321	0.141		-25.98	25.98	90.00	81.00	1.00	1.00	10.76	76.50	76.50
+1.20D+0.50L+0.50S													
Dsgn. L = 13.67 ft	1	0.465	0.211	37.63	-24.54	37.63	90.00	81.00	1.00	1.00	16.17	76.50	76.50
Dsgn. L = 4.83 ft	2	0.303	0.133		-24.54	24.54	90.00	81.00	1.00	1.00	10.16	76.50	76.50
+1.20D+0.50L+0.70S													
Dsgn. L = 13.67 ft	1	0.483	0.220	39.11	-25.50	39.11	90.00	81.00	1.00	1.00	16.81	76.50	76.50
Dsgn. L = 4.83 ft	2	0.315	0.138		-25.50	25.50	90.00	81.00	1.00	1.00	10.56	76.50	76.50
+0.90D													
Dsgn. L = 13.67 ft	1	0.260	0.118	21.03	-13.71	21.03	90.00	81.00	1.00	1.00	9.04	76.50	76.50
Dsgn. L = 4.83 ft	2	0.169	0.074		-13.71	13.71	90.00	81.00	1.00	1.00	5.68	76.50	76.50

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.4203	6.507		0.0000	0.000
	2	0.0000	6.507	+D+0.750L+0.750S	-0.2475	4.830

Vertical Reactions

Support notation : Far left is #

Values in KIPS

Load Combination	Support 1	Support 2	Support 3		
Overall MAXimum	12.624	26.418		-1.472	4.808
Overall MINimum	-2.467	-5.164		-1.472	4.808
D Only	7.812	16.349		-1.472	4.808
+D+L	11.760	24.611		-1.472	4.808
+D+S	10.280	21.513		-1.472	4.808
+D+0.750L	10.773	22.545		-1.472	4.808
+D+0.750L+0.750S	12.624	26.418		-1.472	4.808
+0.60D	4.687	9.809		-1.472	4.808
L Only	3.948	8.262		-1.472	4.808
S Only	2.467	5.164		-1.472	4.808

Steel Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.10.20 PCS STRUCTURAL SOLUTIONS

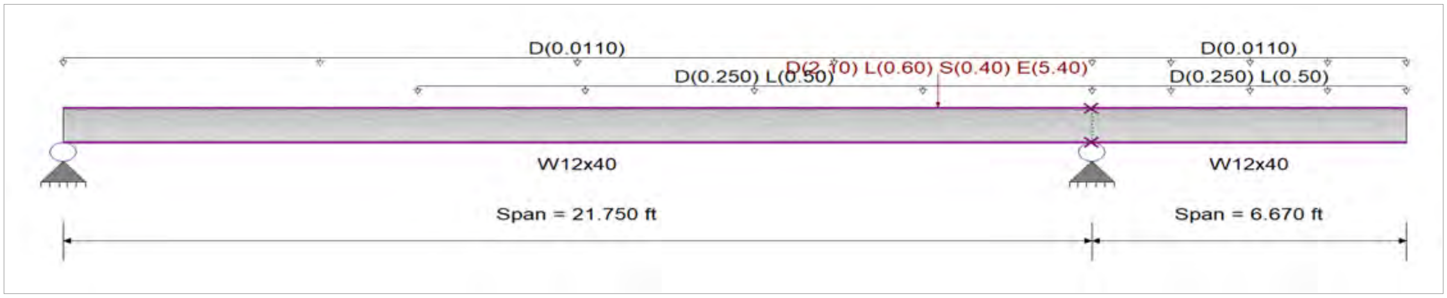
DESCRIPTION: B8

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

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

Beam self weight calculated and added to loading
Load for Span Number 1
Uniform Load : D = 0.020, L = 0.040 ksf, Extent = 7.50 -->> 21.750 ft, Tributary Width = 12.50 ft

Point Load : D = 2.10, L = 0.60, S = 0.40, E = 5.40 k @ 18.50 ft

Uniform Load : D = 0.0110 k/ft, Tributary Width = 1.0 ft

Load for Span Number 2
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 12.50 ft

Uniform Load : D = 0.0110 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.218** : 1	Maximum Shear Stress Ratio =	**0.147** : 1
Section used for this span	**W12x40**	Section used for this span	**W12x40**
Mu : Applied	46.526 k-ft	Vu : Applied	15.523 k
Mn * Phi : Allowable	213.750 k-ft	Vn * Phi : Allowable	105.315 k
Load Combination	+1.20D+1.60L+0.50S	Load Combination	+1.20D+1.60L+0.50S
Location of maximum on span	11.571 ft	Location of maximum on span	21.750 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.156 in	Ratio =	1,668	>=480.	Span: 2 : L Only
Max Upward Transient Deflection	-0.102 in	Ratio =	1,577	>=480.	Span: 2 : L Only
Max Downward Total Deflection	0.308 in	Ratio =	846	>=360.	Span: 2 : +D+0.750L+0.750S+0.5250E
Max Upward Total Deflection	-0.261 in	Ratio =	614	>=360.	Span: 2 : +D+0.750L+0.750S+0.5250E

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	VuMax	Vnx	Phi*Vnx
+1.40D													
Dsgn. L = 21.75 ft	1	0.095	0.067	20.34	-9.37	20.34	237.50	213.75	1.00	1.00	7.06	105.32	105.32
Dsgn. L = 6.67 ft	2	0.044	0.027		-9.37	9.37	237.50	213.75	1.00	1.00	2.81	105.32	105.32
+1.20D+1.60L													
Dsgn. L = 21.75 ft	1	0.216	0.146	46.18	-25.83	46.18	237.50	213.75	1.00	1.00	15.35	105.32	105.32
Dsgn. L = 6.67 ft	2	0.121	0.074		-25.83	25.83	237.50	213.75	1.00	1.00	7.75	105.32	105.32
+1.20D+1.60L+0.50S													
Dsgn. L = 21.75 ft	1	0.218	0.147	46.53	-25.83	46.53	237.50	213.75	1.00	1.00	15.52	105.32	105.32
Dsgn. L = 6.67 ft	2	0.121	0.074		-25.83	25.83	237.50	213.75	1.00	1.00	7.75	105.32	105.32
+1.20D+0.50L													

Steel Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.10.20 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: B8

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	VuMax	Vnx	Phi*Vnx
Dsgn. L = 21.75 ft	1	0.124	0.085	26.40	-13.60	26.40	237.50	213.75	1.00	1.00	8.96	105.32	105.32
Dsgn. L = 6.67 ft	2	0.064	0.039		-13.60	13.60	237.50	213.75	1.00	1.00	4.08	105.32	105.32
+1.20D													
Dsgn. L = 21.75 ft	1	0.082	0.057	17.43	-8.03	17.43	237.50	213.75	1.00	1.00	6.05	105.32	105.32
Dsgn. L = 6.67 ft	2	0.038	0.023		-8.03	8.03	237.50	213.75	1.00	1.00	2.41	105.32	105.32
+1.20D+0.50L+1.60S													
Dsgn. L = 21.75 ft	1	0.129	0.090	27.53	-13.60	27.53	237.50	213.75	1.00	1.00	9.50	105.32	105.32
Dsgn. L = 6.67 ft	2	0.064	0.039		-13.60	13.60	237.50	213.75	1.00	1.00	4.08	105.32	105.32
+1.20D+1.60S													
Dsgn. L = 21.75 ft	1	0.087	0.063	18.59	-8.03	18.59	237.50	213.75	1.00	1.00	6.60	105.32	105.32
Dsgn. L = 6.67 ft	2	0.038	0.023		-8.03	8.03	237.50	213.75	1.00	1.00	2.41	105.32	105.32
+1.20D+0.50L+0.50S													
Dsgn. L = 21.75 ft	1	0.125	0.087	26.75	-13.60	26.75	237.50	213.75	1.00	1.00	9.13	105.32	105.32
Dsgn. L = 6.67 ft	2	0.064	0.039		-13.60	13.60	237.50	213.75	1.00	1.00	4.08	105.32	105.32
+1.20D+0.50L+0.70S+E													
Dsgn. L = 21.75 ft	1	0.173	0.131	36.93	-13.60	36.93	237.50	213.75	1.00	1.00	13.79	105.32	105.32
Dsgn. L = 6.67 ft	2	0.064	0.039		-13.60	13.60	237.50	213.75	1.00	1.00	4.08	105.32	105.32
+0.90D													
Dsgn. L = 21.75 ft	1	0.061	0.043	13.08	-6.03	13.08	237.50	213.75	1.00	1.00	4.54	105.32	105.32
Dsgn. L = 6.67 ft	2	0.028	0.017		-6.03	6.03	237.50	213.75	1.00	1.00	1.81	105.32	105.32
+0.90D+E													
Dsgn. L = 21.75 ft	1	0.112	0.087	23.93	-6.03	23.93	237.50	213.75	1.00	1.00	9.13	105.32	105.32
Dsgn. L = 6.67 ft	2	0.028	0.017		-6.03	6.03	237.50	213.75	1.00	1.00	1.81	105.32	105.32

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S+0.5250E	1	0.3084	11.310		0.0000	0.000
	2	0.0000	11.310	+D+0.750L+0.750S+0.5250E	-0.2606	6.670

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum	3.640	16.579	
Overall MINimum	-0.060	-0.340	
D Only	1.728	7.052	
+D+L	3.640	16.199	
+D+S	1.787	7.392	
+D+0.750L	3.162	13.913	
+D+0.750L+0.750S	3.207	14.168	
+D+0.70E	2.292	10.267	
+D+0.750L+0.750S+0.5250E	3.630	16.579	
+0.60D	1.037	4.231	
+0.60D+0.70E	1.601	7.446	
L Only	1.912	9.148	
S Only	0.060	0.340	
E Only	0.807	4.593	

Steel Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: B9

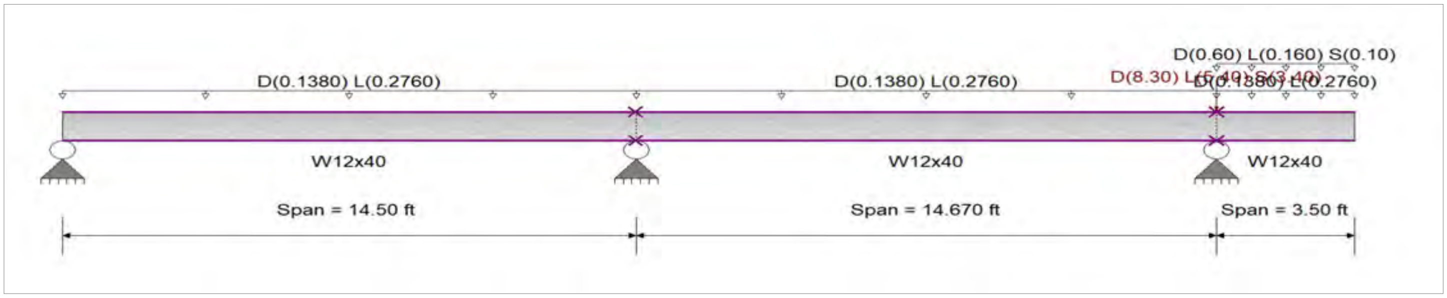
CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method : Load Resistance Factor Design
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling
Bending Axis : Major Axis Bending

Fy : Steel Yield : 50.0 ksi
E: Modulus : 29,000.0 ksi



Applied Loads

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

Beam self weight calculated and added to loading
Load for Span Number 1
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 6.90 ft

Load for Span Number 2
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 6.90 ft

Load for Span Number 3
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 6.90 ft

Uniform Load : D = 0.150, L = 0.040, S = 0.0250 ksf, Tributary Width = 4.0 ft

Point Load : D = 8.30, L = 5.40, S = 3.40 k @ 0.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.070** : 1	Maximum Shear Stress Ratio =	**0.056** : 1
Section used for this span	**W12x40**	Section used for this span	**W12x40**
Mu : Applied	14.911 k-ft	Vu : Applied	5.884 k
Mn * Phi : Allowable	213.750 k-ft	Vn * Phi : Allowable	105.315 k
Load Combination	+1.20D+1.60L	Load Combination	+1.20D+1.60L+0.50S
Location of maximum on span	14.500 ft	Location of maximum on span	14.670 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 2

Maximum Deflection

Max Downward Transient Deflection	0.014 in	Ratio = 12,088	>=480.	Span: 3 : L Only
Max Upward Transient Deflection	-0.003 in	Ratio = 26,775	>=480.	Span: 3 : L Only
Max Downward Total Deflection	0.026 in	Ratio = 6815	>=360.	Span: 3 : +D+L
Max Upward Total Deflection	-0.003 in	Ratio = 58229	>=360.	Span: 3 : +D+S

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	VuMax	Vnx	Phi*Vnx
+1.40D													
Dsgn. L = 14.50 ft	1	0.023	0.020	4.31	-4.95	4.95	237.50	213.75	1.00	1.00	2.15	105.32	105.32
Dsgn. L = 14.67 ft	2	0.031	0.036	0.92	-6.67	6.67	237.50	213.75	1.00	1.00	3.81	105.32	105.32
Dsgn. L = 3.50 ft	3	0.031	0.036		-6.67	6.67	237.50	213.75	1.00	1.00	3.81	105.32	105.32
+1.20D+1.60L													
Dsgn. L = 14.50 ft	1	0.070	0.055	10.57	-14.91	14.91	237.50	213.75	1.00	1.00	5.78	105.32	105.32
Dsgn. L = 14.67 ft	2	0.070	0.054	5.26	-14.91	14.91	237.50	213.75	1.00	1.00	5.71	105.32	105.32
Dsgn. L = 3.50 ft	3	0.047	0.054		-9.99	9.99	237.50	213.75	1.00	1.00	5.71	105.32	105.32
+1.20D+1.60L+0.50S													

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LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: B9

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	VuMax	Vnx	Phi*Vnx
Dsgn. L = 14.50 ft	1	0.069	0.055	10.60	-14.83	14.83	237.50	213.75	1.00	1.00	5.77	105.32	105.32
Dsgn. L = 14.67 ft	2	0.069	0.056	5.13	-14.83	14.83	237.50	213.75	1.00	1.00	5.88	105.32	105.32
Dsgn. L = 3.50 ft	3	0.048	0.056		-10.30	10.30	237.50	213.75	1.00	1.00	5.88	105.32	105.32
+1.20D+0.50L													
Dsgn. L = 14.50 ft	1	0.035	0.029	5.84	-7.58	7.58	237.50	213.75	1.00	1.00	3.07	105.32	105.32
Dsgn. L = 14.67 ft	2	0.035	0.038	2.15	-7.58	7.58	237.50	213.75	1.00	1.00	4.03	105.32	105.32
Dsgn. L = 3.50 ft	3	0.033	0.038		-7.05	7.05	237.50	213.75	1.00	1.00	4.03	105.32	105.32
+1.20D													
Dsgn. L = 14.50 ft	1	0.020	0.017	3.69	-4.24	4.24	237.50	213.75	1.00	1.00	1.84	105.32	105.32
Dsgn. L = 14.67 ft	2	0.027	0.031	0.79	-5.72	5.72	237.50	213.75	1.00	1.00	3.27	105.32	105.32
Dsgn. L = 3.50 ft	3	0.027	0.031		-5.72	5.72	237.50	213.75	1.00	1.00	3.27	105.32	105.32
+1.20D+0.50L+1.60S													
Dsgn. L = 14.50 ft	1	0.034	0.029	5.94	-7.33	7.33	237.50	213.75	1.00	1.00	3.05	105.32	105.32
Dsgn. L = 14.67 ft	2	0.038	0.044	1.78	-8.03	8.03	237.50	213.75	1.00	1.00	4.59	105.32	105.32
Dsgn. L = 3.50 ft	3	0.038	0.044		-8.03	8.03	237.50	213.75	1.00	1.00	4.59	105.32	105.32
+1.20D+1.60S													
Dsgn. L = 14.50 ft	1	0.019	0.017	3.79	-4.00	4.00	237.50	213.75	1.00	1.00	1.82	105.32	105.32
Dsgn. L = 14.67 ft	2	0.031	0.036	0.48	-6.70	6.70	237.50	213.75	1.00	1.00	3.83	105.32	105.32
Dsgn. L = 3.50 ft	3	0.031	0.036		-6.70	6.70	237.50	213.75	1.00	1.00	3.83	105.32	105.32
+1.20D+0.50L+0.50S													
Dsgn. L = 14.50 ft	1	0.035	0.029	5.87	-7.50	7.50	237.50	213.75	1.00	1.00	3.07	105.32	105.32
Dsgn. L = 14.67 ft	2	0.035	0.040	2.03	-7.50	7.50	237.50	213.75	1.00	1.00	4.21	105.32	105.32
Dsgn. L = 3.50 ft	3	0.034	0.040		-7.36	7.36	237.50	213.75	1.00	1.00	4.21	105.32	105.32
+1.20D+0.50L+0.70S													
Dsgn. L = 14.50 ft	1	0.035	0.029	5.88	-7.47	7.47	237.50	213.75	1.00	1.00	3.06	105.32	105.32
Dsgn. L = 14.67 ft	2	0.035	0.041	1.98	-7.48	7.48	237.50	213.75	1.00	1.00	4.28	105.32	105.32
Dsgn. L = 3.50 ft	3	0.035	0.041		-7.48	7.48	237.50	213.75	1.00	1.00	4.28	105.32	105.32
+0.90D													
Dsgn. L = 14.50 ft	1	0.015	0.013	2.77	-3.18	3.18	237.50	213.75	1.00	1.00	1.38	105.32	105.32
Dsgn. L = 14.67 ft	2	0.020	0.023	0.59	-4.29	4.29	237.50	213.75	1.00	1.00	2.45	105.32	105.32
Dsgn. L = 3.50 ft	3	0.020	0.023		-4.29	4.29	237.50	213.75	1.00	1.00	2.45	105.32	105.32

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0255	6.380		0.0000	0.000
L Only	2	0.0081	8.215	+D+S	-0.0021	13.399
+D+S	3	0.0108	3.500		0.0000	13.399

Vertical Reactions

Support notation : Far left is # Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4
Overall MAXimum	2.588	7.514	21.773	
Overall MINimum	-0.011	0.063	-3.802	
D Only	1.047	2.756	12.412	
+D+L	2.588	7.514	21.090	
+D+S	1.057	2.693	16.215	
+D+0.750L	2.203	6.324	18.921	
+D+0.750L+0.750S	2.210	6.277	21.773	
+0.60D	0.628	1.654	7.447	
L Only	1.541	4.758	8.678	
S Only	0.011	-0.063	3.802	

Steel Beam

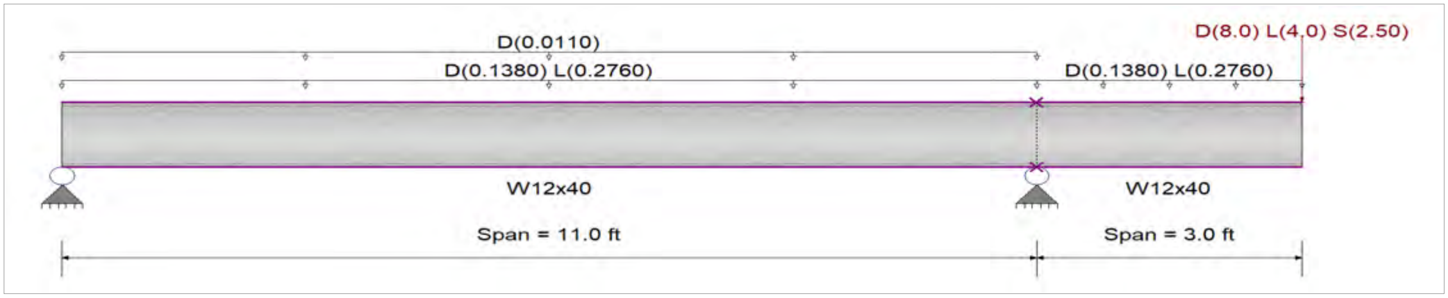
DESCRIPTION: B10

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

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

Beam self weight calculated and added to loading
Load for Span Number 1
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 6.90 ft

Uniform Load : D = 0.0110 k/ft, Tributary Width = 1.0 ft

Load for Span Number 2
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 6.90 ft

Point Load : D = 8.0, L = 4.0, S = 2.50 k @ 3.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.256** : 1	Maximum Shear Stress Ratio =	**0.182** : 1
Section used for this span	**W12x40**	Section used for this span	**W12x40**
Mu : Applied	54.698 k-ft	Vu : Applied	19.216 k
Mn * Phi : Allowable	213.750 k-ft	Vn * Phi : Allowable	105.315 k
Load Combination	+1.20D+1.60L+0.50S	Load Combination	+1.20D+1.60L+0.50S
Location of maximum on span	11.000 ft	Location of maximum on span	11.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.027 in	Ratio = 2,679	>=480.	Span: 2 : S Only
Max Upward Transient Deflection	-0.011 in	Ratio = 11,621	>=480.	Span: 2 : L Only
Max Downward Total Deflection	0.097 in	Ratio = 746	>=360.	Span: 2 : +D+0.750L+0.750S
Max Upward Total Deflection	-0.047 in	Ratio = 2813	>=360.	Span: 2 : +D+0.750L+0.750S

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	VuMax	Vnx	Phi*Vnx
+1.40D													
Dsgn. L = 11.00 ft	1	0.162	0.113		-34.72	34.72	237.50	213.75	1.00	1.00	11.95	105.32	105.32
Dsgn. L = 3.00 ft	2	0.162	0.113		-34.72	34.72	237.50	213.75	1.00	1.00	11.95	105.32	105.32
+1.20D+1.60L													
Dsgn. L = 11.00 ft	1	0.238	0.171		-50.95	50.95	237.50	213.75	1.00	1.00	17.97	105.32	105.32
Dsgn. L = 3.00 ft	2	0.238	0.171		-50.95	50.95	237.50	213.75	1.00	1.00	17.97	105.32	105.32
+1.20D+1.60L+0.50S													
Dsgn. L = 11.00 ft	1	0.256	0.182		-54.70	54.70	237.50	213.75	1.00	1.00	19.22	105.32	105.32
Dsgn. L = 3.00 ft	2	0.256	0.182		-54.70	54.70	237.50	213.75	1.00	1.00	19.22	105.32	105.32
+1.20D+0.50L													
Dsgn. L = 11.00 ft	1	0.170	0.120		-36.38	36.38	237.50	213.75	1.00	1.00	12.65	105.32	105.32
Dsgn. L = 3.00 ft	2	0.170	0.120		-36.38	36.38	237.50	213.75	1.00	1.00	12.65	105.32	105.32

Steel Beam

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LIC# : KW-06014122, Build:20.21.8.31 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: B10

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	VuMax	Vnx	Phi*Vnx
+1.20D													
Dsgn. L = 11.00 ft	1	0.139	0.097		-29.76	29.76	237.50	213.75	1.00	1.00	10.24	105.32	105.32
Dsgn. L = 3.00 ft	2	0.139	0.097		-29.76	29.76	237.50	213.75	1.00	1.00	10.24	105.32	105.32
+1.20D+0.50L+1.60S													
Dsgn. L = 11.00 ft	1	0.226	0.158		-48.38	48.38	237.50	213.75	1.00	1.00	16.65	105.32	105.32
Dsgn. L = 3.00 ft	2	0.226	0.158		-48.38	48.38	237.50	213.75	1.00	1.00	16.65	105.32	105.32
+1.20D+1.60S													
Dsgn. L = 11.00 ft	1	0.195	0.135		-41.76	41.76	237.50	213.75	1.00	1.00	14.24	105.32	105.32
Dsgn. L = 3.00 ft	2	0.195	0.135		-41.76	41.76	237.50	213.75	1.00	1.00	14.24	105.32	105.32
+1.20D+0.50L+0.50S													
Dsgn. L = 11.00 ft	1	0.188	0.132		-40.13	40.13	237.50	213.75	1.00	1.00	13.90	105.32	105.32
Dsgn. L = 3.00 ft	2	0.188	0.132		-40.13	40.13	237.50	213.75	1.00	1.00	13.90	105.32	105.32
+1.20D+0.50L+0.70S													
Dsgn. L = 11.00 ft	1	0.195	0.137		-41.63	41.63	237.50	213.75	1.00	1.00	14.40	105.32	105.32
Dsgn. L = 3.00 ft	2	0.195	0.137		-41.63	41.63	237.50	213.75	1.00	1.00	14.40	105.32	105.32
+0.90D													
Dsgn. L = 11.00 ft	1	0.104	0.073		-22.32	22.32	237.50	213.75	1.00	1.00	7.68	105.32	105.32
Dsgn. L = 3.00 ft	2	0.104	0.073		-22.32	22.32	237.50	213.75	1.00	1.00	7.68	105.32	105.32

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
	1	0.0000	0.000	+D+0.750L+0.750S	-0.0469	6.644
+D+0.750L+0.750S	2	0.0966	3.000		0.0000	6.644

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum	-1.897	19.877	4.808
Overall MINimum	-0.314	-3.182	4.808
D Only	-1.215	11.828	4.808
+D+L	-0.901	19.378	4.808
+D+S	-1.897	15.010	4.808
+D+0.750L	-0.979	17.491	4.808
+D+0.750L+0.750S	-1.491	19.877	4.808
+0.60D	-0.729	7.097	4.808
L Only	0.314	7.550	4.808
S Only	-0.682	3.182	4.808

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

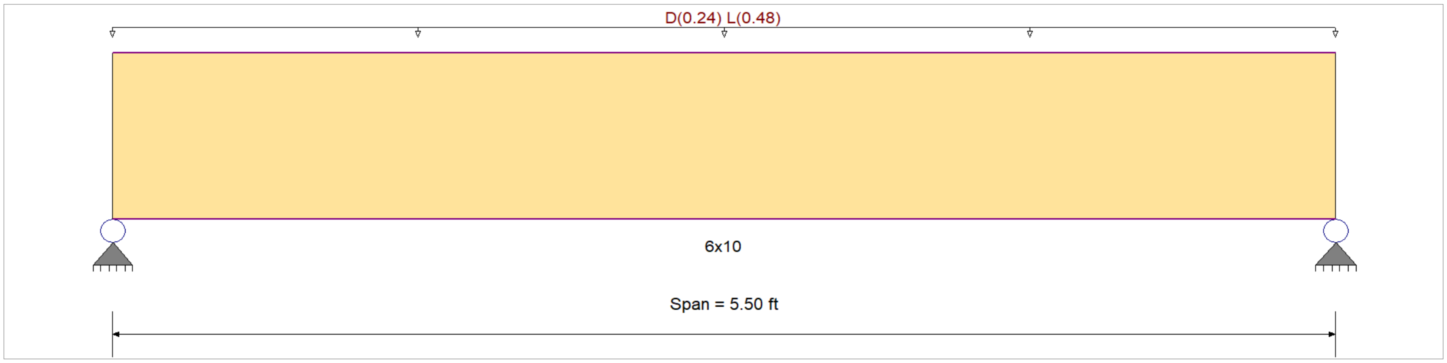
DESCRIPTION: B11

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	750.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	750.0 psi	Ebend- xx	1,300.0 ksi
		Fc - Prll	700.0 psi	Eminbend - xx	470.0 ksi
Wood Species	Douglas Fir-Larch	Fc - Perp	625.0 psi		
Wood Grade	No.2	Fv	170.0 psi		
		Ft	475.0 psi	Density	31.210 pcf
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 loads
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 12.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.535** : 1	Maximum Shear Stress Ratio	=	**0.243** : 1
Section used for this span		**6x10**	Section used for this span		**6x10**
fb: Actual	=	401.11 psi	fv: Actual	=	41.30 psi
Fb: Allowable	=	750.00 psi	Fv: Allowable	=	170.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	2.750 ft	Location of maximum on span	=	4.717 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.019 in	Ratio =	3391	>=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0	<480	n/a
Max Downward Total Deflection	0.030 in	Ratio =	2226	>=360	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0	<360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	Moment Values M	fb	F'b	Shear Values V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 5.50 ft	1	0.204	0.093	0.90	1.000	1.00	1.00	1.00	1.00	1.00	0.95	137.85	675.00	0.49	14.19	153.00
+D+L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 5.50 ft	1	0.535	0.243	1.00	1.000	1.00	1.00	1.00	1.00	1.00	2.77	401.11	750.00	1.44	41.30	170.00
+D+0.750L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 5.50 ft	1	0.358	0.162	1.25	1.000	1.00	1.00	1.00	1.00	1.00	2.31	335.30	937.50	1.20	34.52	212.50
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 5.50 ft	1	0.069	0.031	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.57	82.71	1200.00	0.30	8.52	272.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0296	2.770		0.0000	0.000

Wood Beam

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DESCRIPTION: B11

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	2.011	2.011
Overall MINimum	1.320	1.320
D Only	0.691	0.691
+D+L	2.011	2.011
+D+0.750L	1.681	1.681
+0.60D	0.415	0.415
L Only	1.320	1.320

Wood Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.31 | PCS STRUCTURAL SOLUTIONS |

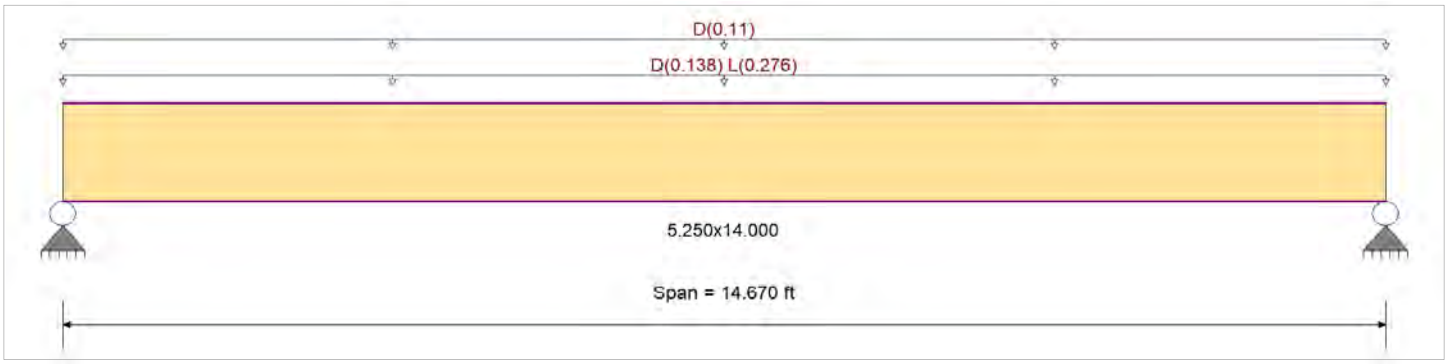
DESCRIPTION: B12 - Wood

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,900.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	2,900.0 psi	Ebend- xx	2,000.0 ksi
		Fc - Prll	3,200.0 psi	Eminbend - xx	1,000.0 ksi
Wood Species	Louisiana Pacific	Fc - Perp	750.0 psi		
Wood Grade	SolidStart LVL 2900Fb-2.0E	Fv	285.0 psi		
		Ft	1,800.0 psi	Density	28.720 pcf
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 loads
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 6.90 ft
Uniform Load : D = 0.110 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.350**: 1	Maximum Shear Stress Ratio	=	**0.240** : 1
Section used for this span		**5.250x14.000**	Section used for this span		**5.250x14.000**
fb: Actual	=	1,013.91 psi	fv: Actual	=	68.27 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	285.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	7.335 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.120 in	Ratio =	1461 >=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <480	n/a
Max Downward Total Deflection	0.235 in	Ratio =	748 >=360	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0 <360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 14.670 ft	1	0.189	0.130	0.90	1.000	1.00	1.00	1.00	1.00	1.00	7.07	494.40	2610.00	1.63	33.29	256.50
+D+L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 14.670 ft	1	0.350	0.240	1.00	1.000	1.00	1.00	1.00	1.00	1.00	14.49	1,013.91	2900.00	3.35	68.27	285.00
+D+0.750L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 14.670 ft	1	0.244	0.167	1.25	1.000	1.00	1.00	1.00	1.00	1.00	12.63	884.04	3625.00	2.92	59.53	356.25
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 14.670 ft	1	0.064	0.044	1.60	1.000	1.00	1.00	1.00	1.00	1.00	4.24	296.64	4640.00	0.98	19.97	456.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.2352	7.389		0.0000	0.000

Wood Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.31 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: B12 - Wood

Vertical Reactions

Support notation : Far left is #´ Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	3.951	3.951
Overall MINimum	2.024	2.024
D Only	1.927	1.927
+D+L	3.951	3.951
+D+0.750L	3.445	3.445
+0.60D	1.156	1.156
L Only	2.024	2.024

Steel Beam

Project File: 21201 enercalc - brt.ec6

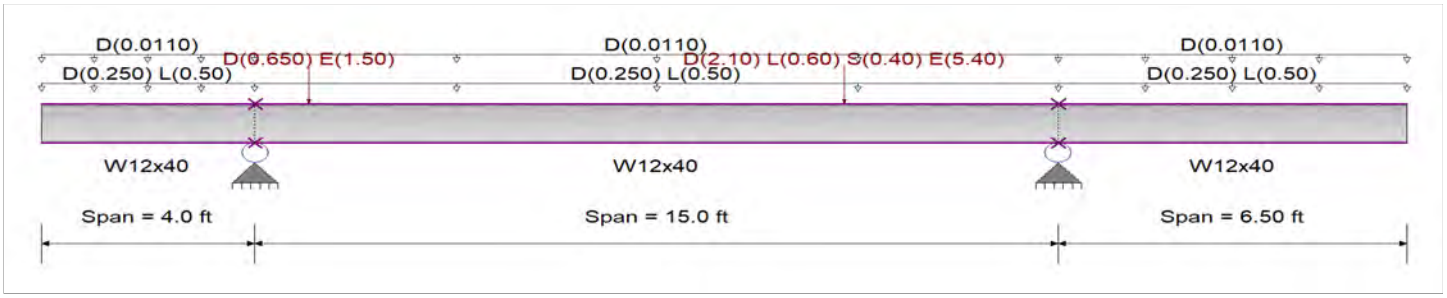
DESCRIPTION: B13

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

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

Beam self weight calculated and added to loading
Load for Span Number 1
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 12.50 ft

Uniform Load : D = 0.0110 k/ft, Tributary Width = 1.0 ft

Load for Span Number 2
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 12.50 ft

Point Load : D = 0.650, E = 1.50 k @ 1.0 ft

Point Load : D = 2.10, L = 0.60, S = 0.40, E = 5.40 k @ 11.0 ft

Uniform Load : D = 0.0110 k/ft, Tributary Width = 1.0 ft

Load for Span Number 3
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 12.50 ft

Uniform Load : D = 0.0110 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.133** : 1	Maximum Shear Stress Ratio =	**0.118** : 1
Section used for this span	**W12x40**	Section used for this span	**W12x40**
Mu : Applied	28.471 k-ft	Vu : Applied	12.476 k
Mn * Phi : Allowable	213.750 k-ft	Vn * Phi : Allowable	105.315 k
Load Combination	+1.20D+0.50L+0.70S+E	Load Combination	+1.20D+1.60L+0.50S
Location of maximum on span	10.100 ft	Location of maximum on span	15.000 ft
Span # where maximum occurs	Span # 2	Span # where maximum occurs	Span # 2

Maximum Deflection

Max Downward Transient Deflection	0.059 in	Ratio =	3,071	>=480.	Span: 3 : E Only
Max Upward Transient Deflection	-0.091 in	Ratio =	1,708	>=480.	Span: 3 : E Only
Max Downward Total Deflection	0.094 in	Ratio =	1919	>=360.	Span: 3 : +D+0.750L+0.750S+0.5250E
Max Upward Total Deflection	-0.067 in	Ratio =	1435	>=360.	Span: 3 : +D+0.750L+0.750S+0.5250E

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	VuMax	Vnx	Phi*Vnx
+1.40D													

Steel Beam

DESCRIPTION: B13

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	VuMax	Vnx	Phi*Vnx
Dsgn. L = 4.00 ft	1	0.016	0.042		-3.37	3.37	237.50	213.75	1.00	1.00	4.43	105.32	105.32
Dsgn. L = 15.00 ft	2	0.057	0.055	12.20	-8.90	12.20	237.50	213.75	1.00	1.00	5.75	105.32	105.32
Dsgn. L = 6.50 ft	3	0.042	0.026		-8.90	8.90	237.50	213.75	1.00	1.00	2.74	105.32	105.32
+1.20D+1.60L													
Dsgn. L = 4.00 ft	1	0.043	0.089		-9.29	9.29	237.50	213.75	1.00	1.00	9.35	105.32	105.32
Dsgn. L = 15.00 ft	2	0.115	0.117	23.11	-24.53	24.53	237.50	213.75	1.00	1.00	12.33	105.32	105.32
Dsgn. L = 6.50 ft	3	0.115	0.072		-24.53	24.53	237.50	213.75	1.00	1.00	7.55	105.32	105.32
+1.20D+1.60L+0.50S													
Dsgn. L = 4.00 ft	1	0.043	0.089		-9.29	9.29	237.50	213.75	1.00	1.00	9.40	105.32	105.32
Dsgn. L = 15.00 ft	2	0.115	0.118	23.50	-24.53	24.53	237.50	213.75	1.00	1.00	12.48	105.32	105.32
Dsgn. L = 6.50 ft	3	0.115	0.072		-24.53	24.53	237.50	213.75	1.00	1.00	7.55	105.32	105.32
+1.20D+0.50L													
Dsgn. L = 4.00 ft	1	0.023	0.053		-4.89	4.89	237.50	213.75	1.00	1.00	5.53	105.32	105.32
Dsgn. L = 15.00 ft	2	0.067	0.069	14.34	-12.91	14.34	237.50	213.75	1.00	1.00	7.24	105.32	105.32
Dsgn. L = 6.50 ft	3	0.060	0.038		-12.91	12.91	237.50	213.75	1.00	1.00	3.97	105.32	105.32
+1.20D													
Dsgn. L = 4.00 ft	1	0.014	0.036		-2.89	2.89	237.50	213.75	1.00	1.00	3.79	105.32	105.32
Dsgn. L = 15.00 ft	2	0.049	0.047	10.46	-7.63	10.46	237.50	213.75	1.00	1.00	4.93	105.32	105.32
Dsgn. L = 6.50 ft	3	0.036	0.022		-7.63	7.63	237.50	213.75	1.00	1.00	2.35	105.32	105.32
+1.20D+0.50L+1.60S													
Dsgn. L = 4.00 ft	1	0.023	0.054		-4.89	4.89	237.50	213.75	1.00	1.00	5.70	105.32	105.32
Dsgn. L = 15.00 ft	2	0.073	0.073	15.69	-12.91	15.69	237.50	213.75	1.00	1.00	7.71	105.32	105.32
Dsgn. L = 6.50 ft	3	0.060	0.038		-12.91	12.91	237.50	213.75	1.00	1.00	3.97	105.32	105.32
+1.20D+1.60S													
Dsgn. L = 4.00 ft	1	0.014	0.038		-2.89	2.89	237.50	213.75	1.00	1.00	3.96	105.32	105.32
Dsgn. L = 15.00 ft	2	0.056	0.051	11.92	-7.63	11.92	237.50	213.75	1.00	1.00	5.39	105.32	105.32
Dsgn. L = 6.50 ft	3	0.036	0.022		-7.63	7.63	237.50	213.75	1.00	1.00	2.35	105.32	105.32
+1.20D+0.50L+0.50S													
Dsgn. L = 4.00 ft	1	0.023	0.053		-4.89	4.89	237.50	213.75	1.00	1.00	5.58	105.32	105.32
Dsgn. L = 15.00 ft	2	0.069	0.070	14.76	-12.91	14.76	237.50	213.75	1.00	1.00	7.39	105.32	105.32
Dsgn. L = 6.50 ft	3	0.060	0.038		-12.91	12.91	237.50	213.75	1.00	1.00	3.97	105.32	105.32
+1.20D+0.50L+0.70S+E													
Dsgn. L = 4.00 ft	1	0.023	0.080		-4.89	4.89	237.50	213.75	1.00	1.00	8.44	105.32	105.32
Dsgn. L = 15.00 ft	2	0.133	0.109	28.47	-12.91	28.47	237.50	213.75	1.00	1.00	11.50	105.32	105.32
Dsgn. L = 6.50 ft	3	0.060	0.038		-12.91	12.91	237.50	213.75	1.00	1.00	3.97	105.32	105.32
+0.90D													
Dsgn. L = 4.00 ft	1	0.010	0.027		-2.17	2.17	237.50	213.75	1.00	1.00	2.84	105.32	105.32
Dsgn. L = 15.00 ft	2	0.037	0.035	7.84	-5.72	7.84	237.50	213.75	1.00	1.00	3.69	105.32	105.32
Dsgn. L = 6.50 ft	3	0.027	0.017		-5.72	5.72	237.50	213.75	1.00	1.00	1.76	105.32	105.32
+0.90D+E													
Dsgn. L = 4.00 ft	1	0.010	0.054		-2.17	2.17	237.50	213.75	1.00	1.00	5.68	105.32	105.32
Dsgn. L = 15.00 ft	2	0.108	0.074	23.13	-5.72	23.13	237.50	213.75	1.00	1.00	7.75	105.32	105.32
Dsgn. L = 6.50 ft	3	0.027	0.017		-5.72	5.72	237.50	213.75	1.00	1.00	1.76	105.32	105.32

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
	1	0.0000	0.000	+D+0.750L+0.750S+0.5250E	-0.0669	0.000
+D+0.750L+0.750S+0.5250E	2	0.0938	7.700		0.0000	0.000
	3	0.0000	7.700	+D+0.70E	-0.0923	6.500

Vertical Reactions

Support notation : Far left is #· Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4
Overall MAXimum		10.040	14.320	
Overall MINimum		-0.107	-0.293	
D Only		4.365	6.061	
+D+L		9.837	13.938	
+D+S		4.471	6.354	
+D+0.750L		8.469	11.969	
+D+0.750L+0.750S		8.549	12.189	
+D+0.70E		6.353	8.903	
+D+0.750L+0.750S+0.5250E		10.040	14.320	
+0.60D		2.619	3.636	
+0.60D+0.70E		4.607	6.478	

Steel Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.10.20 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: B13

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4
L Only		5.473	7.878	
S Only		0.107	0.293	
E Only		2.840	4.060	

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 | PCS STRUCTURAL SOLUTIONS |

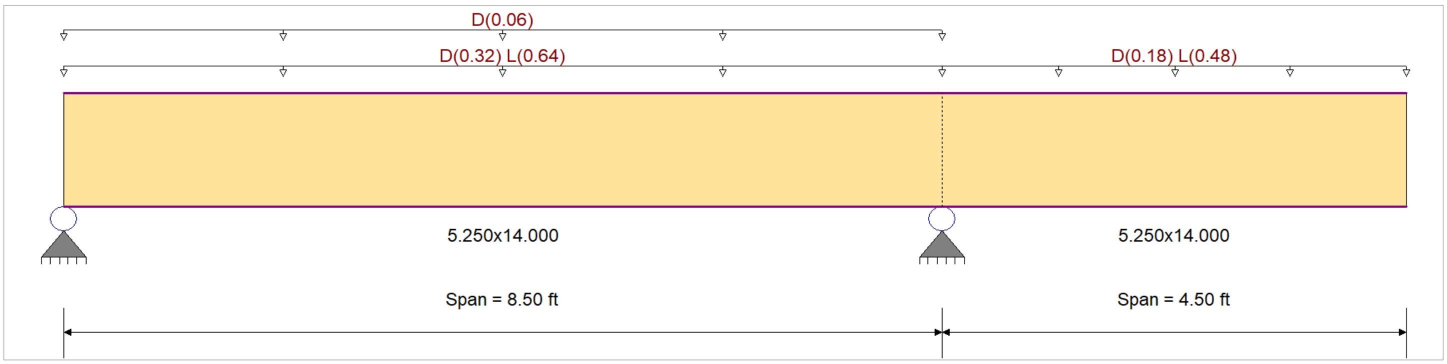
DESCRIPTION: B14

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,900.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	2,900.0 psi	Ebend- xx	2,000.0 ksi
		Fc - Prll	3,200.0 psi	Eminbend - xx	1,000.0 ksi
Wood Species	Louisiana Pacific	Fc - Perp	750.0 psi		
Wood Grade	SolidStart LVL 2900Fb-2.0E	Fv	285.0 psi		
		Ft	1,800.0 psi	Density	28.720 pcf
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 loads
Load for Span Number 1
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 16.0 ft
Uniform Load : D = 0.060 , Tributary Width = 1.0 ft
Load for Span Number 2
Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 12.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.165** : 1	Maximum Shear Stress Ratio	=	**0.288** : 1
Section used for this span		**5.250x14.000**	Section used for this span		**5.250x14.000**
fb: Actual	=	477.97 psi	fv: Actual	=	82.08 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	285.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	8.500 ft	Location of maximum on span	=	7.360 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.016 in	Ratio =	6380 >=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <480	n/a
Max Downward Total Deflection	0.029 in	Ratio =	3511 >=360	Span: 1 : +D+L
Max Upward Total Deflection	-0.007 in	Ratio =	14464 >=360	Span: 2 : D Only

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 8.50 ft	1	0.071	0.116	0.90	1.000	1.00	1.00	1.00	1.00	1.00	2.65	185.21	2610.00	1.46	29.78	256.50
Length = 4.50 ft	2	0.053	0.116	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.97	137.91	2610.00	0.65	29.78	256.50
+D+L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 8.50 ft	1	0.165	0.288	1.00	1.000	1.00	1.00	1.00	1.00	1.00	6.83	477.97	2900.00	4.02	82.08	285.00
Length = 4.50 ft	2	0.165	0.288	1.00	1.000	1.00	1.00	1.00	1.00	1.00	6.83	477.97	2900.00	2.26	82.08	285.00
+D+0.750L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 8.50 ft	1	0.108	0.194	1.25	1.000	1.00	1.00	1.00	1.00	1.00	5.62	392.95	3625.00	3.38	69.00	356.25
Length = 4.50 ft	2	0.108	0.194	1.25	1.000	1.00	1.00	1.00	1.00	1.00	5.62	392.95	3625.00	1.85	69.00	356.25

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: B14

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 8.50 ft	**1**	0.024	0.039	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.59	111.12	4640.00	0.88	17.87	456.00
Length = 4.50 ft	**2**	0.018	0.039	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.18	82.74	4640.00	0.39	17.87	456.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0291	3.894		0.0000	0.000
L Only	2	0.0092	4.500	D Only	-0.0066	3.721

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum	3.594	8.237	
Overall MINimum	2.148	5.452	
D Only	1.445	2.785	
+D+L	3.594	8.237	
+D+0.750L	3.057	6.874	
+0.60D	0.867	1.671	
L Only	2.148	5.452	

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

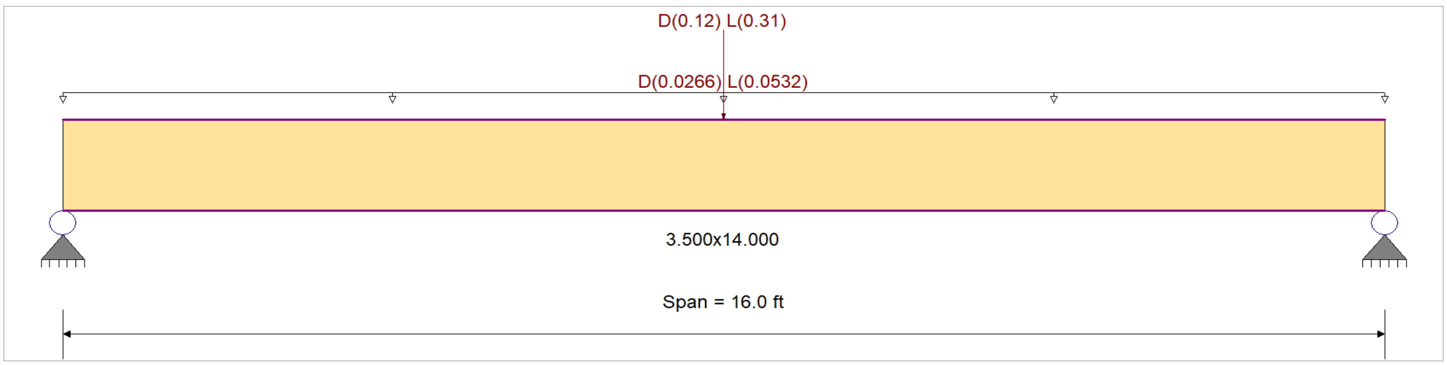
DESCRIPTION: B15

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,900.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	2,900.0 psi	Ebend- xx	2,000.0 ksi
		Fc - Prll	3,200.0 psi	Eminbend - xx	1,000.0 ksi
Wood Species	Louisiana Pacific	Fc - Perp	750.0 psi		
Wood Grade	SolidStart LVL 2900Fb-2.0E	Fv	285.0 psi		
		Ft	1,800.0 psi	Density	28.720 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 = 0.020, L = 0.040 ksf, Tributary Width = 1.330 ft
Point Load : D = 0.120, L = 0.310 k @ 8.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.155** : 1	Maximum Shear Stress Ratio	=	**0.082** : 1
Section used for this span		**3.500x14.000**	Section used for this span		**3.500x14.000**
fb: Actual	=	448.54 psi	fv: Actual	=	23.41 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	285.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	8.000 ft	Location of maximum on span	=	14.891 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.078 in	Ratio =	2461 >=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <480	n/a
Max Downward Total Deflection	0.114 in	Ratio =	1687 >=360	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0 <360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 16.0 ft	1	0.054	0.029	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.33	139.72	2610.00	0.24	7.45	256.50
+D+L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 16.0 ft	1	0.155	0.082	1.00	1.000	1.00	1.00	1.00	1.00	1.00	4.27	448.54	2900.00	0.76	23.41	285.00
+D+0.750L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 16.0 ft	1	0.102	0.055	1.25	1.000	1.00	1.00	1.00	1.00	1.00	3.54	371.34	3625.00	0.63	19.42	356.25
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 16.0 ft	1	0.018	0.010	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.80	83.83	4640.00	0.15	4.47	456.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.1138	8.058		0.0000	0.000

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: B15

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.853	0.853
Overall MINimum	0.581	0.581
D Only	0.273	0.273
+D+L	0.853	0.853
+D+0.750L	0.708	0.708
+0.60D	0.164	0.164
L Only	0.581	0.581

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

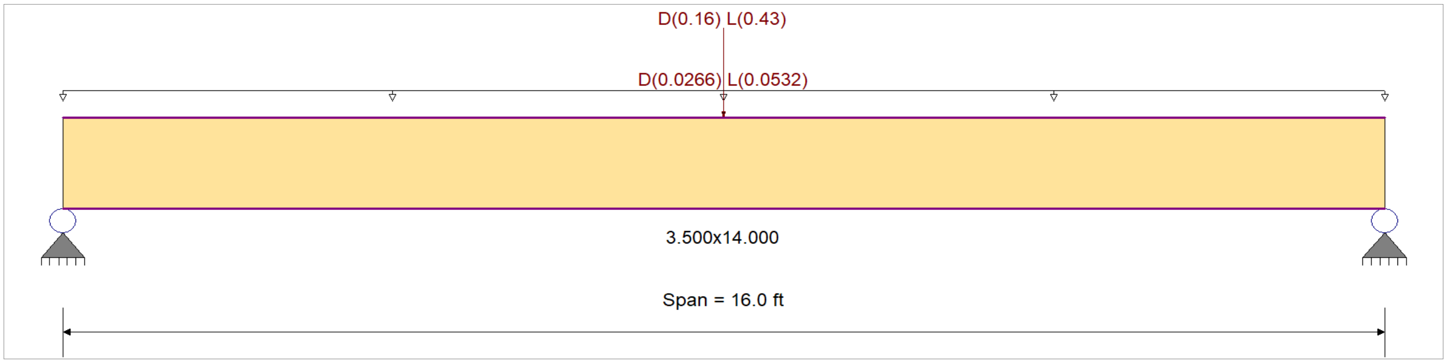
DESCRIPTION: SCL @ EXERCISE RM SHAFT

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,900.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	2,900.0 psi	Ebend- xx	2,000.0 ksi
		Fc - Prll	3,200.0 psi	Eminbend - xx	1,000.0 ksi
Wood Species	Louisiana Pacific	Fc - Perp	750.0 psi		
Wood Grade	SolidStart LVL 2900Fb-2.0E	Fv	285.0 psi		
		Ft	1,800.0 psi	Density	28.720 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 = 0.020, L = 0.040 ksf, Tributary Width = 1.330 ft
Point Load : D = 0.160, L = 0.430 k @ 8.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.178** : 1	Maximum Shear Stress Ratio	=	**0.091** : 1
Section used for this span		**3.500x14.000**	Section used for this span		**3.500x14.000**
fb: Actual	=	515.71 psi	fv: Actual	=	25.86 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	285.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	8.000 ft	Location of maximum on span	=	14.891 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.089 in	Ratio =	2154 >=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <480	n/a
Max Downward Total Deflection	0.129 in	Ratio =	1493 >=360	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0 <360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios										Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L		M	fb	F'b	V	fv	F'v
D Only														0.00	0.00	0.00	0.00
Length = 16.0 ft	1	0.060	0.031	0.90	1.000	1.00	1.00	1.00	1.00	1.00		1.49	156.51	2610.00	0.26	8.06	256.50
+D+L					1.000	1.00	1.00	1.00	1.00	1.00				0.00	0.00	0.00	0.00
Length = 16.0 ft	1	0.178	0.091	1.00	1.000	1.00	1.00	1.00	1.00	1.00		4.91	515.71	2900.00	0.84	25.86	285.00
+D+0.750L					1.000	1.00	1.00	1.00	1.00	1.00				0.00	0.00	0.00	0.00
Length = 16.0 ft	1	0.117	0.060	1.25	1.000	1.00	1.00	1.00	1.00	1.00		4.06	425.91	3625.00	0.70	21.41	356.25
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00				0.00	0.00	0.00	0.00
Length = 16.0 ft	1	0.020	0.011	1.60	1.000	1.00	1.00	1.00	1.00	1.00		0.89	93.91	4640.00	0.16	4.84	456.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.1286	8.058		0.0000	0.000

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: SCL @ EXERCISE RM SHAFT

Vertical Reactions

Support notation : Far left is #· Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.933	0.933
Overall MINimum	0.641	0.641
D Only	0.293	0.293
+D+L	0.933	0.933
+D+0.750L	0.773	0.773
+0.60D	0.176	0.176
L Only	0.641	0.641

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

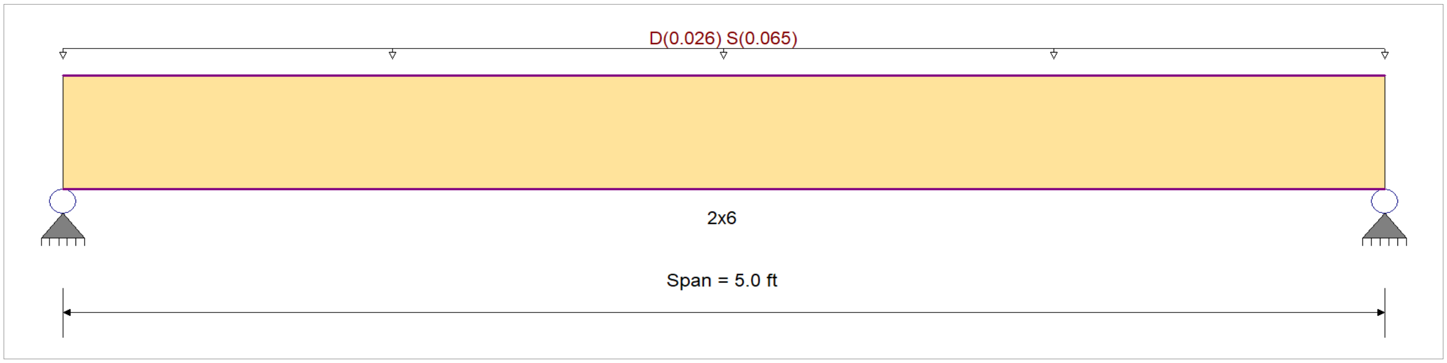
DESCRIPTION: B16

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	875 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	875 psi	Ebend- xx	1300 ksi
		Fc - Prll	600 psi	Eminbend - xx	470 ksi
Wood Species	Douglas Fir-Larch	Fc - Perp	625 psi		
Wood Grade	No.2	Fv	170 psi		
		Ft	425 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 = 0.010, S = 0.0250 ksf, Tributary Width = 2.60 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.265** : 1	Maximum Shear Stress Ratio	=	**0.173** : 1
Section used for this span		**2x6**	Section used for this span		**2x6**
fb: Actual	=	451.24 psi	fv: Actual	=	33.82 psi
Fb: Allowable	=	1,700.56 psi	Fv: Allowable	=	195.50 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	2.500 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.034 in	Ratio =	1764	>=480	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0	<480	n/a
Max Downward Total Deflection	0.048 in	Ratio =	1260	>=360	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0	<360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 5.0 ft	1	0.097	0.063	0.90	1.300	1.00	1.00	1.00	1.00	1.00	0.08	128.93	1330.88	0.05	9.66	153.00
+D+S					1.300	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 5.0 ft	1	0.265	0.173	1.15	1.300	1.00	1.00	1.00	1.00	1.00	0.28	451.24	1700.56	0.19	33.82	195.50
+D+0.750S					1.300	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 5.0 ft	1	0.218	0.142	1.15	1.300	1.00	1.00	1.00	1.00	1.00	0.23	370.66	1700.56	0.15	27.78	195.50
+0.60D					1.300	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 5.0 ft	1	0.033	0.021	1.60	1.300	1.00	1.00	1.00	1.00	1.00	0.05	77.36	2366.00	0.03	5.80	272.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.0476	2.518		0.0000	0.000

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: B16

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.228	0.228
Overall MINimum	0.163	0.163
D Only	0.065	0.065
+D+S	0.228	0.228
+D+0.750S	0.187	0.187
+0.60D	0.039	0.039
S Only	0.163	0.163

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

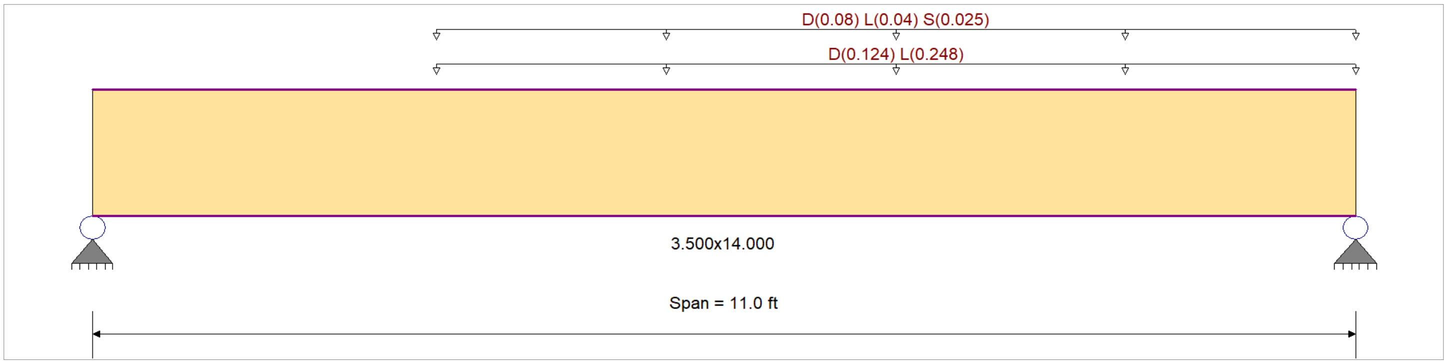
DESCRIPTION: B17

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,900.0 psi	*E : Modulus of Elasticit*	
Load Combination	IBC 2018	Fb -	2,900.0 psi	Ebend- xx	2,000.0 ksi
		Fc - Prll	3,200.0 psi	Eminbend - xx	1,000.0 ksi
Wood Species	Louisiana Pacific	Fc - Perp	750.0 psi		
Wood Grade	SolidStart LVL 2900Fb-2.0E	Fv	285.0 psi		
		Ft	1,800.0 psi	Density	28.720 pcf
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 = 0.020, L = 0.040 ksf, Extent = 3.0 -->> 11.0 ft, Tributary Width = 6.20 ft
Uniform Load : D = 0.080, L = 0.040, S = 0.0250 k/ft, Extent = 3.0 -->> 11.0 ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.231**: 1	Maximum Shear Stress Ratio	=	**0.208** : 1
Section used for this span		**3.500x14.000**	Section used for this span		**3.500x14.000**
fb: Actual	=	669.16 psi	fv: Actual	=	59.14 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	285.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	5.901 ft	Location of maximum on span	=	9.836 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.050 in	Ratio =	2665	>=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0	<480	n/a
Max Downward Total Deflection	0.085 in	Ratio =	1560	>=360	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0	<360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 11.0 ft	**1**	0.106	0.096	0.90	1.000	1.00	1.00	1.00	1.00	1.00	2.64	277.46	2610.00	0.80	24.52	256.50
+D+L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.0 ft	**1**	0.231	0.208	1.00	1.000	1.00	1.00	1.00	1.00	1.00	6.38	669.16	2900.00	1.93	59.14	285.00
+D+S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.0 ft	**1**	0.093	0.084	1.15	1.000	1.00	1.00	1.00	1.00	1.00	2.97	311.46	3335.00	0.90	27.53	327.75
+D+0.750L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.0 ft	**1**	0.158	0.142	1.25	1.000	1.00	1.00	1.00	1.00	1.00	5.44	571.24	3625.00	1.65	50.49	356.25
+D+0.750L+0.750S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.0 ft	**1**	0.179	0.161	1.15	1.000	1.00	1.00	1.00	1.00	1.00	5.69	596.74	3335.00	1.72	52.74	327.75
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.0 ft	**1**	0.036	0.032	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.59	166.48	4640.00	0.48	14.71	456.00

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: B17

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0846	5.661		0.0000	0.000

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.431	2.505
Overall MINimum	0.073	0.127
D Only	0.593	1.039
+D+L	1.431	2.505
+D+S	0.666	1.166
+D+0.750L	1.222	2.138
+D+0.750L+0.750S	1.276	2.234
+0.60D	0.356	0.623
L Only	0.838	1.466
S Only	0.073	0.127

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

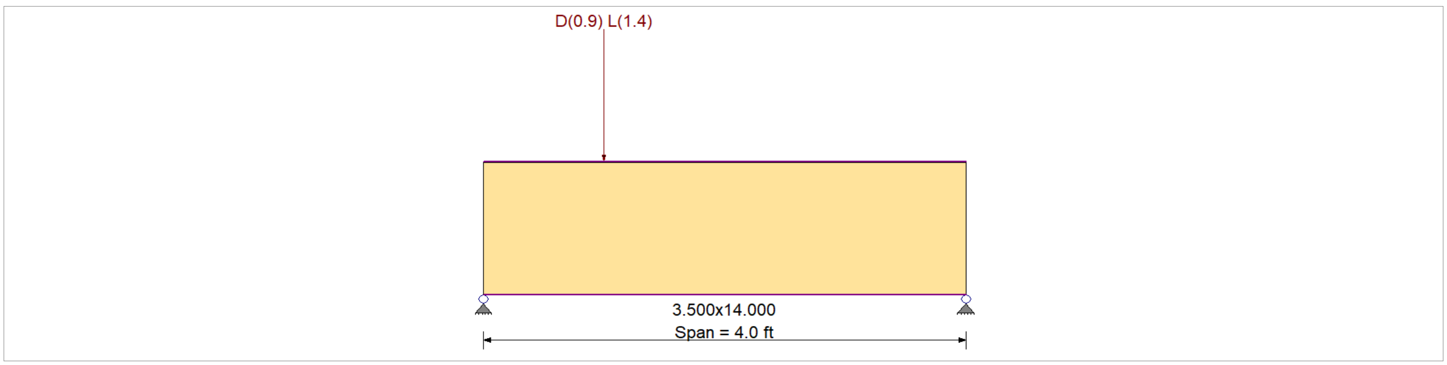
DESCRIPTION: B18

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,900.0 psi	*E : Modulus of Elasticit*	
Load Combination	IBC 2018	Fb -	2,900.0 psi	Ebend- xx	2,000.0 ksi
		Fc - Prll	3,200.0 psi	Eminbend - xx	1,000.0 ksi
Wood Species	Louisiana Pacific	Fc - Perp	750.0 psi		
Wood Grade	SolidStart LVL 2900Fb-2.0E	Fv	285.0 psi		
		Ft	1,800.0 psi	Density	28.720 pcf
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 loads
Point Load : D = 0.90, L = 1.40 k @ 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.063: 1	Maximum Shear Stress Ratio	=	0.063 : 1
Section used for this span		**3.500x14.000**	Section used for this span		**3.500x14.000**
fb: Actual	=	182.16 psi	fv: Actual	=	17.86 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	285.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	1.007 ft	Location of maximum on span	=	2.847 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.001 in	Ratio =	33854 >=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <480	n/a
Max Downward Total Deflection	0.002 in	Ratio =	20304 >=360	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0 <360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 4.0 ft	1	0.028	0.028	0.90	1.000	1.00	1.00	1.00	1.00	1.00	0.69	72.22	2610.00	0.23	7.14	256.50
+D+L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 4.0 ft	1	0.063	0.063	1.00	1.000	1.00	1.00	1.00	1.00	1.00	1.74	182.16	2900.00	0.58	17.86	285.00
+D+0.750L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 4.0 ft	1	0.043	0.043	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.47	154.67	3625.00	0.50	15.18	356.25
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 4.0 ft	1	0.009	0.009	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.41	43.33	4640.00	0.14	4.28	456.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0024	1.781		0.0000	0.000

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: B18

Vertical Reactions

Support notation : Far left is #· Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.745	0.595
Overall MINimum	1.050	0.350
D Only	0.695	0.245
+D+L	1.745	0.595
+D+0.750L	1.482	0.507
+0.60D	0.417	0.147
L Only	1.050	0.350

Wood Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.10.20 PCS STRUCTURAL SOLUTIONS

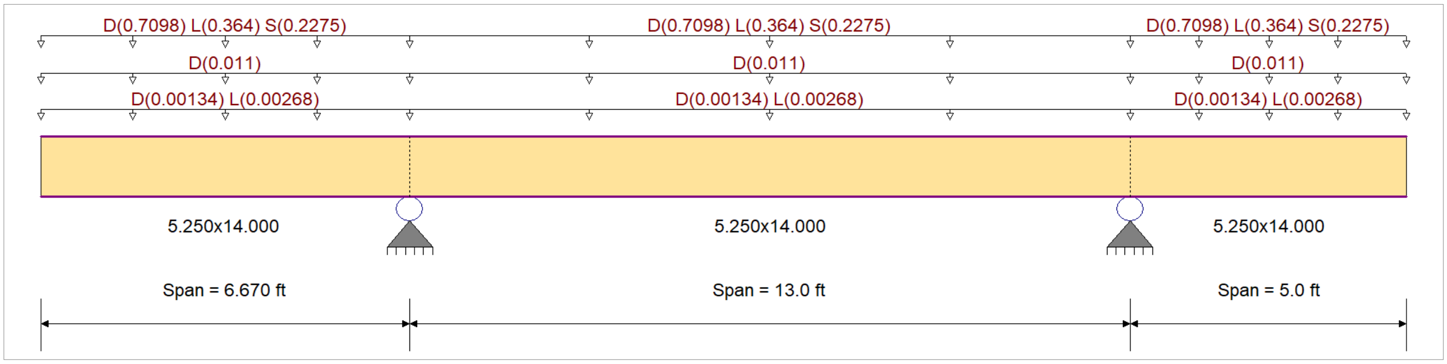
DESCRIPTION: B19

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,900.0 psi	*E : Modulus of Elasticity*	
Load Combination :	IBC 2018	Fb -	2,900.0 psi	Ebend- xx	2,000.0 ksi
		Fc - Prll	3,200.0 psi	Eminbend - xx	1,000.0 ksi
Wood Species :	Louisiana Pacific	Fc - Perp	750.0 psi		
Wood Grade :	SolidStart LVL 2900Fb-2.0E	Fv	285.0 psi		
		Ft	1,800.0 psi	Density	28.720 pcf
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 loads
Load for Span Number 1
  Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 0.0670 ft
  Uniform Load : D = 0.0110 , Tributary Width = 1.0 ft
  Uniform Load : D = 0.0780, L = 0.040, S = 0.0250 ksf, Tributary Width = 9.10 ft
Load for Span Number 2
  Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 0.0670 ft
  Uniform Load : D = 0.0110 , Tributary Width = 1.0 ft
  Uniform Load : D = 0.0780, L = 0.040, S = 0.0250 ksf, Tributary Width = 9.10 ft
Load for Span Number 3
  Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 0.0670 ft
  Uniform Load : D = 0.0110 , Tributary Width = 1.0 ft
  Uniform Load : D = 0.0780, L = 0.040, S = 0.0250 ksf, Tributary Width = 9.10 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.592** 1	Maximum Shear Stress Ratio	=	**0.487** : 1
Section used for this span		**5.250x14.000**	Section used for this span		**5.250x14.000**
fb: Actual	=	1,717.52 psi	fv: Actual	=	138.66 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	285.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	0.000 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 2	Span # where maximum occurs	=	Span # 2

Maximum Deflection

Max Downward Transient Deflection	0.122 in	Ratio =	1312	>=480	Span: 3 : L Only
Max Upward Transient Deflection	-0.008 in	Ratio =	19600	>=480	Span: 2 : L Only
Max Downward Total Deflection	0.393 in	Ratio =	406	>=360	Span: 3 : +D+0.750L+0.750S
Max Upward Total Deflection	-0.026 in	Ratio =	6078	>=360	Span: 2 : +D+0.750L+0.750S

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00

Wood Beam

DESCRIPTION: B19

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
Length = 6.670 ft	**2**	0.439	0.361	0.90	1.000	1.00	1.00	1.00	1.00	1.00	16.39	1,146.80	2610.00	4.54	92.58	256.50
Length = 13.0 ft	**2**	0.439	0.361	0.90	1.000	1.00	1.00	1.00	1.00	1.00	16.39	1,146.80	2610.00	4.54	92.58	256.50
Length = 5.0 ft	**3**	0.247	0.361	0.90	1.000	1.00	1.00	1.00	1.00	1.00	9.21	644.43	2610.00	2.85	92.58	256.50
+D+L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.670 ft	**2**	0.592	0.487	1.00	1.000	1.00	1.00	1.00	1.00	1.00	24.55	1,717.52	2900.00	6.79	138.66	285.00
Length = 13.0 ft	**2**	0.592	0.487	1.00	1.000	1.00	1.00	1.00	1.00	1.00	24.55	1,717.52	2900.00	6.79	138.66	285.00
Length = 5.0 ft	**3**	0.333	0.487	1.00	1.000	1.00	1.00	1.00	1.00	1.00	13.79	965.14	2900.00	4.27	138.66	285.00
+D+S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.670 ft	**2**	0.450	0.370	1.15	1.000	1.00	1.00	1.00	1.00	1.00	21.45	1,500.90	3335.00	5.94	121.17	327.75
Length = 13.0 ft	**2**	0.450	0.370	1.15	1.000	1.00	1.00	1.00	1.00	1.00	21.45	1,500.90	3335.00	5.94	121.17	327.75
Length = 5.0 ft	**3**	0.253	0.370	1.15	1.000	1.00	1.00	1.00	1.00	1.00	12.05	843.41	3335.00	3.73	121.17	327.75
+D+0.750L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.670 ft	**2**	0.434	0.357	1.25	1.000	1.00	1.00	1.00	1.00	1.00	22.51	1,574.84	3625.00	6.23	127.14	356.25
Length = 13.0 ft	**2**	0.434	0.357	1.25	1.000	1.00	1.00	1.00	1.00	1.00	22.51	1,574.84	3625.00	6.23	127.14	356.25
Length = 5.0 ft	**3**	0.244	0.357	1.25	1.000	1.00	1.00	1.00	1.00	1.00	12.65	884.96	3625.00	3.91	127.14	356.25
+D+0.750L+0.750S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.670 ft	**2**	0.552	0.453	1.15	1.000	1.00	1.00	1.00	1.00	1.00	26.30	1,840.41	3335.00	7.28	148.58	327.75
Length = 13.0 ft	**2**	0.552	0.453	1.15	1.000	1.00	1.00	1.00	1.00	1.00	26.30	1,840.41	3335.00	7.28	148.58	327.75
Length = 5.0 ft	**3**	0.310	0.453	1.15	1.000	1.00	1.00	1.00	1.00	1.00	14.78	1,034.20	3335.00	4.57	148.58	327.75
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.670 ft	**2**	0.148	0.122	1.60	1.000	1.00	1.00	1.00	1.00	1.00	9.83	688.08	4640.00	2.72	55.55	456.00
Length = 13.0 ft	**2**	0.148	0.122	1.60	1.000	1.00	1.00	1.00	1.00	1.00	9.83	688.08	4640.00	2.72	55.55	456.00
Length = 5.0 ft	**3**	0.083	0.122	1.60	1.000	1.00	1.00	1.00	1.00	1.00	5.53	386.66	4640.00	1.71	55.55	456.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.3930	0.000		0.0000	0.000
+D+0.750L+0.750S	2	0.0057	7.866	+D+0.750L+0.750S	-0.0257	2.076
+D+0.750L+0.750S	3	0.1122	5.000		0.0000	2.076

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4
Overall MAXimum		16.459	12.712	
Overall MINimum		3.167	2.446	
D Only		10.256	7.921	
+D+L		15.360	11.863	
+D+S		13.423	10.367	
+D+0.750L		14.084	10.877	
+D+0.750L+0.750S		16.459	12.712	
+0.60D		6.154	4.753	
L Only		5.104	3.942	
S Only		3.167	2.446	

Project Title: MERCER ISLAND RESIDENCE
Engineer: BRT
Project ID: 21-201
Project Descr:

Steel Beam with Torsional Loads

Project File: 21201enercalc_brt.ec6

LIC# : KW-06014122, Build:20.22.4.16   PCS STRUCTURAL SOLUTIONS   (c) ENERCALC INC 1983-2022

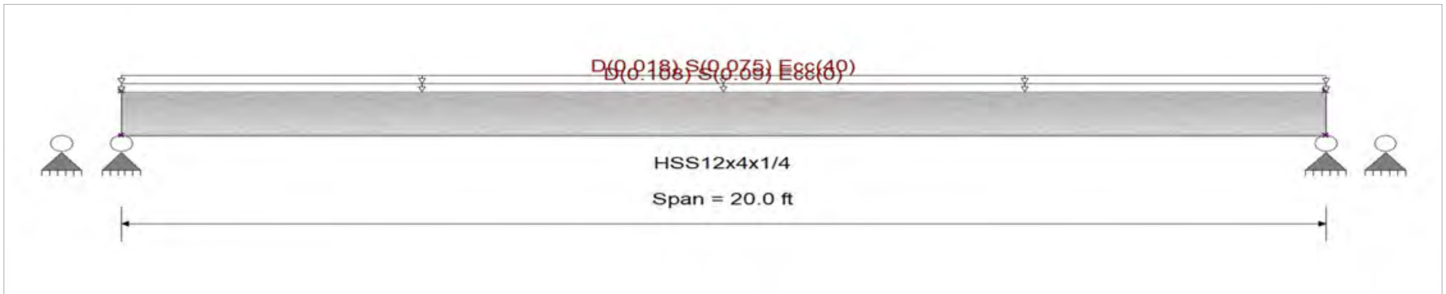
DESCRIPTION: Grid 7 Beam Above sliding door

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Analysis Settings

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Completely Unbraced	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		
Load Combination	IBC 2018		



Applied Loads

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

Beam self weight calculated and added to loads
Load for Span Number 0
Uniform Load : D = 0.030, S = 0.0250 ksf, Tributary Width = 3.60 ft
Uniform Load : D = 0.0060, S = 0.0250 ksf, Tributary Width = 3.0 ft, Tors Ecc. = 40.0 in

DESIGN SUMMARY

Design OK

Max. Flange Normal Stress Ratio =	**0.232** : 1	**Maximum Shear Stress Ratio =**	**0.102** : 1
Flange Normal Stress	13.45 ksi	Flange Shear Stress	2.75 ksi
Phi vn : Flange Normal Stress *(Phi Mn/Sxx)*	57.89 ksi	Web Shear Stress	3.55 ksi
		Vn * Phi : Allowable	27.00 ksi
Max Mu : Applied	22.31 k-ft		
Section used for this span	**HSS12x4x1/4**	Section used for this span	**HSS12x4x1/4**
Load Combination	+1.20D+1.60S	Load Combination	+1.20D+1.60S

Maximum Rotation = 0.1909 deg at 9.84 ft

Maximum Deflection

Max Download Transient Load Deflection	0.173 in	Max Downward Total Deflection	0.333 in
Ratio =	1385	Ratio =	721
Max Upward Transient Load Deflection	0.000 in	Max Upward Total Deflection	0.000 in
Ratio =	0 <360	Ratio =	0 <240

Maximum Forces & Stresses for Load Combinations

Load Combination	Max Stress Ratio	Bending Max Mu (kft)	Vu (k)	Flange Normal (ksi) Total	Allow	Ratio	Flange Shear (ksi) Total	Allow	Ratio	Web Shear (ksi) Total	Allow	Ratio
+1.40D	0.111	10.63	2.13	6.408	57.889	0.111	0.489	27.000	0.018	0.869	27.000	0.032
+1.20D	0.095	9.11	1.82	5.493	57.889	0.095	0.419	27.000	0.016	0.745	27.000	0.028
+1.20D+0.50S	0.138	13.23	2.65	7.980	57.889	0.138	1.147	27.000	0.042	1.620	27.000	0.060
+1.20D+1.60S	0.232	22.31	4.46	13.453	57.889	0.232	2.749	27.000	0.102	3.546	27.000	0.131
+1.20D+0.70S	0.155	14.88	2.98	8.975	57.889	0.155	1.438	27.000	0.053	1.971	27.000	0.073
+0.90D	0.071	6.83	1.37	4.120	57.889	0.071	0.314	27.000	0.012	0.559	27.000	0.021

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
span_1	1	0.3326	10.080		0.0000	0.000

Vertical Reactions - Unfactored

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	3.168	3.168
D Only	1.518	1.518
+D+S	3.168	3.168

Steel Beam with Torsional Loads

Project File: 21201enercalc_brt.ec6

LIC# : KW-06014122, Build:20.22.4.16 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: Grid 7 Beam Above sliding door

Vertical Reactions - Unfactored

Values in KIPS

Load Combination	Support 1	Support 2
+D+0.750S	2.756	2.756
+0.60D	0.911	0.911
S Only	1.650	1.650

Steel Beam

Project File: 21201 enercalc - brt.ec6

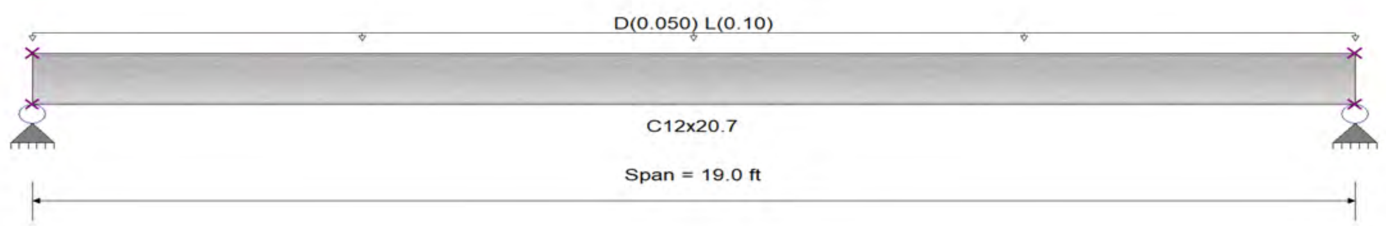
DESCRIPTION: STAIR STRINGERS

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	36.0 ksi
Beam Bracing :	Completely Unbraced	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

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

Beam self weight calculated and added to loading
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 2.50 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.420** : 1	Maximum Shear Stress Ratio =	**0.035** : 1
Section used for this span	**C12x20.7**	Section used for this span	**C12x20.7**
Mu : Applied	11.048 k-ft	Vu : Applied	2.326 k
Mn * Phi : Allowable	26.277 k-ft	Vn * Phi : Allowable	65.785 k
Load Combination	+1.20D+1.60L	Load Combination	+1.20D+1.60L
Location of maximum on span	9.500 ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.079 in	Ratio =	2,895	>=600.	
Max Upward Transient Deflection	0.000 in	Ratio =	0	<600.0	Span: 1 : L Only
Max Downward Total Deflection	0.134 in	Ratio =	1696	>=360.	Span: 1 : +D+L
Max Upward Total Deflection	0.000 in	Ratio =	0	<360.0	

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	VuMax	Vnx	Phi*Vnx
+1.40D													
Dsgn. L = 19.00 ft	1	0.170	0.014	4.47		4.47	29.20	26.28	1.14	1.00	0.94	73.09	65.78
+1.20D+1.60L													
Dsgn. L = 19.00 ft	1	0.420	0.035	11.05		11.05	29.20	26.28	1.14	1.00	2.33	73.09	65.78
+1.20D+0.50L													
Dsgn. L = 19.00 ft	1	0.232	0.019	6.08		6.08	29.20	26.28	1.14	1.00	1.28	73.09	65.78
+1.20D													
Dsgn. L = 19.00 ft	1	0.146	0.012	3.83		3.83	29.20	26.28	1.14	1.00	0.81	73.09	65.78
+0.90D													
Dsgn. L = 19.00 ft	1	0.109	0.009	2.87		2.87	29.20	26.28	1.14	1.00	0.60	73.09	65.78

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.1344	9.554		0.0000	0.000

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.622	1.622
Overall MINimum	-0.403	-0.403
D Only	0.672	0.672
+D+L	1.622	1.622
+D+0.750L	1.384	1.384

Steel Beam

DESCRIPTION: STAIR STRINGERS

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
+0.60D	0.403	0.403
L Only	0.950	0.950

Steel Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.9.6   PCS STRUCTURAL SOLUTIONS

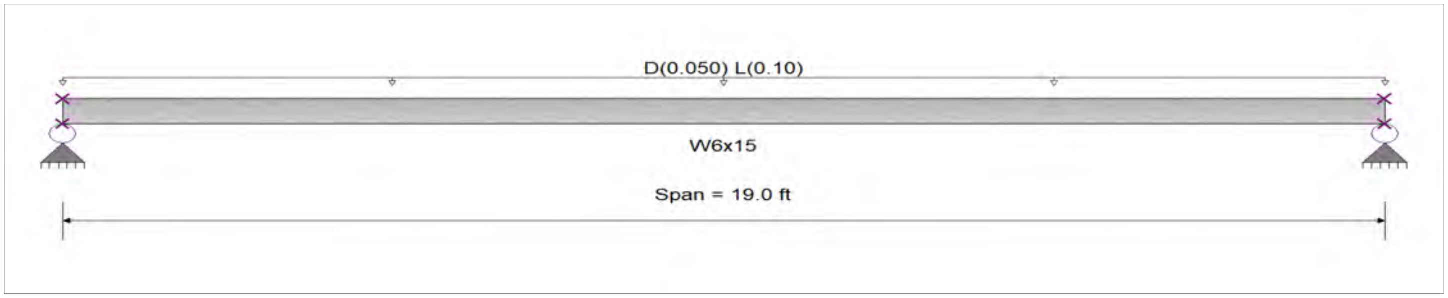
DESCRIPTION: STAIR STRINGERS - exterior

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method :	Load Resistance Factor Design	Fy : Steel Yield :	36.0 ksi
Beam Bracing :	Completely Unbraced	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

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

Beam self weight calculated and added to loading
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 2.50 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.473** : 1	Maximum Shear Stress Ratio =	**0.076** : 1
Section used for this span	**W6x15**	Section used for this span	**W6x15**
Mu : Applied	10.744 k-ft	Vu : Applied	2.262 k
Mn * Phi : Allowable	22.697 k-ft	Vn * Phi : Allowable	29.758 k
Load Combination	+1.20D+1.60L	Load Combination	+1.20D+1.60L
Location of maximum on span	9.500 ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.349 in	Ratio =	653	>=600.	
Max Upward Transient Deflection	0.000 in	Ratio =	0	<600.0	Span: 1 : L Only
Max Downward Total Deflection	0.576 in	Ratio =	396	>=360.	Span: 1 : +D+L
Max Upward Total Deflection	0.000 in	Ratio =	0	<360.0	

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	max Mu +	max Mu -	Mu Max	Mnx	Phi*Mnx	Cb	Rm	VuMax	Vnx	Phi*Vnx
+1.40D													
Dsgn. L = 19.00 ft	1	0.181	0.029	4.11		4.11	25.22	22.70	1.14	1.00	0.87	29.76	29.76
+1.20D+1.60L													
Dsgn. L = 19.00 ft	1	0.473	0.076	10.74		10.74	25.22	22.70	1.14	1.00	2.26	29.76	29.76
+1.20D+0.50L													
Dsgn. L = 19.00 ft	1	0.255	0.041	5.78		5.78	25.22	22.70	1.14	1.00	1.22	29.76	29.76
+1.20D													
Dsgn. L = 19.00 ft	1	0.155	0.025	3.52		3.52	25.22	22.70	1.14	1.00	0.74	29.76	29.76
+0.90D													
Dsgn. L = 19.00 ft	1	0.116	0.019	2.64		2.64	25.22	22.70	1.14	1.00	0.56	29.76	29.76

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.5762	9.554		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1   Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.568	1.568
Overall MINimum	-0.371	-0.371
D Only	0.618	0.618
+D+L	1.568	1.568
+D+0.750L	1.331	1.331

Steel Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.9.6 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: STAIR STRINGERS - exterior

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
+0.60D	0.371	0.371
L Only	0.950	0.950

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

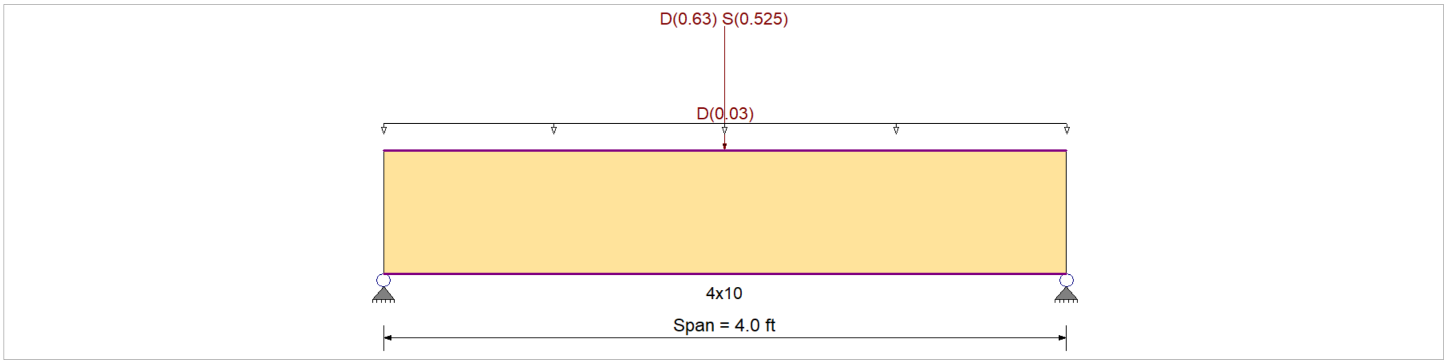
DESCRIPTION: H2

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	875.0 psi	*E : Modulus of Elasticit*	
Load Combination	IBC 2018	Fb -	875.0 psi	Ebend- xx	1,300.0 ksi
		Fc - Prll	600.0 psi	Eminbend - xx	470.0 ksi
Wood Species	Douglas Fir-Larch	Fc - Perp	625.0 psi		
Wood Grade	No.2	Fv	170.0 psi		
		Ft	425.0 psi	Density	31.210 pcf
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 loads
Point Load : D = 0.630, S = 0.5250 k @ 2.0 ft
Uniform Load : D = 0.030 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.204** : 1	Maximum Shear Stress Ratio	=	**0.148** : 1
Section used for this span		**4x10**	Section used for this span		**4x10**
fb: Actual	=	295.49 psi	fv: Actual	=	28.88 psi
Fb: Allowable	=	1,449.00 psi	Fv: Allowable	=	195.50 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	2.000 ft	Location of maximum on span	=	3.241 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.004 in	Ratio =	11843 >=360	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.010 in	Ratio =	4984 >=240	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 4.0 ft	1	0.149	0.109	0.90	1.200	1.00	1.00	1.00	1.00	1.00	0.70	169.27	1134.00	0.36	16.72	153.00
+D+S					1.200	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 4.0 ft	1	0.204	0.148	1.15	1.200	1.00	1.00	1.00	1.00	1.00	1.23	295.49	1449.00	0.62	28.88	195.50
+D+0.750S					1.200	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 4.0 ft	1	0.182	0.132	1.15	1.200	1.00	1.00	1.00	1.00	1.00	1.10	263.94	1449.00	0.56	25.84	195.50
+0.60D					1.200	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 4.0 ft	1	0.050	0.037	1.60	1.200	1.00	1.00	1.00	1.00	1.00	0.42	101.56	2016.00	0.22	10.03	272.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.0096	2.015		0.0000	0.000

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: H2

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.652	0.652
Overall MINimum	0.263	0.263
D Only	0.389	0.389
+D+S	0.652	0.652
+D+0.750S	0.586	0.586
+0.60D	0.233	0.233
S Only	0.263	0.263

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

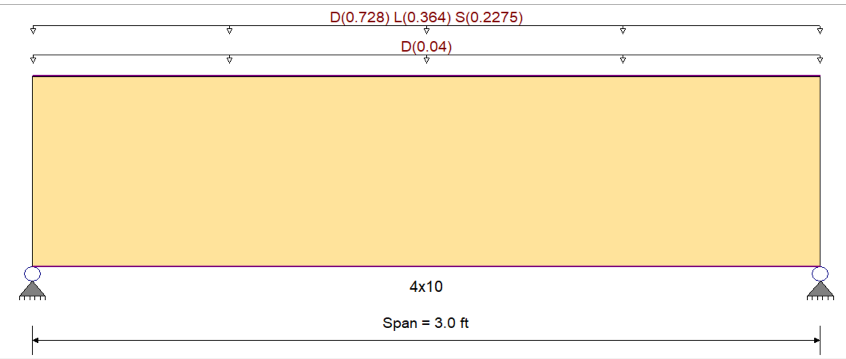
DESCRIPTION: H3

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	875.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	875.0 psi	Ebend- xx	1,300.0 ksi
		Fc - Prll	600.0 psi	Eminbend - xx	470.0 ksi
Wood Species	Douglas Fir-Larch	Fc - Perp	625.0 psi		
Wood Grade	No.2	Fv	170.0 psi		
		Ft	425.0 psi	Density	31.210 pcf
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 loads
Uniform Load : D = 0.040 , Tributary Width = 1.0 ft
Uniform Load : D = 0.080, L = 0.040, S = 0.0250 ksf, Tributary Width = 9.10 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.245 : 1**	Maximum Shear Stress Ratio	=	**0.228 : 1**
Section used for this span		**4x10**	Section used for this span		**4x10**
fb: Actual	=	308.08 psi	fv: Actual	=	38.71 psi
Fb: Allowable	=	1,260.00 psi	Fv: Allowable	=	170.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	1.500 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.002 in	Ratio =	16190 >=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <480	n/a
Max Downward Total Deflection	0.007 in	Ratio =	4835 >=360	Span: 1 : +D+0.750L+0.750S
Max Upward Total Deflection	0 in	Ratio =	0 <360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 3.0 ft	1	0.185	0.172	0.90	1.200	1.00	1.00	1.00	1.00	1.00	0.87	209.63	1134.00	0.57	26.34	153.00
+D+L					1.200	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 3.0 ft	1	0.245	0.228	1.00	1.200	1.00	1.00	1.00	1.00	1.00	1.28	308.08	1260.00	0.84	38.71	170.00
+D+S					1.200	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 3.0 ft	1	0.187	0.174	1.15	1.200	1.00	1.00	1.00	1.00	1.00	1.13	271.16	1449.00	0.74	34.07	195.50
+D+0.750L					1.200	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 3.0 ft	1	0.180	0.168	1.25	1.200	1.00	1.00	1.00	1.00	1.00	1.18	283.47	1575.00	0.77	35.62	212.50
+D+0.750L+0.750S					1.200	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 3.0 ft	1	0.227	0.212	1.15	1.200	1.00	1.00	1.00	1.00	1.00	1.37	329.62	1449.00	0.89	41.42	195.50
+0.60D					1.200	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 3.0 ft	1	0.062	0.058	1.60	1.200	1.00	1.00	1.00	1.00	1.00	0.52	125.78	2016.00	0.34	15.80	272.00

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: H3

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.0074	1.511		0.0000	0.000

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.828	1.828
Overall MINimum	0.341	0.341
D Only	1.163	1.163
+D+L	1.709	1.709
+D+S	1.504	1.504
+D+0.750L	1.572	1.572
+D+0.750L+0.750S	1.828	1.828
+0.60D	0.698	0.698
L Only	0.546	0.546
S Only	0.341	0.341

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

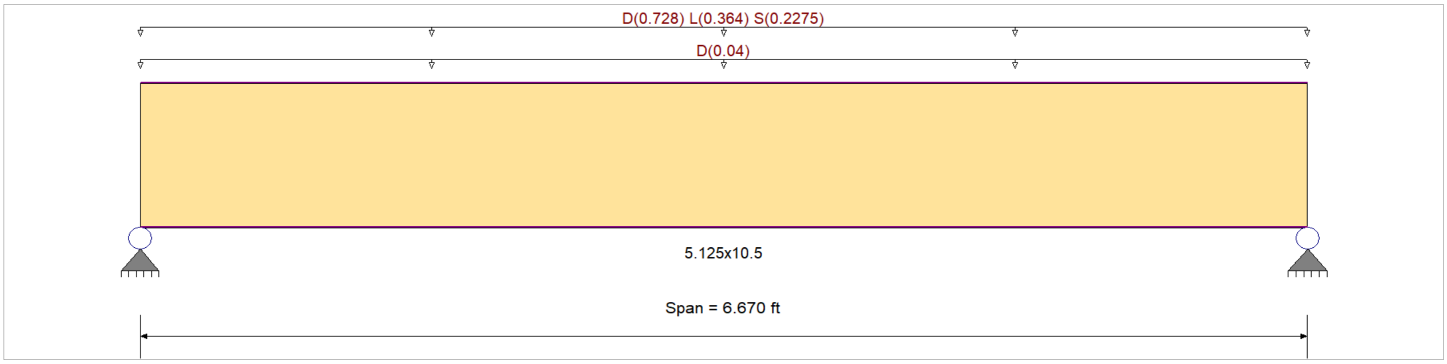
DESCRIPTION: H4

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,400.0 psi	*E : Modulus of Elasticit*	
Load Combination	IBC 2018	Fb -	1,850.0 psi	Ebend- xx	1,800.0 ksi
		Fc - Prll	1,650.0 psi	Eminbend - xx	950.0 ksi
Wood Species	DF/DF	Fc - Perp	650.0 psi	Ebend- yy	1,600.0 ksi
Wood Grade	24F-V4	Fv	265.0 psi	Eminbend - yy	850.0 ksi
		Ft	1,100.0 psi	Density	31.210 pcf
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 loads
Uniform Load : D = 0.040 , Tributary Width = 1.0 ft
Uniform Load : D = 0.080, L = 0.040, S = 0.0250 ksf, Tributary Width = 9.10 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.338** : 1	Maximum Shear Stress Ratio	=	**0.299** : 1
Section used for this span		**5.125x10.5**	Section used for this span		**5.125x10.5**
fb: Actual	=	810.44 psi	fv: Actual	=	79.16 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	=	3.335 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.018 in	Ratio =	4368 >=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <480	n/a
Max Downward Total Deflection	0.062 in	Ratio =	1299 >=360	Span: 1 : +D+0.750L+0.750S
Max Upward Total Deflection	0 in	Ratio =	0 <360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 6.670 ft	1	0.256	0.226	0.90	1.000	1.00	1.00	1.00	1.00	1.00	4.34	552.50	2160.00	1.94	53.96	238.50
+D+L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.670 ft	1	0.338	0.299	1.00	1.000	1.00	1.00	1.00	1.00	1.00	6.36	810.44	2400.00	2.84	79.16	265.00
+D+S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.670 ft	1	0.259	0.229	1.15	1.000	1.00	1.00	1.00	1.00	1.00	5.60	713.71	2760.00	2.50	69.71	304.75
+D+0.750L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.670 ft	1	0.249	0.220	1.25	1.000	1.00	1.00	1.00	1.00	1.00	5.85	745.95	3000.00	2.61	72.86	331.25
+D+0.750L+0.750S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.670 ft	1	0.314	0.278	1.15	1.000	1.00	1.00	1.00	1.00	1.00	6.80	866.86	2760.00	3.04	84.67	304.75
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.670 ft	1	0.086	0.076	1.60	1.000	1.00	1.00	1.00	1.00	1.00	2.60	331.50	3840.00	1.16	32.38	424.00

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: H4

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.0616	3.359		0.0000	0.000

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	4.080	4.080
Overall MINimum	0.759	0.759
D Only	2.600	2.600
+D+L	3.814	3.814
+D+S	3.359	3.359
+D+0.750L	3.511	3.511
+D+0.750L+0.750S	4.080	4.080
+0.60D	1.560	1.560
L Only	1.214	1.214
S Only	0.759	0.759

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

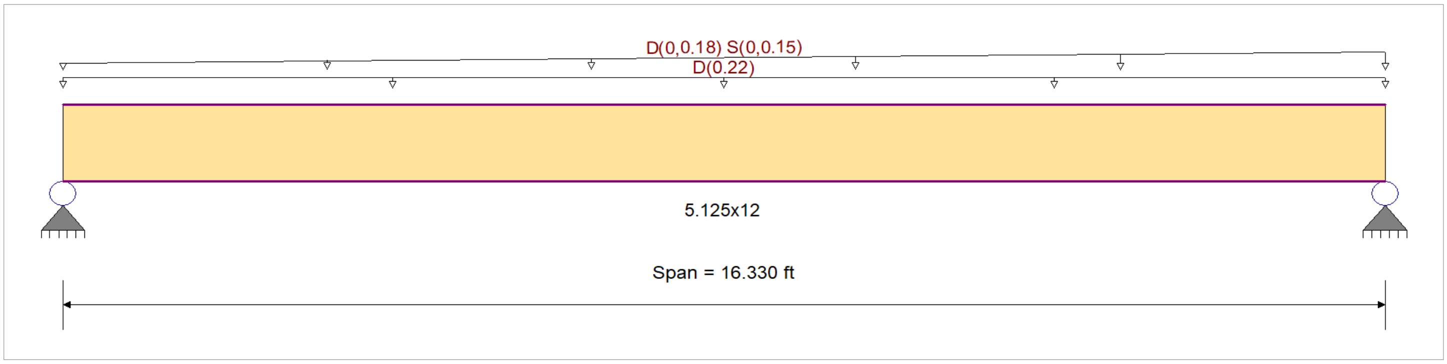
DESCRIPTION: H5

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2400 psi	*E : Modulus of Elasticit*	
Load Combination	IBC 2018	Fb -	1850 psi	Ebend- xx	1800 ksi
		Fc - Prll	1650 psi	Eminbend - xx	950 ksi
Wood Species	DF/DF	Fc - Perp	650 psi	Ebend- yy	1600 ksi
Wood Grade	24F-V4	Fv	265 psi	Eminbend - yy	850 ksi
		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.

Beam self weight calculated and added to loads
Uniform Load : D = 0.220 , Tributary Width = 1.0 ft
Varying Uniform Load : D= 0.030->0.030, S= 0.0250->0.0250 ksf, Extent = 0.0 -->> 16.330 ft, Trib Width = 0.0->6.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.488** : 1	Maximum Shear Stress Ratio	=	**0.255** : 1
Section used for this span		**5.125x12**	Section used for this span		**5.125x12**
fb: Actual	=	1,053.73 psi	fv: Actual	=	60.87 psi
Fb: Allowable	=	2,160.00 psi	Fv: Allowable	=	238.50 psi
Load Combination		D Only	Load Combination		D Only
Location of maximum on span	=	8.523 ft	Location of maximum on span	=	15.376 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.091 in	Ratio =	2153 >=480	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0 <480	n/a
Max Downward Total Deflection	0.483 in	Ratio =	406 >=360	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 16.330 ft	1	0.488	0.255	0.90	1.000	1.00	1.00	1.00	1.00	1.00	10.80	1,053.73	2160.00	2.50	60.87	238.50
+D+S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 16.330 ft	1	0.472	0.254	1.15	1.000	1.00	1.00	1.00	1.00	1.00	13.34	1,301.50	2760.00	3.17	77.40	304.75
+D+0.750S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 16.330 ft	1	0.449	0.240	1.15	1.000	1.00	1.00	1.00	1.00	1.00	12.70	1,239.46	2760.00	3.00	73.27	304.75
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 16.330 ft	1	0.165	0.086	1.60	1.000	1.00	1.00	1.00	1.00	1.00	6.48	632.24	3840.00	1.50	36.52	424.00

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: H5

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.4827	8.344		0.0000	0.000

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	2.803	3.701
Overall MINimum	0.408	0.817
D Only	2.395	2.885
+D+S	2.803	3.701
+D+0.750S	2.701	3.497
+0.60D	1.437	1.731
S Only	0.408	0.817

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

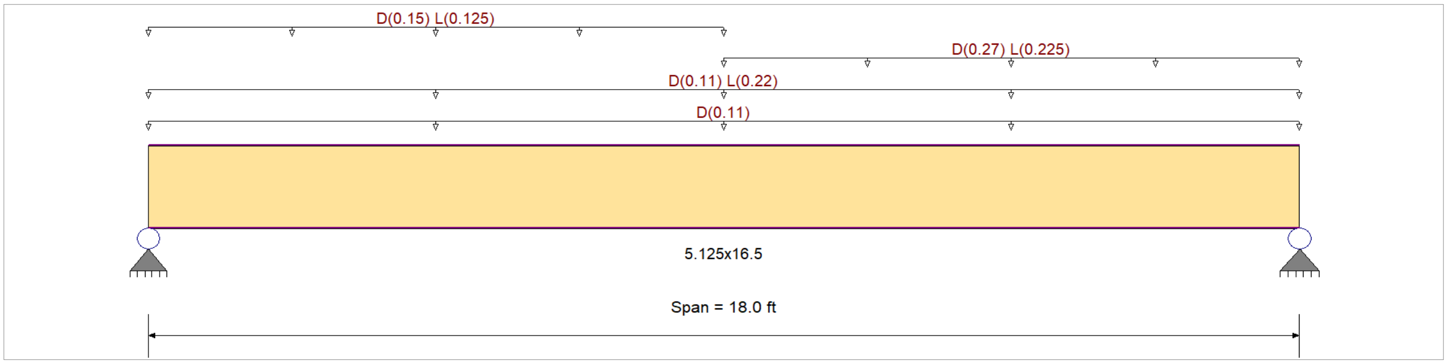
DESCRIPTION: H6

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,400.0 psi	*E : Modulus of Elasticit*	
Load Combination	IBC 2018	Fb -	1,850.0 psi	Ebend- xx	1,800.0 ksi
		Fc - Prll	1,650.0 psi	Eminbend - xx	950.0 ksi
Wood Species	DF/DF	Fc - Perp	650.0 psi	Ebend- yy	1,600.0 ksi
Wood Grade	24F-V4	Fv	265.0 psi	Eminbend - yy	850.0 ksi
		Ft	1,100.0 psi	Density	31.210 pcf
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 loads
Uniform Load : D = 0.110 , Tributary Width = 1.0 ft
Uniform Load : D = 0.020, L = 0.040 ksf, Tributary Width = 5.50 ft
Uniform Load : D = 0.030, L = 0.0250 ksf, Extent = 9.0 -->> 18.0 ft, Tributary Width = 9.0 ft
Uniform Load : D = 0.030, L = 0.0250 ksf, Extent = 0.0 -->> 9.0 ft, Tributary Width = 5.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.749** : 1	Maximum Shear Stress Ratio	=	**0.457** : 1
Section used for this span		**5.125x16.5**	Section used for this span		**5.125x16.5**
fb: Actual	=	1,769.10 psi	fv: Actual	=	121.20 psi
Fb: Allowable	=	2,360.89 psi	Fv: Allowable	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	9.526 ft	Location of maximum on span	=	16.686 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.272 in	Ratio =	794 >=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <480	n/a
Max Downward Total Deflection	0.580 in	Ratio =	372 >=360	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0 <360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 18.0 ft	1	0.443	0.271	0.90	0.984	1.00	1.00	1.00	1.00	1.00	18.23	940.66	2124.80	3.64	64.52	238.50
+D+L					0.984	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 18.0 ft	1	0.749	0.457	1.00	0.984	1.00	1.00	1.00	1.00	1.00	34.28	1,769.10	2360.89	6.83	121.20	265.00
+D+0.750L					0.984	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 18.0 ft	1	0.529	0.323	1.25	0.984	1.00	1.00	1.00	1.00	1.00	30.27	1,561.99	2951.11	6.03	107.03	331.25
+0.60D					0.984	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 18.0 ft	1	0.149	0.091	1.60	0.984	1.00	1.00	1.00	1.00	1.00	10.94	564.40	3777.42	2.18	38.71	424.00

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: H6

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.5802	9.131		0.0000	0.000

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	7.095	8.085
Overall MINimum	3.330	3.780
D Only	3.765	4.305
+D+L	7.095	8.085
+D+0.750L	6.262	7.140
+0.60D	2.259	2.583
L Only	3.330	3.780

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: H7

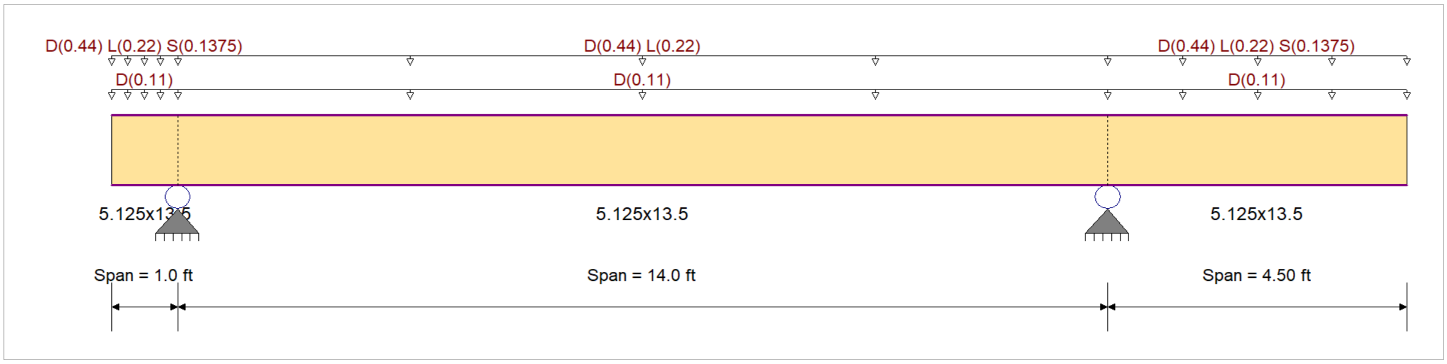
CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,400.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	1,850.0 psi	Ebend- xx	1,800.0 ksi
		Fc - Prll	1,650.0 psi	Eminbend - xx	950.0 ksi
Wood Species	DF/DF	Fc - Perp	650.0 psi	Ebend- yy	1,600.0 ksi
Wood Grade	24F-V4	Fv	265.0 psi	Eminbend - yy	850.0 ksi
		Ft	1,100.0 psi	Density	31.210 pcf

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 loads
Load for Span Number 1
  Uniform Load : D = 0.110 , Tributary Width = 1.0 ft
  Uniform Load : D = 0.080, L = 0.040, S = 0.0250 ksf, Tributary Width = 5.50 ft
Load for Span Number 2
  Uniform Load : D = 0.110 , Tributary Width = 1.0 ft
  Uniform Load : D = 0.080, L = 0.040 ksf, Tributary Width = 5.50 ft
Load for Span Number 3
  Uniform Load : D = 0.110 , Tributary Width = 1.0 ft
  Uniform Load : D = 0.080, L = 0.040, S = 0.0250 ksf, Tributary Width = 5.50 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.490** : 1	Maximum Shear Stress Ratio	=	**0.426** : 1
Section used for this span		**5.125x13.5**	Section used for this span		**5.125x13.5**
fb: Actual	=	1,175.32 psi	fv: Actual	=	112.81 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	=	6.353 ft	Location of maximum on span	=	12.941 ft
Span # where maximum occurs	=	Span # 2	Span # where maximum occurs	=	Span # 2

Maximum Deflection

Max Downward Transient Deflection	0.076 in	Ratio =	1428 >=480	Span: 2 : L Only
Max Upward Transient Deflection	-0.018 in	Ratio =	1352 >=480	Span: 3 : L Only
Max Downward Total Deflection	0.270 in	Ratio =	400 >=360	Span: 2 : +D+L
Max Upward Total Deflection	-0.063 in	Ratio =	378 >=360	Span: 3 : +D+L

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 1.0 ft	**1**	0.013	0.270	0.90	1.000	1.00	1.00	1.00	1.00	1.00	0.28	21.78	1665.00	2.97	64.35	238.50
Length = 14.0 ft	**2**	0.392	0.340	0.90	1.000	1.00	1.00	1.00	1.00	1.00	10.97	845.93	2160.00	3.75	81.20	238.50
Length = 4.50 ft	**3**	0.265	0.340	0.90	1.000	1.00	1.00	1.00	1.00	1.00	5.72	440.97	1665.00	1.92	81.20	238.50
+D+L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: H7

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
Length = 1.0 ft	1	0.016	0.337	1.00	1.000	1.00	1.00	1.00	1.00	1.00	0.39	30.26	1850.00	4.12	89.41	265.00
Length = 14.0 ft	2	0.490	0.426	1.00	1.000	1.00	1.00	1.00	1.00	1.00	15.25	1,175.32	2400.00	5.20	112.81	265.00
Length = 4.50 ft	3	0.331	0.426	1.00	1.000	1.00	1.00	1.00	1.00	1.00	7.95	612.68	1850.00	2.67	112.81	265.00
+D+S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.013	0.204	1.15	1.000	1.00	1.00	1.00	1.00	1.00	0.35	27.08	2127.50	2.87	62.30	304.75
Length = 14.0 ft	2	0.288	0.273	1.15	1.000	1.00	1.00	1.00	1.00	1.00	10.32	795.26	2760.00	3.84	83.25	304.75
Length = 4.50 ft	3	0.258	0.273	1.15	1.000	1.00	1.00	1.00	1.00	1.00	7.11	548.29	2127.50	2.39	83.25	304.75
+D+0.750L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.012	0.251	1.25	1.000	1.00	1.00	1.00	1.00	1.00	0.36	28.14	2312.50	3.84	83.15	331.25
Length = 14.0 ft	2	0.364	0.317	1.25	1.000	1.00	1.00	1.00	1.00	1.00	14.18	1,092.97	3000.00	4.84	104.91	331.25
Length = 4.50 ft	3	0.246	0.317	1.25	1.000	1.00	1.00	1.00	1.00	1.00	7.39	569.75	2312.50	2.48	104.91	331.25
+D+0.750L+0.750S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.015	0.268	1.15	1.000	1.00	1.00	1.00	1.00	1.00	0.42	32.11	2127.50	3.76	81.61	304.75
Length = 14.0 ft	2	0.382	0.349	1.15	1.000	1.00	1.00	1.00	1.00	1.00	13.68	1,054.80	2760.00	4.91	106.45	304.75
Length = 4.50 ft	3	0.306	0.349	1.15	1.000	1.00	1.00	1.00	1.00	1.00	8.44	650.24	2127.50	2.84	106.45	304.75
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.004	0.091	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.17	13.07	2960.00	1.78	38.61	424.00
Length = 14.0 ft	2	0.132	0.115	1.60	1.000	1.00	1.00	1.00	1.00	1.00	6.58	507.56	3840.00	2.25	48.72	424.00
Length = 4.50 ft	3	0.089	0.115	1.60	1.000	1.00	1.00	1.00	1.00	1.00	3.43	264.58	2960.00	1.15	48.72	424.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
	1	0.0000	0.000	+D+L	-0.0633	0.000
+D+L	2	0.2697	6.824		0.0000	0.000
	3	0.0000	6.824	+D+L	-0.1762	4.500

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4
Overall MAXimum		5.740	9.567	
Overall MINimum		0.043	0.713	
D Only		4.132	6.886	
+D+L		5.740	9.567	
+D+S		4.174	7.599	
+D+0.750L		5.338	8.897	
+D+0.750L+0.750S		5.370	9.432	
+0.60D		2.479	4.132	
L Only		1.609	2.681	
S Only		0.043	0.713	

Steel Column

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: C1

Code References

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Steel Section Name : **HSS4x4x1/4**

Analysis Method :	Load Resistance Factor
Steel Stress Grade	
Fy : Steel Yield	50.0 ksi
E : Elastic Bending Modulus	29,000.0 ksi

Overall Column Height 11.0 ft
Top & Bottom Fixity Top & Bottom Pinned
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 11.0 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 11.0 ft, K = 1.0

Applied Loads

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

Column self weight included : 134.310 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 11.0 ft, Xecc = 2.0 in, Yecc = 2.0 in, D = 2.070, S = 2.560 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS	Max. Axial+Bending Stress Ratio =	**0.1633**	: 1
	Load Combination	+1.20D+1.60S	
	Location of max.above base	11.0	ft
	At maximum location values are . . .		
	Pu	6.741	k
	0.9 * Pn	87.370	k
	Mu-x	-1.097	k-ft
	0.9 * Mn-x :	17.588	k-ft
	Mu-y	-1.097	k-ft
	0.9 * Mn-y :	17.588	k-ft
PASS	Maximum Shear Stress Rati	**0.002881**	: 1
	Load Combination	+1.20D+1.60S	
	Location of max.above base	0.0	ft
	At maximum location values are . . .		
	Vu : Applied	0.09970	k
	Vn * Phi : Allowable	34.611	k

Maximum Load Reactions . .

Top along X-X	k
Bottom along X-X	k
Top along Y-Y	k
Bottom along Y-Y	k

Maximum Load Deflections . . .

Along Y-Y in at ft above base
for load combination :

Along X-X in at ft above base
for load combination :

Load Combination Results

Load Combination	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Cbx	Cby	KxLx/Ry	KyLy/Rx	Maximum Shear Ratios: Stress Ratio	Status	Location

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	Axial Reaction @ Base	X-X Axis Reaction k @ Base	X-X Axis Reaction k @ Top	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Mx - End Moments k-ft @ Base	Mx - End Moments k-ft @ Top	My - End Moments @ Base	My - End Moments @ Top

Extreme Reactions

Item	Extreme Value	Axial Reaction @ Base	X-X Axis Reaction k @ Base	X-X Axis Reaction k @ Top	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Mx - End Moments k-ft @ Base	Mx - End Moments k-ft @ Top	My - End Moments @ Base	My - End Moments @ Top

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance

Steel Section Properties : HSS4x4x1/4

Steel Section Properties : HSS4x4x1/4

Steel Column

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: C1

Depth	=	4.000	in	I xx	=	7.80	in^4	J	=	12.800	in^4
Design Thick	=	0.233	in	S xx	=	3.90	in^3				
Width	=	4.000	in	R xx	=	1.520	in				
Wall Thick	=	0.250	in	Zx	=	4.690	in^3				
Area	=	3.370	in^2	I yy	=	7.800	in^4	C	=	6.560	in^3
Weight	=	12.210	plf	S yy	=	3.900	in^3				
				R yy	=	1.520	in				
Ycg	=	0.000	in								

Sketches

Wood Column

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.10.20 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: C2 - GLB

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Analysis Method	Allowable Stress Design		
End Fixities	Top & Bottom Pinned		
Overall Column Height		31	ft

(Used for non-slender calculations)

Wood Species	GluLam Column, Species: DF		
Wood Grade	L2, >= 4 Laminations		
Fb +	1,800.0 psi	Fv	230.0 psi
Fb -	1,700.0 psi	Ft	1,250.0 psi
Fc - Prll	1,950.0 psi	Density	pcf
Fc - Perp	560.0 psi		

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1,600.0	1,600.0	1,600.0 ksi
Minimum	850.0	850.0	

Wood Section Name	**3.125x12**
Wood Grading/Manuf.	Western
Wood Member Type	GLB
Exact Width	**3.125** in
Exact Depth	**12.0** in
Area	37.50 in^2
Ix	450.0 in^4
Iy	30.518 in^4

Allow Stress Modification Factors

Cf or Cv for Bending	1.0
Cf or Cv for Compressior	1.0
Cf or Cv for Tension	1.0
Cm : Wet Use Factor	1.0
Ct : Temperature Fact	1.0
Cfu : Flat Use Factor	1.0
Kf : Built-up columns	1.0 *NDS 15.3.2*
Use Cr : Repetitive ?	No

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 11
Y-Y (depth) axis : Fully braced against buckling ABOUT X-X Axis

Applied Loads

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

Column self weight included : 0.0 lbs * Dead Load Factor
AXIAL LOADS . . .
- Axial Load at 31.0 ft, Yecc = 6.0 in, D = 0.60, S = 0.50 k
- Axial Load at 31.0 ft, Xecc = 1.563 in, D = 0.90, L = 2.0, S = 0.30 k
- Axial Load at 22.0 ft, D = 2.0, Lr = 0.610, L = 1.30 k
- Axial Load at 11.0 ft, D = 1.10, L = 1.60 k

BENDING LOADS . . .
- Lat. Uniform Load creating Mx-x, W = 0.0520 k/ft

DESIGN SUMMARY

Bending & Shear Check Results

PASS	Max. Axial+Bending Stress Ratio =	**0.6627 : 1**
	Load Combination	+D+L
	Governing NDS Forumla	Comp Only, fc/Fc'
	Location of max.above base	0.0 ft
	At maximum location values are . .	
	Applied Axial	9.50 k
	Applied Mx	0.0 k-ft
	Applied My	0.0 k-ft
	Fc : Allowable	382.279 psi
PASS	Maximum Shear Stress Ratio =	**0.05362 : 1**
	Load Combination	+D+0.60W
	Location of max.above base	31.0 ft
	Applied Design Shear	19.731 psi
	Allowable Shear	368.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.8060 k	Bottom along Y-Y	0.8060 k
Top along X-X	0.01218 k	Bottom along X-X	0.01218 k

Maximum SERVICE Load Lateral Deflections . . .

Along Y-Y 1.517 in at 15.604 ft above base
for load combination : W Only
Along X-X -0.8310 in at 18.101 ft above base
for load combination : +D+L

Other Factors used to calculate allowable stresses . . .

Bending	Compression	Tension

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
D Only	0.900	0.217	0.3219	PASS	0.0 ft	0.001870	PASS	31.0 ft
+D+L	1.000	0.196	0.6627	PASS	0.0 ft	0.002118	PASS	31.0 ft
+D+Lr	1.250	0.158	0.3614	PASS	0.0 ft	0.001346	PASS	31.0 ft
+D+S	1.150	0.171	0.3753	PASS	31.0 ft	0.002683	PASS	31.0 ft
+D+0.750Lr+0.750L	1.250	0.158	0.6058	PASS	0.0 ft	0.001403	PASS	31.0 ft
+D+0.750L+0.750S	1.150	0.171	0.6168	PASS	0.0 ft	0.002378	PASS	31.0 ft

Wood Column

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.10.20 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: C2 - GLB

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
+D+0.60W	1.600	0.124	0.3341	PASS	10.819 ft	0.05362	PASS	31.0 ft
+D+0.750Lr+0.750L+0.450W	1.600	0.124	0.6031	PASS	0.0 ft	0.04048	PASS	31.0 ft
+D+0.750L+0.750S+0.450W	1.600	0.124	0.6129	PASS	0.0 ft	0.04113	PASS	31.0 ft
+0.60D+0.60W	1.600	0.124	0.2739	PASS	15.604 ft	0.05320	PASS	31.0 ft
+0.60D	1.600	0.124	0.1906	PASS	0.0 ft	0.000631	PASS	31.0 ft

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction k @ Base	@ Top	Y-Y Axis Reaction @ Base	@ Top	Axial Reaction @ Base	My - End Moments k-ft @ Base	@ Top	Mx - End Moments @ Base	@ Top
D Only	-0.004	0.004	-0.010	0.010	4.600				
+D+L	-0.012	0.012	-0.010	0.010	9.500				
+D+Lr	-0.004	0.004	-0.010	0.010	5.210				
+D+S	-0.005	0.005	-0.018	0.018	5.400				
+D+0.750Lr+0.750L	-0.010	0.010	-0.010	0.010	8.733				
+D+0.750L+0.750S	-0.011	0.011	-0.016	0.016	8.875				
+D+0.60W	-0.004	0.004	0.474	0.493	4.600				
+D+0.750Lr+0.750L+0.450W	-0.010	0.010	0.353	0.372	8.733				
+D+0.750L+0.750S+0.450W	-0.011	0.011	0.347	0.378	8.875				
+0.60D+0.60W	-0.002	0.002	0.478	0.489	2.760				
+0.60D	-0.002	0.002	-0.006	0.006	2.760				
Lr Only					0.610				
L Only	-0.008	0.008			4.900				
S Only	-0.001	0.001	-0.008	0.008	0.800				
W Only			0.806	0.806					

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	-0.2579 in	18.101 ft	-0.045 in	18.101 ft
+D+L	-0.8310 in	18.101 ft	-0.045 in	18.101 ft
+D+Lr	-0.2579 in	18.101 ft	-0.045 in	18.101 ft
+D+S	-0.3438 in	18.101 ft	-0.082 in	18.101 ft
+D+0.750Lr+0.750L	-0.6877 in	18.101 ft	-0.045 in	18.101 ft
+D+0.750L+0.750S	-0.7522 in	18.101 ft	-0.073 in	18.101 ft
+D+0.60W	-0.2579 in	18.101 ft	0.867 in	15.396 ft
+D+0.750Lr+0.750L+0.450W	-0.6877 in	18.101 ft	0.639 in	15.396 ft
+D+0.750L+0.750S+0.450W	-0.7522 in	18.101 ft	0.612 in	15.396 ft
+0.60D+0.60W	-0.1547 in	18.101 ft	0.884 in	15.604 ft
+0.60D	-0.1547 in	18.101 ft	-0.027 in	18.101 ft
Lr Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
L Only	-0.5731 in	18.101 ft	0.000 in	0.000 ft
S Only	-0.0860 in	18.101 ft	-0.037 in	18.101 ft
W Only	0.0000 in	0.000 ft	1.517 in	15.604 ft

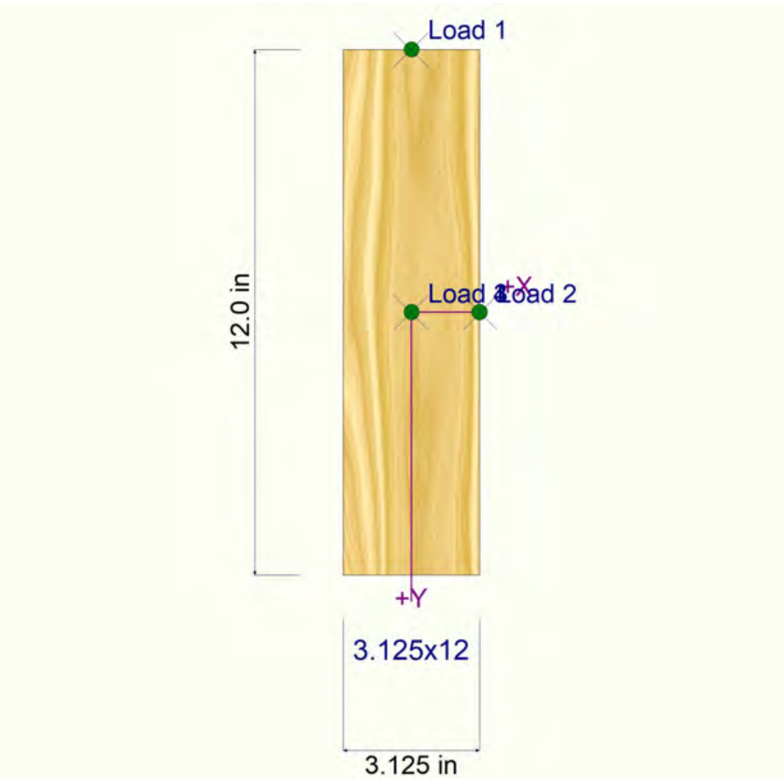
Wood Column

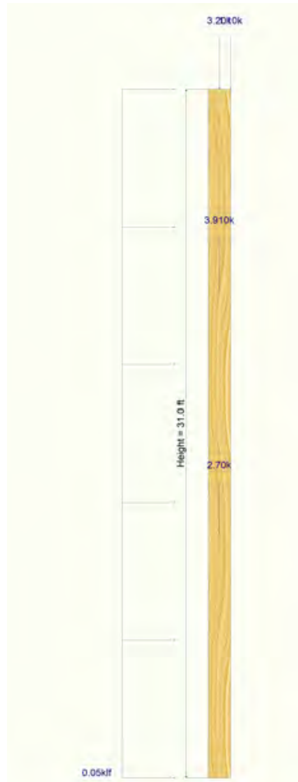
Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.10.20 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: C2 - GLB

Sketches





Steel Column

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.31 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: C3

Code References

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Steel Section Name : **HSS4x4x3/8**
Analysis Method : Load Resistance Factor
Steel Stress Grade
Fy : Steel Yield 50.0 ksi
E : Elastic Bending Modulus 29,000.0 ksi

Overall Column Height 11.0 ft
Top & Bottom Fixity Top & Bottom Pinned
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 11.0 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 11.0 ft, K = 1.0

Applied Loads

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

Column self weight included : 189.172 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 11.0 ft, D = 16.40, L = 10.20, S = 5.20 k
Axial Load at 11.0 ft, Xecc = 4.50 in, D = 1.80, L = 1.90 k
Axial Load at 11.0 ft, Xecc = -4.50 in, D = 1.60, L = 3.110 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio =	**0.4505**	: 1
Load Combination	+1.20D+1.60L+0.50S	
Location of max.above base	11.0	ft
At maximum location values are . . .		
Pu	50.923	k
0.9 * Pn	119.287	k
Mu-x	0.0	k-ft
0.9 * Mn-x :	23.963	k-ft
Mu-y	0.6360	k-ft
0.9 * Mn-y :	23.963	k-ft
PASS Maximum Shear Stress Ratio	**0.001247**	: 1
Load Combination	+1.20D+1.60L	
Location of max.above base	0.0	ft
At maximum location values are . . .		
Vu : Applied	0.05782	k
Vn * Phi : Allowable	46.377	k

Maximum Load Reactions . .

Top along X-X	0.4499 k
Bottom along X-X	0.4499 k
Top along Y-Y	0.0 k
Bottom along Y-Y	0.0 k

Maximum Load Deflections . . .

Along Y-Y 0.0 in at 0.0 ft above base
for load combination :

Along X-X -0.2242 in at 6.423 ft above base
for load combination : +D+0.750L+0.750S+0.5250E

Load Combination Results

Load Combination	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Cbx	Cby	KxLx/Ry	KyLy/Rx	Maximum Shear Ratios: Stress Ratio	Status	Location

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	Axial Reaction @ Base	X-X Axis Reaction k @ Base	@ Top	Y-Y Axis Reaction @ Base	@ Top	Mx - End Moments k-ft @ Base	@ Top	My - End Moments @ Base	@ Top

Extreme Reactions

Item	Extreme Value	Axial Reaction @ Base	X-X Axis Reaction k @ Base	@ Top	Y-Y Axis Reaction @ Base	@ Top	Mx - End Moments k-ft @ Base	@ Top	My - End Moments @ Base	@ Top

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance

Steel Section Properties : HSS4x4x3/8

Steel Section Properties : HSS4x4x3/8

Steel Column

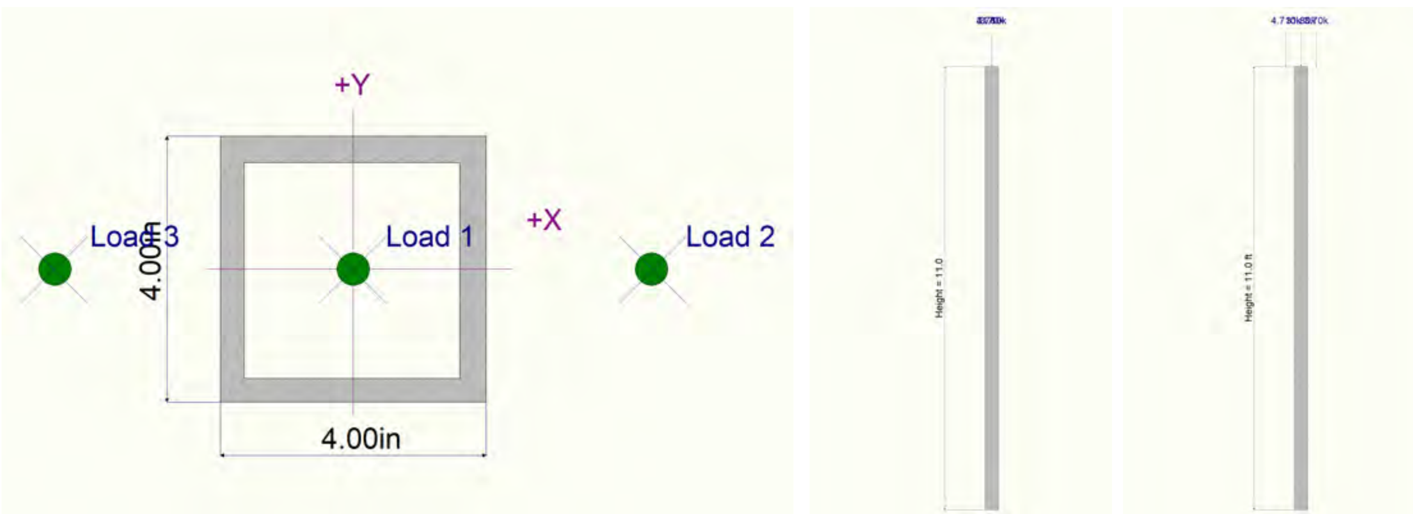
Project File: 21201 enercalc - brt.ec6

DESCRIPTION: C3

Depth	=	4.000 in	I xx	=	10.30 in^4	J	=	17.500 in^4
Design Thick	=	0.349 in	S xx	=	5.13 in^3			
Width	=	4.000 in	R xx	=	1.470 in			
Wall Thick	=	0.375 in	Zx	=	6.390 in^3			
Area	=	4.780 in^2	I yy	=	10.300 in^4	C	=	9.140 in^3
Weight	=	17.197 plf	S yy	=	5.130 in^3			
			R yy	=	1.470 in			

Ycg = 0.000 in

Sketches



Steel Column

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: C4

Code References

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Steel Section Name : **HSS4x4x1/4**

Analysis Method :	Load Resistance Factor
Steel Stress Grade	
Fy : Steel Yield	50.0 ksi
E : Elastic Bending Modulus	29,000.0 ksi

Overall Column Height 11.0 ft
Top & Bottom Fixity Top & Bottom Pinned
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 11.0 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 11.0 ft, K = 1.0

Applied Loads

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

Column self weight included : 134.310 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 11.0 ft, Xecc = 4.50 in, Yecc = 4.50 in, D = 2.40, L = 5.70 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio =	0.5813	: 1
Load Combination	+1.20D+1.60L	
Location of max.above base	11.0	ft
At maximum location values are . . .		
Pu	12.161	k
0.9 * Pn	87.370	k
Mu-x	-4.50	k-ft
0.9 * Mn-x :	17.588	k-ft
Mu-y	-4.50	k-ft
0.9 * Mn-y :	17.588	k-ft
PASS Maximum Shear Stress Rati	0.01182	: 1
Load Combination	+1.20D+1.60L	
Location of max.above base	0.0	ft
At maximum location values are . . .		
Vu : Applied	0.4091	k
Vn * Phi : Allowable	34.611	k

Maximum Load Reactions . .

Top along X-X	k
Bottom along X-X	k
Top along Y-Y	k
Bottom along Y-Y	k

Maximum Load Deflections . . .

Along Y-Y in at ft above base
for load combination :

Along X-X in at ft above base
for load combination :

Load Combination Results

Load Combination	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Cbx	Cby	KxLx/Ry	KyLy/Rx	Maximum Shear Ratios: Stress Ratio	Status	Location

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	Axial Reaction @ Base	X-X Axis Reaction k @ Base	@ Top	Y-Y Axis Reaction @ Base	@ Top	Mx - End Moments k-ft @ Base	@ Top	My - End Moments @ Base	@ Top

Extreme Reactions

Item	Extreme Value	Axial Reaction @ Base	X-X Axis Reaction k @ Base	@ Top	Y-Y Axis Reaction @ Base	@ Top	Mx - End Moments k-ft @ Base	@ Top	My - End Moments @ Base	@ Top

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance

Steel Section Properties : HSS4x4x1/4

Steel Section Properties : HSS4x4x1/4

Steel Column

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: C4

Depth	=	4.000	in	I xx	=	7.80	in^4	J	=	12.800	in^4
Design Thick	=	0.233	in	S xx	=	3.90	in^3				
Width	=	4.000	in	R xx	=	1.520	in				
Wall Thick	=	0.250	in	Zx	=	4.690	in^3				
Area	=	3.370	in^2	I yy	=	7.800	in^4	C	=	6.560	in^3
Weight	=	12.210	plf	S yy	=	3.900	in^3				
				R yy	=	1.520	in				
Ycg	=	0.000	in								

Sketches

Steel Column

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: C5

Code References

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Steel Section Name : **HSS4x4x1/4**
Analysis Method : Load Resistance Factor
Steel Stress Grade
Fy : Steel Yield 50.0 ksi
E : Elastic Bending Modulus 29,000.0 ksi

Overall Column Height 11.50 ft
Top & Bottom Fixity Top & Bottom Pinned
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 11.50 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 11.50 ft, K = 1.0

Applied Loads

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

Column self weight included : 140.415 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 11.50 ft, D = 4.40, L = 5.50, S = 0.10, E = 7.60 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio =	**0.1912** : 1	
Load Combination	+1.20D+0.50L+0.70S+E	
Location of max.above base	0.0	ft
At maximum location values are . . .		
Pu	15.869	k
0.9 * Pn	83.004	k
Mu-x	0.0	k-ft
0.9 * Mn-x :	17.588	k-ft
Mu-y	0.0	k-ft
0.9 * Mn-y :	17.588	k-ft
PASS Maximum Shear Stress Rati	**0.0** : 1	
Load Combination	0.0	
Location of max.above base	0.0	ft
At maximum location values are . . .		
Vu : Applied	0.0	k
Vn * Phi : Allowable	0.0	k

Maximum Load Reactions . .

Top along X-X	0.0 k
Bottom along X-X	0.0 k
Top along Y-Y	0.0 k
Bottom along Y-Y	0.0 k

Maximum Load Deflections . . .

Along Y-Y 0.0 in at 0.0ft above base
for load combination :

Along X-X 0.0 in at 0.0ft above base
for load combination :

Load Combination Results

Load Combination	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Cbx	Cby	KxLx/Ry	KyLy/Rx	Maximum Shear Ratios: Stress Ratio	Status	Location

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	Axial Reaction @ Base	X-X Axis Reaction k @ Base	X-X Axis Reaction k @ Top	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Mx - End Moments k-ft @ Base	Mx - End Moments k-ft @ Top	My - End Moments @ Base	My - End Moments @ Top

Extreme Reactions

Item	Extreme Value	Axial Reaction @ Base	X-X Axis Reaction k @ Base	X-X Axis Reaction k @ Top	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Mx - End Moments k-ft @ Base	Mx - End Moments k-ft @ Top	My - End Moments @ Base	My - End Moments @ Top

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance

Steel Section Properties : HSS4x4x1/4

Steel Section Properties : HSS4x4x1/4

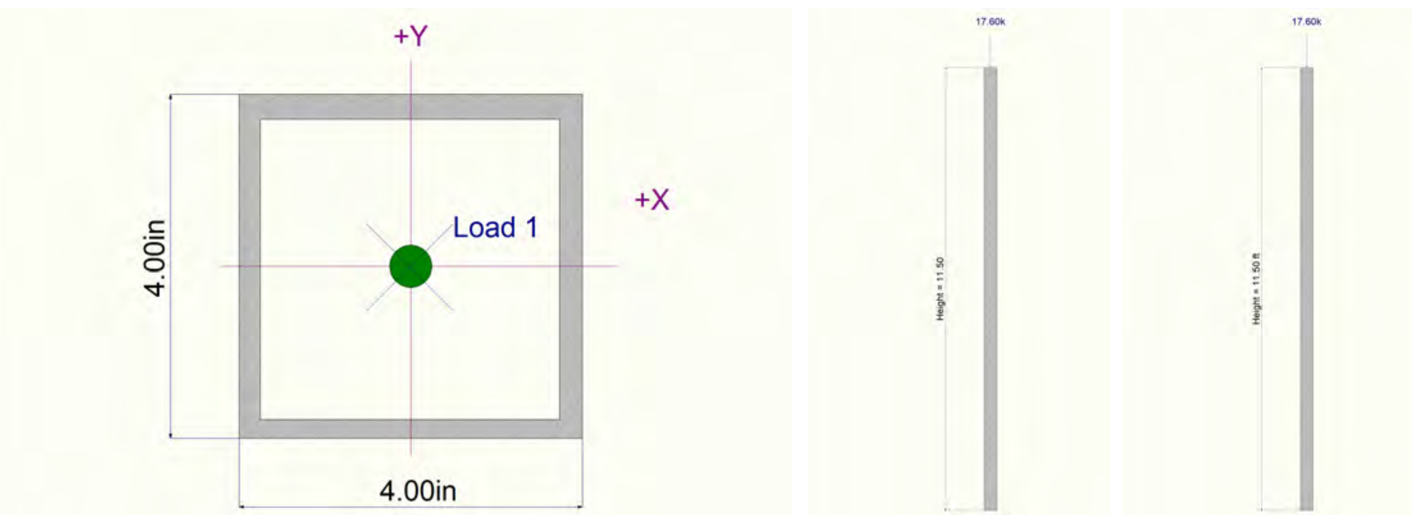
Steel Column

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: C5

Depth	=	4.000	in	I xx	=	7.80	in^4	J	=	12.800	in^4
Design Thick	=	0.233	in	S xx	=	3.90	in^3				
Width	=	4.000	in	R xx	=	1.520	in				
Wall Thick	=	0.250	in	Zx	=	4.690	in^3				
Area	=	3.370	in^2	I yy	=	7.800	in^4	C	=	6.560	in^3
Weight	=	12.210	plf	S yy	=	3.900	in^3				
				R yy	=	1.520	in				
Ycg	=	0.000	in								

Sketches



Steel Column

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.10.20 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: C6

Code References

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Steel Section Name : **HSS5x5x3/8**
Analysis Method : Load Resistance Factor
Steel Stress Grade
Fy : Steel Yield 50.0 ksi
E : Elastic Bending Modulus 29,000.0 ksi

Overall Column Height 22 ft
Top & Bottom Fixity Top & Bottom Pinned
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 11 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 22 ft, K = 1.0

Applied Loads

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

Column self weight included : 490.636 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 22.0 ft, D = 13.0, L = 6.60, S = 4.10 k
Axial Load at 11.0 ft, D = 2.0, L = 2.10, E = 3.90 k
Axial Load at 11.0 ft, D = 4.0, L = 2.10 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio =	**0.6098** : 1	
Load Combination	+1.20D+1.60L+0.50S	
Location of max.above base	0.0	ft
At maximum location values are . . .		
Pu	42.719	k
0.9 * Pn	70.049	k
Mu-x	0.0	k-ft
0.9 * Mn-x :	39.750	k-ft
Mu-y	0.0	k-ft
0.9 * Mn-y :	39.750	k-ft
PASS Maximum Shear Stress Rati	**0.0** : 1	
Load Combination	0.0	
Location of max.above base	0.0	ft
At maximum location values are . . .		
Vu : Applied	0.0	k
Vn * Phi : Allowable	0.0	k

Maximum Load Reactions . .

Top along X-X	0.0 k
Bottom along X-X	0.0 k
Top along Y-Y	0.0 k
Bottom along Y-Y	0.0 k

Maximum Load Deflections . . .

Along Y-Y 0.0 in at 0.0ft above base
for load combination :

Along X-X 0.0 in at 0.0ft above base
for load combination :

Load Combination Results

Load Combination	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Cbx	Cby	KxLx/Ry	KyLy/Rx	Maximum Shear Ratios: Stress Ratio	Status	Location
+1.40D	0.390	PASS	0.00 ft	1.00	1.00	70.59	141.18	0.000	PASS	0.00 ft
+1.20D+1.60L	0.581	PASS	0.00 ft	1.00	1.00	70.59	141.18	0.000	PASS	0.00 ft
+1.20D+1.60L+0.50S	0.610	PASS	0.00 ft	1.00	1.00	70.59	141.18	0.000	PASS	0.00 ft
+1.20D+0.50L	0.411	PASS	0.00 ft	1.00	1.00	70.59	141.18	0.000	PASS	0.00 ft
+1.20D	0.334	PASS	0.00 ft	1.00	1.00	70.59	141.18	0.000	PASS	0.00 ft
+1.20D+0.50L+1.60S	0.505	PASS	0.00 ft	1.00	1.00	70.59	141.18	0.000	PASS	0.00 ft
+1.20D+1.60S	0.428	PASS	0.00 ft	1.00	1.00	70.59	141.18	0.000	PASS	0.00 ft
+1.20D+0.50L+0.50S	0.440	PASS	0.00 ft	1.00	1.00	70.59	141.18	0.000	PASS	0.00 ft
+1.20D+0.50L+0.70S+E	0.508	PASS	0.00 ft	1.00	1.00	70.59	141.18	0.000	PASS	0.00 ft
+0.90D	0.250	PASS	0.00 ft	1.00	1.00	70.59	141.18	0.000	PASS	0.00 ft
+0.90D+E	0.306	PASS	0.00 ft	1.00	1.00	70.59	141.18	0.000	PASS	0.00 ft

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	Axial Reaction @ Base	X-X Axis Reaction k @ Base	@ Top	Y-Y Axis Reaction @ Base	@ Top	Mx - End Moments k-ft @ Base	@ Top	My - End Moments @ Base	@ Top
D Only	19.491								
+D+L	30.291								

Steel Column

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.10.20 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: C6

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	Axial Reaction @ Base	X-X Axis Reaction k @ Base	X-X Axis Reaction k @ Top	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Mx - End Moments k-ft @ Base	Mx - End Moments k-ft @ Top	My - End Moments @ Base	My - End Moments @ Top
+D+S	23.591								
+D+0.750L	27.591								
+D+0.750L+0.750S	30.666								
+D+0.70E	22.221								
+D+0.750L+0.750S+0.5250E	32.713								
+0.60D	11.694								
+0.60D+0.70E	14.424								
L Only	10.800								
S Only	4.100								
E Only	3.900								

Extreme Reactions

Item	Extreme Value	Axial Reaction @ Base	X-X Axis Reaction k @ Base	X-X Axis Reaction k @ Top	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Mx - End Moments k-ft @ Base	Mx - End Moments k-ft @ Top	My - End Moments @ Base	My - End Moments @ Top
Axial @ Base	Maximum	32.713								
"	Minimum	3.900								
Reaction, X-X Axis Base	Maximum	19.491								
"	Minimum	19.491								
Reaction, Y-Y Axis Base	Maximum	19.491								
"	Minimum	19.491								
Reaction, X-X Axis Top	Maximum	19.491								
"	Minimum	19.491								
Reaction, Y-Y Axis Top	Maximum	19.491								
"	Minimum	19.491								
Moment, X-X Axis Base	Maximum	19.491								
"	Minimum	19.491								
Moment, Y-Y Axis Base	Maximum	19.491								
"	Minimum	19.491								
Moment, X-X Axis Top	Maximum	19.491								
"	Minimum	19.491								
Moment, Y-Y Axis Top	Maximum	19.491								
"	Minimum	19.491								

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+L	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+S	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.750L	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.750L+0.750S	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.70E	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.750L+0.750S+0.5250E	0.0000 in	0.000 ft	0.000 in	0.000 ft
+0.60D	0.0000 in	0.000 ft	0.000 in	0.000 ft
+0.60D+0.70E	0.0000 in	0.000 ft	0.000 in	0.000 ft
L Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
S Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
E Only	0.0000 in	0.000 ft	0.000 in	0.000 ft

Steel Section Properties : HSS5x5x3/8

Steel Section Properties : HSS5x5x3/8

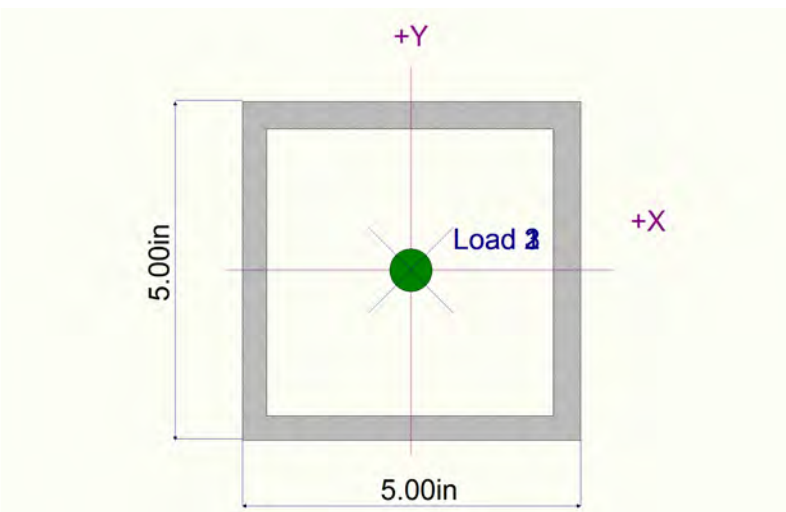
Steel Column

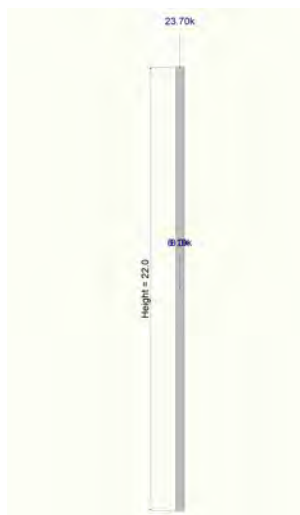
Project File: 21201 enercalc - brt.ec6

DESCRIPTION: C6

Depth	=	5.000	in	I xx	=	21.70	in^4	J	=	36.100	in^4
Design Thick	=	0.349	in	S xx	=	8.68	in^3				
Width	=	5.000	in	R xx	=	1.870	in				
Wall Thick	=	0.375	in	Zx	=	10.600	in^3				
Area	=	6.180	in^2	I yy	=	21.700	in^4	C	=	14.900	in^3
Weight	=	22.302	plf	S yy	=	8.680	in^3				
				R yy	=	1.870	in				
Ycg	=	0.000	in								

Sketches





Steel Column

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.31 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: C7

Code References

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Steel Section Name : **HSS4x4x1/4**
Analysis Method : Load Resistance Factor
Steel Stress Grade
Fy : Steel Yield 50.0 ksi
E : Elastic Bending Modulus 29,000.0 ksi

Overall Column Height 11.0 ft
Top & Bottom Fixity Top & Bottom Pinned
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 11.0 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 11.0 ft, K = 1.0

Applied Loads

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

Column self weight included : 133.989 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 11.0 ft, Xecc = 4.50 in, D = 9.0, L = 4.60, S = 2.90 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio = **0.5980** : 1
Load Combination +1.20D+1.60L+0.50S
Location of max.above base 11.0 ft
At maximum location values are . . .
Pu 19.771 k
0.9 * Pn 87.370 k
Mu-x 0.0 k-ft
0.9 * Mn-x : 17.588 k-ft
Mu-y -7.354 k-ft
0.9 * Mn-y : 17.588 k-ft

PASS Maximum Shear Stress Rati **0.01932** : 1
Load Combination +1.20D+1.60L+0.50S
Location of max.above base 0.0 ft
At maximum location values are . . .
Vu : Applied 0.6685 k
Vn * Phi : Allowable 34.611 k

Maximum Load Reactions . .
Top along X-X 0.4986 k
Bottom along X-X 0.4986 k
Top along Y-Y 0.0 k
Bottom along Y-Y 0.0 k

Maximum Load Deflections . . .
Along Y-Y 0.0 in at 0.0ft above base
for load combination :
Along X-X -0.3280 in at 6.423ft above base
for load combination :+D+0.750L+0.750S

Load Combination Results

Load Combination	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Cbx	Cby	KxLx/Ry	KyLy/Rx	Maximum Shear Ratios: Stress Ratio	Status	Location
+1.40D	0.342	PASS	11.00 ft	1.00	1.66	86.84	86.84	0.012	PASS	0.00 ft
+1.20D+1.60L	0.554	PASS	11.00 ft	1.00	1.66	86.84	86.84	0.018	PASS	0.00 ft
+1.20D+1.60L+0.50S	0.598	PASS	11.00 ft	1.00	1.66	86.84	86.84	0.019	PASS	0.00 ft
+1.20D+0.50L	0.355	PASS	11.00 ft	1.00	1.66	86.84	86.84	0.013	PASS	0.00 ft
+1.20D	0.293	PASS	11.00 ft	1.00	1.66	86.84	86.84	0.011	PASS	0.00 ft
+1.20D+0.50L+1.60S	0.541	PASS	11.00 ft	1.00	1.66	86.84	86.84	0.017	PASS	0.00 ft
+1.20D+1.60S	0.418	PASS	11.00 ft	1.00	1.66	86.84	86.84	0.015	PASS	0.00 ft
+1.20D+0.50L+0.50S	0.394	PASS	11.00 ft	1.00	1.66	86.84	86.84	0.014	PASS	0.00 ft
+1.20D+0.50L+0.70S	0.410	PASS	11.00 ft	1.00	1.66	86.84	86.84	0.015	PASS	0.00 ft
+0.90D	0.220	PASS	11.00 ft	1.00	1.66	86.84	86.84	0.008	PASS	0.00 ft

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	Axial Reaction @ Base	X-X Axis Reaction k @ Base	X-X Axis Reaction @ Top	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Mx - End Moments k-ft @ Base	Mx - End Moments @ Top	My - End Moments @ Base	My - End Moments @ Top
D Only	9.134	0.307	0.307						
+D+L	13.734	0.464	0.464						
+D+S	12.034	0.406	0.406						
+D+0.750L	12.584	0.424	0.424						
+D+0.750L+0.750S	14.759	0.499	0.499						

Steel Column

Project File: 21201 enercalc - brt.ec6

DESCRIPTION: C7

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	Axial Reaction @ Base	X-X Axis Reaction k @ Base	@ Top	Y-Y Axis Reaction @ Base	@ Top	Mx - End Moments k-ft @ Base	@ Top	My - End Moments @ Base	@ Top
+0.60D	5.480	0.184	0.184						
L Only	4.600	0.157	0.157						
S Only	2.900	0.099	0.099						

Extreme Reactions

Item	Extreme Value	Axial Reaction @ Base	X-X Axis Reaction k @ Base	@ Top	Y-Y Axis Reaction @ Base	@ Top	Mx - End Moments k-ft @ Base	@ Top	My - End Moments @ Base	@ Top
Axial @ Base	Maximum	14.759	0.499	0.499						-5.484
"	Minimum	2.900	0.099	0.099						-1.088
Reaction, X-X Axis Base	Maximum	14.759	0.499	0.499						-5.484
"	Minimum	2.900	0.099	0.099						-1.088
Reaction, Y-Y Axis Base	Maximum	9.134	0.307	0.307						-3.375
"	Minimum	9.134	0.307	0.307						-3.375
Reaction, X-X Axis Top	Maximum	14.759	0.499	0.499						-5.484
"	Minimum	2.900	0.099	0.099						-1.088
Reaction, Y-Y Axis Top	Maximum	2.900	0.099	0.099						-1.088
"	Minimum	9.134	0.307	0.307						-3.375
Moment, X-X Axis Base	Maximum	9.134		0.307						-3.375
"	Minimum	9.134		0.307						-3.375
Moment, Y-Y Axis Base	Maximum	9.134	0.307	0.307				-3.375		
"	Minimum	9.134	0.307	0.307				-3.375		
Moment, X-X Axis Top	Maximum	9.134	0.307	0.307						-3.375
"	Minimum	9.134	0.307	0.307						-3.375
Moment, Y-Y Axis Top	Maximum	2.900	0.099	0.099						-1.088
"	Minimum	14.759	0.499	0.499						-5.484

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	-0.2019 in	6.423 ft	0.000 in	0.000 ft
+D+L	-0.3050 in	6.423 ft	0.000 in	0.000 ft
+D+S	-0.2669 in	6.423 ft	0.000 in	0.000 ft
+D+0.750L	-0.2792 in	6.423 ft	0.000 in	0.000 ft
+D+0.750L+0.750S	-0.3280 in	6.423 ft	0.000 in	0.000 ft
+0.60D	-0.1211 in	6.423 ft	0.000 in	0.000 ft
L Only	-0.1032 in	6.423 ft	0.000 in	0.000 ft
S Only	-0.0650 in	6.423 ft	0.000 in	0.000 ft

Steel Section Properties : HSS4x4x1/4

Depth	=	4.000 in	I xx	=	7.80 in^4	J	=	12.800 in^4
Design Thick	=	0.233 in	S xx	=	3.90 in^3			
Width	=	4.000 in	R xx	=	1.520 in			
Wall Thick	=	0.250 in	Zx	=	4.690 in^3			
Area	=	3.370 in^2	I yy	=	7.800 in^4	C	=	6.560 in^3
Weight	=	12.181 plf	S yy	=	3.900 in^3			
			R yy	=	1.520 in			
Ycg	=	0.000 in						

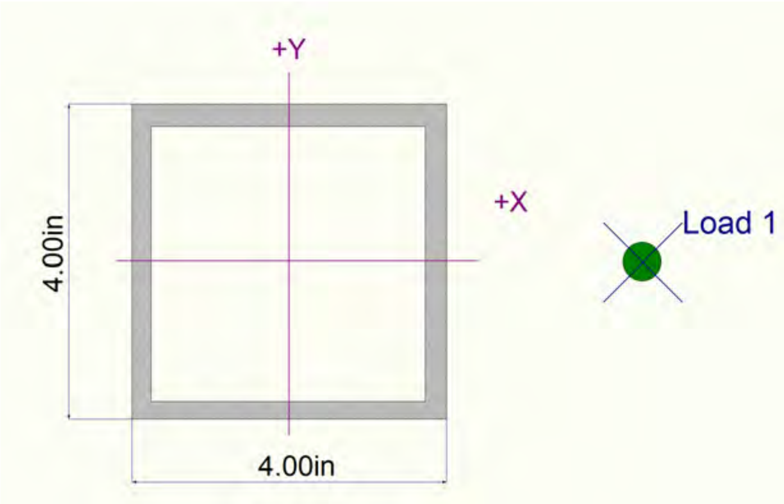
Steel Column

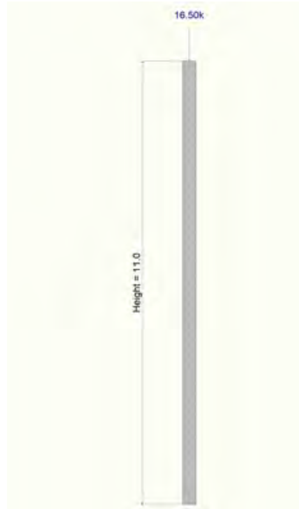
Project File: 21201 enercalc - brt.ec6

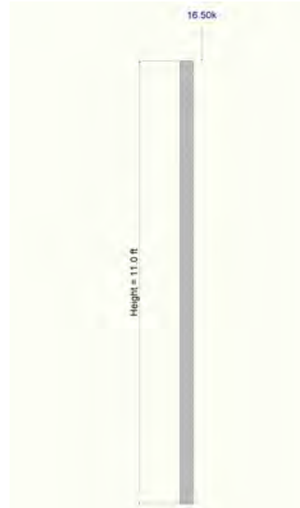
LIC# : KW-06014122, Build:20.21.8.31 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: C7

Sketches







Wood Column

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.10.20 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: C8

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Analysis Method	Allowable Stress Design	Wood Section Name	**3.125x12**
End Fixities	Top & Bottom Pinned	Wood Grading/Manuf.	Western
Overall Column Height	22 ft	Wood Member Type	GLB
(Used for non-slender calculations)			
Wood Species	GluLam Column, Species: DF	Exact Width	**3.125** in
Wood Grade	L2, >= 4 Laminations	Exact Depth	**12.0** in
		Area	37.50 in^2
		Ix	450.0 in^4
		Iy	30.518 in^4

Fb +	1,800.0 psi	Fv	230.0 psi
Fb -	1,700.0 psi	Ft	1,250.0 psi
Fc - Prll	1,950.0 psi	Density	pcf
Fc - Perp	560.0 psi		

Allow Stress Modification Factors

Cf or Cv for Bending	1.0
Cf or Cv for Compressioi	1.0
Cf or Cv for Tension	1.0
Cm : Wet Use Factor	1.0
Ct : Temperature Fact	1.0
Cfu : Flat Use Factor	1.0
Kf : Built-up columns	1.0 *NDS 15.3.2*
Use Cr : Repetitive ?	No

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1,600.0	1,600.0	1,600.0 ksi
Minimum	850.0	850.0	

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 11
Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 22

Applied Loads

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

Column self weight included : 0.0 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 22.0 ft, D = 6.810, L = 4.240, S = 2.130 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS	Max. Axial+Bending Stress Ratio =	**0.8054 : 1**
	Load Combination	+D+0.750L+0.750S
	Governing NDS Forumla	Comp Only, fc/Fc'
	Location of max.above base	0.0 ft
	At maximum location values are . .	
	Applied Axial	11.588 k
	Applied Mx	0.0 k-ft
	Applied My	0.0 k-ft
	Fc : Allowable	383.681 psi
PASS	Maximum Shear Stress Ratio =	**0.0 : 1**
	Load Combination	+0.60D
	Location of max.above base	22.0 ft
	Applied Design Shear	0.0 psi
	Allowable Shear	368.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.0 k	Bottom along Y-Y	0.0 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .

Along Y-Y 0.0 in at 0.0 ft above base
for load combination : n/a

Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

Other Factors used to calculate allowable stresses . . .

Bending	Compression	Tension

Load Combination Results

Load Combination	C_D	C_P	Max. Axial + Bending Stress Ratio	Status	Location	Max. Shear Stress Ratio	Status	Location
D Only	0.900	0.217	0.4766	PASS	0.0 ft	0.0	PASS	22.0 ft
+D+L	1.000	0.196	0.7708	PASS	0.0 ft	0.0	PASS	22.0 ft
+D+S	1.150	0.171	0.6214	PASS	0.0 ft	0.0	PASS	22.0 ft
+D+0.750L	1.250	0.158	0.6930	PASS	0.0 ft	0.0	PASS	22.0 ft
+D+0.750L+0.750S	1.150	0.171	0.8054	PASS	0.0 ft	0.0	PASS	22.0 ft
+0.60D	1.600	0.124	0.2822	PASS	0.0 ft	0.0	PASS	22.0 ft

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction (k) @ Base	X-X @ Top	Y-Y Axis Reaction @ Base	Y-Y @ Top	Axial Reaction @ Base	My - End Moments (k-ft) @ Base	My @ Top	Mx - End Moments @ Base	Mx @ Top
D Only					6.810				

Wood Column

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.10.20 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: C8

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction k @ Base	X-X Axis Reaction k @ Top	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Axial Reaction @ Base	My - End Moments k-ft @ Base	My - End Moments k-ft @ Top	Mx - End Moments @ Base	Mx - End Moments @ Top
+D+L					11.050				
+D+S					8.940				
+D+0.750L					9.990				
+D+0.750L+0.750S					11.588				
+0.60D					4.086				
L Only					4.240				
S Only					2.130				

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+L	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+S	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.750L	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.750L+0.750S	0.0000 in	0.000 ft	0.000 in	0.000 ft
+0.60D	0.0000 in	0.000 ft	0.000 in	0.000 ft
L Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
S Only	0.0000 in	0.000 ft	0.000 in	0.000 ft

Sketches

Wood Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.10.20 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

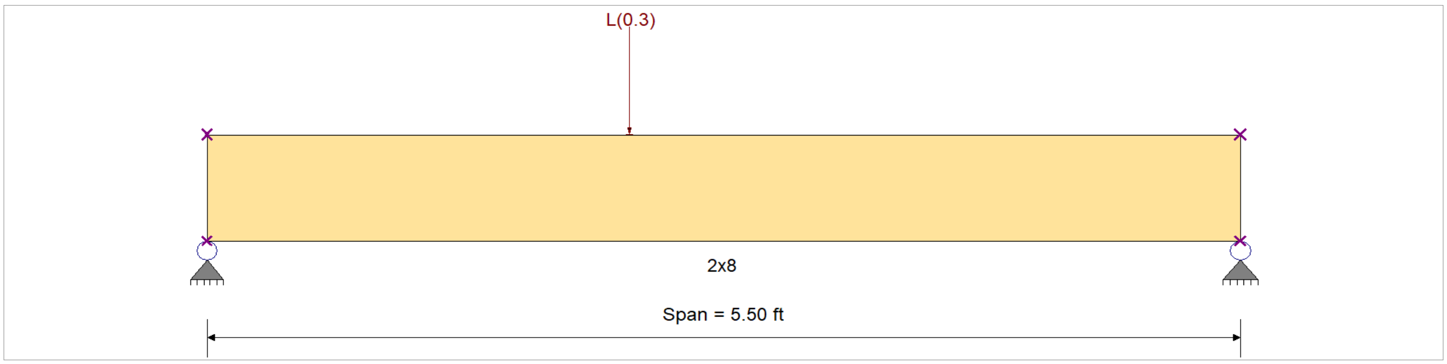
DESCRIPTION: SUNSHADE FRAMING

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	975 psi	*E : Modulus of Elasticity*	
Load Combination :	IBC 2018	Fb -	975 psi	Ebend- xx	1000 ksi
		Fc - Prll	725 psi	Eminbend - xx	370 ksi
Wood Species :	Western Cedars	Fc - Perp	425 psi		
Wood Grade :	No.1	Fv	140 psi		
		Ft	475 psi	Density	22.47 pcf
Beam Bracing :	Completely Unbraced				



Applied Loads

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

Beam self weight calculated and added to loads
Point Load : L = 0.30 k @ 2.250 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.339** : 1	Maximum Shear Stress Ratio	=	**0.178** : 1
Section used for this span		**2x8**	Section used for this span		**2x8**
fb: Actual	=	369.61 psi	fv: Actual	=	24.95 psi
Fb: Allowable	=	1,089.66 psi	Fv: Allowable	=	140.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	2.248 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.036 in	Ratio =	1817 >=360	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.037 in	Ratio =	1781 >=240	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 5.50 ft	1	0.006	0.004	0.90	1.200	1.00	1.00	1.00	1.00	0.82	0.01	5.86	1038.69	0.00	0.50	126.00
+D+L					1.200	1.00	1.00	1.00	1.00	0.82			0.00	0.00	0.00	0.00
Length = 5.50 ft	1	0.339	0.178	1.00	1.200	1.00	1.00	1.00	1.00	0.78	0.40	369.61	1089.66	0.18	24.95	140.00
+D+0.750L					1.200	1.00	1.00	1.00	1.00	0.78			0.00	0.00	0.00	0.00
Length = 5.50 ft	1	0.239	0.108	1.25	1.200	1.00	1.00	1.00	1.00	0.66	0.31	278.62	1163.93	0.14	18.84	175.00
+0.60D					1.200	1.00	1.00	1.00	1.00	0.66			0.00	0.00	0.00	0.00
Length = 5.50 ft	1	0.003	0.001	1.60	1.200	1.00	1.00	1.00	1.00	0.54	0.00	3.52	1208.22	0.00	0.30	224.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0370	2.609		0.0000	0.000

Wood Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.10.20 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: SUNSHADE FRAMING

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.182	0.127
Overall MINimum	0.177	0.123
D Only	0.005	0.005
+D+L	0.182	0.127
+D+0.750L	0.138	0.097
+0.60D	0.003	0.003
L Only	0.177	0.123

Wood Beam

Project Filename: 21201_AMP.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

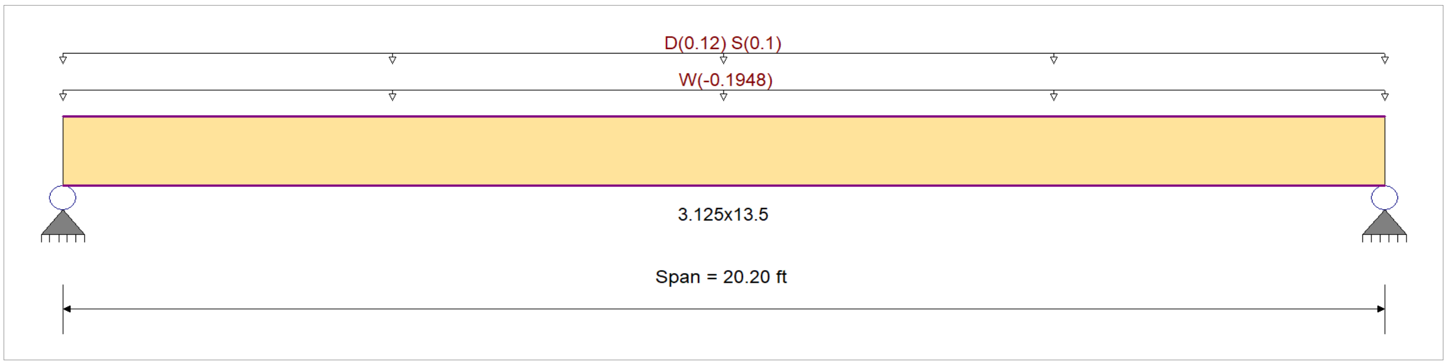
DESCRIPTION: Mullion Beam

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,400.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	1,850.0 psi	Ebend- xx	1,800.0 ksi
		Fc - Prll	1,650.0 psi	Eminbend - xx	950.0 ksi
Wood Species	DF/DF	Fc - Perp	650.0 psi	Ebend- yy	1,600.0 ksi
Wood Grade	24F-V4	Fv	265.0 psi	Eminbend - yy	850.0 ksi
		Ft	1,100.0 psi	Density	31.210 pcf
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 loads
Uniform Load : W = -0.04870 ksf, Tributary Width = 4.0 ft
Uniform Load : D = 0.030, S = 0.0250 ksf, Tributary Width = 4.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.535 : 1**	Maximum Shear Stress Ratio	=	**0.240 : 1**
Section used for this span		**3.125x13.5**	Section used for this span		**3.125x13.5**
fb: Actual	=	1,477.53 psi	fv: Actual	=	73.28 psi
Fb: Allowable	=	2,760.00 psi	Fv: Allowable	=	304.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	10.100 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.327 in	Ratio =	741 >=360	Span: 1 : S Only
Max Upward Transient Deflection	-0.382 in	Ratio =	634 >=360	Span: 1 : +0.60W
Max Downward Total Deflection	0.749 in	Ratio =	323 >=240	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 20.20 ft	1	0.386	0.173	0.90	1.000	1.00	1.00	1.00	1.00	1.00	6.59	832.72	2160.00	1.16	41.30	238.50
+D+S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 20.20 ft	1	0.535	0.240	1.15	1.000	1.00	1.00	1.00	1.00	1.00	11.69	1,477.53	2760.00	2.06	73.28	304.75
+D+0.750S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 20.20 ft	1	0.477	0.214	1.15	1.000	1.00	1.00	1.00	1.00	1.00	10.41	1,316.33	2760.00	1.84	65.28	304.75
+D+0.60W					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 20.20 ft	1	0.021	0.009	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.63	79.08	3840.00	0.11	3.92	424.00
+D+0.450W					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 20.20 ft	1	0.070	0.031	1.60	1.000	1.00	1.00	1.00	1.00	1.00	2.12	267.49	3840.00	0.37	13.27	424.00
+D+0.750S+0.450W					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 20.20 ft	1	0.196	0.088	1.60	1.000	1.00	1.00	1.00	1.00	1.00	5.94	751.09	3840.00	1.05	37.25	424.00

Wood Beam

Project Filename: 21201_AMP.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: Mullion Beam

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
+0.60D+0.60W					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 20.20 ft	**1**	0.086	0.030	1.60	1.000	1.00	1.00	1.00	1.00	1.00	2.01	254.01	2960.00	0.35	12.60	424.00
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 20.20 ft	**1**	0.130	0.058	1.60	1.000	1.00	1.00	1.00	1.00	1.00	3.95	499.63	3840.00	0.70	24.78	424.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.7487	10.174		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	2.314	2.314
Overall MINimum	1.010	1.010
D Only	1.304	1.304
+D+S	2.314	2.314
+D+0.750S	2.062	2.062
+D+0.60W	0.124	0.124
+D+0.450W	0.419	0.419
+D+0.750S+0.450W	1.176	1.176
+0.60D+0.60W	-0.398	-0.398
+0.60D	0.783	0.783
S Only	1.010	1.010
W Only	-1.967	-1.967

Wood Column

Project File: 21201_AMP.ec6

LIC# : KW-06014122, Build:20.21.10.20 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: Curtain Wall Mullion

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Analysis Method	Allowable Stress Design		
End Fixities	Top & Bottom Pinned		
Overall Column Height		31 ft	
(Used for non-slender calculations)			
Wood Species	GluLam Column, Species: DF		
Wood Grade	L2, >= 4 Laminations		
Fb +	1,800.0 psi	Fv	230.0 psi
Fb -	1,700.0 psi	Ft	1,250.0 psi
Fc - Prll	1,950.0 psi	Density	pcf
Fc - Perp	560.0 psi		

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1,600.0	1,600.0	1,600.0 ksi
Minimum	850.0	850.0	

Wood Section Name	**3.125x12**
Wood Grading/Manuf.	Western
Wood Member Type	GLB
Exact Width	**3.125** in
Exact Depth	**12.0** in
Area	37.50 in^2
Ix	450.0 in^4
Iy	30.518 in^4

Allow Stress Modification Factors

Cf or Cv for Bending	1.0
Cf or Cv for Compressio	1.0
Cf or Cv for Tension	1.0
Cm : Wet Use Factor	1.0
Ct : Temperature Fact	1.0
Cfu : Flat Use Factor	1.0
Kf : Built-up columns	1.0 *NDS 15.3.2*
Use Cr : Repetitive ?	No

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 1
Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 31

Applied Loads

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

Column self weight included : 0.0 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 31.0 ft, Yecc = -6.0 in, D = 1.30, S = 1.10 k
Axial Load at 15.50 ft, Yecc = -1.274 in, D = 0.6480 k
BENDING LOADS . . .
Wind: Lat. Uniform Load creating Mx-x, W = 0.1040 k/ft

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio = **0.5816 : 1**

Load Combination	+D+0.60W
Governing NDS Forumla	Comp + Mxx, NDS Eq. 3.9-3
Location of max.above base	15.396 ft
At maximum location values are .	
Applied Axial	1.948 k
Applied Mx	7.852 k-ft
Applied My	0.0 k-ft
Fc : Allowable	386.146 psi

PASS Maximum Shear Stress Ratio = **0.1077 : 1**

Load Combination	+D+0.60W
Location of max.above base	0.0 ft
Applied Design Shear	39.615 psi
Allowable Shear	368.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	1.612 k	Bottom along Y-Y	1.612 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .

Along Y-Y 0.8592 in at 15.812 ft above base
for load combination : +D+0.2520W
Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

Other Factors used to calculate allowable stresses . . .

Bending	Compression	Tension

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
D Only	0.900	0.217	0.1366	PASS	15.396 ft	0.004481	PASS	31.0 ft
+D+S	1.150	0.171	0.2128	PASS	15.396 ft	0.006190	PASS	31.0 ft
+D+0.750S	1.150	0.171	0.1935	PASS	15.396 ft	0.005519	PASS	31.0 ft
+D+0.60W	1.600	0.124	0.5816	PASS	15.396 ft	0.1077	PASS	0.0 ft
+D+0.450W	1.600	0.124	0.4471	PASS	15.396 ft	0.08137	PASS	0.0 ft
+D+0.750S+0.450W	1.600	0.124	0.4954	PASS	15.396 ft	0.08282	PASS	0.0 ft
+0.60D	1.600	0.124	0.08082	PASS	15.396 ft	0.001512	PASS	31.0 ft

Wood Column

Project File: 21201_AMP.ec6

LIC# : KW-06014122, Build:20.21.10.20 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: Curtain Wall Mullion

Maximum Reactions

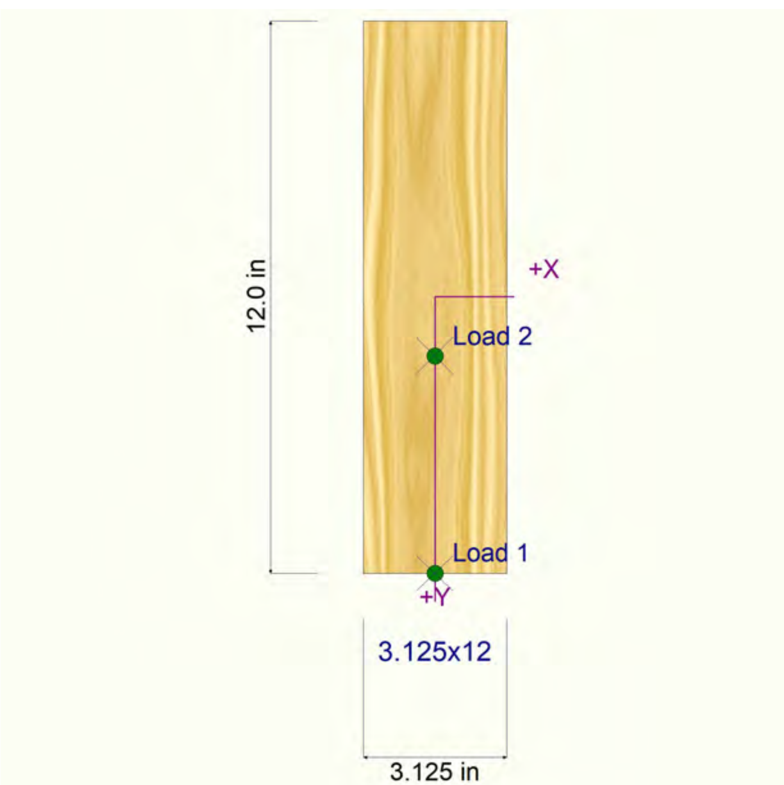
Note: Only non-zero reactions are listed.

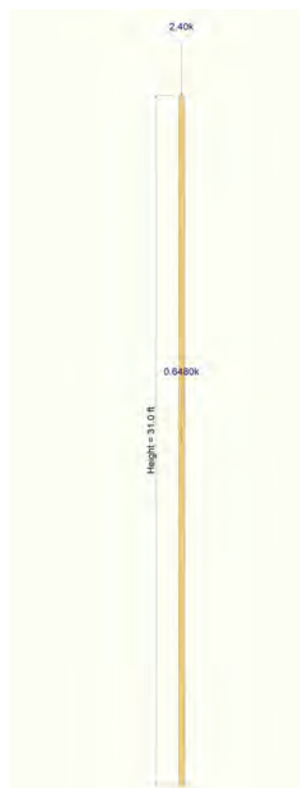
Load Combination	X-X Axis Reaction @ Base	k @ Top	Y-Y Axis Reaction @ Base	@ Top	Axial Reaction @ Base	My - End Moments @ Base	k-ft @ Top	Mx - End Moments @ Base	@ Top
D Only			0.023	-0.023	1.948				
+D+S			0.041	-0.041	3.048				
+D+0.750S			0.036	-0.036	2.773				
+D+0.60W			0.990	0.944	1.948				
+D+0.450W			0.749	0.702	1.948				
+D+0.750S+0.450W			0.762	0.689	2.773				
+0.60D+0.60W			0.981	0.953	1.169				
+0.60D			0.014	-0.014	1.169				
S Only			0.018	-0.018	1.100				
W Only			1.612	1.612					

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	0.0000 in	0.000 ft	0.096 in	17.685 ft
+D+S	0.0000 in	0.000 ft	0.178 in	17.893 ft
+D+0.750S	0.0000 in	0.000 ft	0.158 in	17.893 ft
+D+0.2520W	0.0000 in	0.000 ft	0.859 in	15.812 ft
+D+0.1890W	0.0000 in	0.000 ft	0.668 in	15.812 ft
+D+0.750S+0.1890W	0.0000 in	0.000 ft	0.729 in	16.020 ft
+0.60D+0.2520W	0.0000 in	0.000 ft	0.821 in	15.812 ft
+0.60D	0.0000 in	0.000 ft	0.058 in	17.685 ft

Sketches

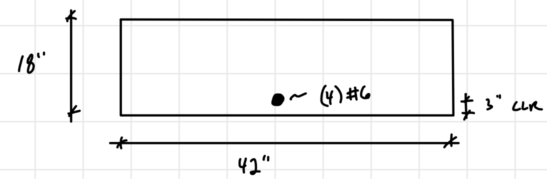




GRADE BEAM / PILES

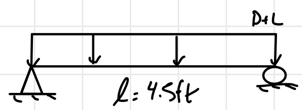
CORE WALL – 36,178 lb / 4 piles → 9,045 lb / pile < 20,000 lb ✓ok

4.5 ft spacing ea. way



$f'_c = 3000$ psi

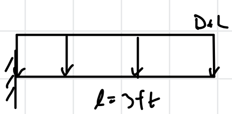
Service to ult.

① 

$D = (36{,}200\text{ lb}/2)/4.5\text{ft} = (4.03\text{ klf}/0.6)1.2 = 8.06\text{ klf}$

$L = 8\text{ft}(40\text{psf}) = 320\text{ plf}\ (1.6) = 0.512\text{ klf}$

OR

② 

① $M_{MAX} = \dfrac{wl^2}{8} = 21.7$ k·ft

$V_{max} = \dfrac{wl}{2} = 19.3^k$

② $M_{MAX} = \dfrac{wl^2}{2} = 38.6$ k·ft

$V_{MAX} = wl = 25.7^k$

MOMENT: $a = \dfrac{1.76\text{in}^2\,(60{,}000\text{psi})}{0.85\,(3000\text{psi})\,(42\text{in})} = 0.99$ in

$\phi M_n = 0.9\,(60{,}000\text{ psi})\,(1.76\text{in}^2)\left(14.625\text{in} - \dfrac{0.99\text{in}}{2}\right) = \underline{\underline{111.9\text{ k·ft}}} > 38.6$ kft ✓ok

SHEAR: $\phi V_n = 2\,(1.0)\,(0.75)\,(42\text{in})\,(14.625\text{in})\sqrt{3000\text{ psi}} = \underline{\underline{50.4^k}} > 25.7^k$ ✓ok

∴ USE MIN. REINF. FOR SHEAR

GRADE BEAM / PILES

GB3

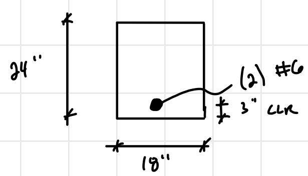
FROM B10 | POINT LOAD SPREADS @ 45° ANGLE FROM T.O.W. DOWN AND ENGAGES (3) PILES

$P_{MAX} = (8.25^k + 22.5^k) / 3 \text{ PILES} = 10{,}250 \text{ lb} < 20{,}000 \text{ lb}$ ✓OK

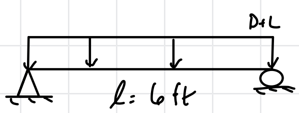
CONC WALL WT.

CONTROLS FOR GB2 + GB4 ALSO B/C HIGHEST PT. LOAD, LARGEST SPACING B/T PILES + SMALLEST DIA. PILE.

6 ft SPACING → CAN SUPPORT $20{,}000 \text{ lb} / 6 \text{ ft} = 3.33 \text{ klf}$



$f'_c = 3000 \text{ psi}$



$D_u = 6.06 \text{ klf}$
$L_u = 1.03 \text{ klf}$
} CONTROLLING GRAVITY CASE FROM S/W 6

① $M_u = \dfrac{w\ell^2}{8} = 40.2 \text{ k·ft}$

$V_u = \dfrac{w\ell}{2} = 26.8^k$

MOMENT:

$$a = \frac{0.88 \text{ in}^2 \, (60{,}000 \text{ psi})}{0.85 \, (3000 \text{ psi}) \, (18 \text{ in})} = 1.15 \text{ in}$$

$$\phi M_n = 0.9 \, (60{,}000 \text{ psi}) \, (0.88 \text{ in}^2) \left(20.625 \text{ in} - \frac{1.15 \text{ in}}{2}\right) = \underline{\underline{79.4 \text{ k·ft}}} \gg 38.6 \text{ k·ft}$$ ✓OK

SHEAR:

$$\phi V_n = 2 \, (1.0) \, (0.75) \, (18 \text{ in}) \, (20.625 \text{ in}) \sqrt{3000 \text{ psi}} = \underline{\underline{30.5^k}} \gg 26.8^k$$ ✓OK

∴ USE MIN. REINF. FOR SHEAR

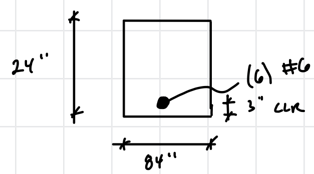
Grade Beam / Piles

$P_{ALLOW} = 30{,}000 \text{ lb}$

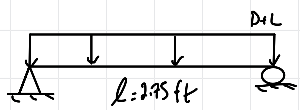
GB2

From S/W S calcs

2.75 ft spacing → can support $30{,}000 \text{ lb} / 2.75 \text{ ft} = 10.9 \text{ klf} > 2.51 \text{ klf}$ ✓ ok



$f'_c = 3000 \text{ psi}$

1


$D = 2.51 \text{ klf}$

$L = 0.4 \text{ klf}$

1 $M_{MAX} = \frac{w\ell^2}{8} = 2.75 \text{ k·ft}$

$V_{MAX} = \frac{w\ell}{2} = 4 \text{ k}$

Moment: $a = \frac{2.64 \text{ in}^2 (60{,}000 \text{ psi})}{0.85 (3000 \text{ psi})(84 \text{ in})} = 0.74 \text{ in}$

✓ ok

$\phi M_n = 0.9 (60{,}000 \text{ psi})(2.64 \text{ in}^2)\left(20.625 \text{ in} - \frac{0.74 \text{ in}}{2}\right) = \underline{\underline{240 \text{ k·ft}}} >> 2.75 \text{ k·ft}$

Shear: $\phi V_n = 2(1.0)(0.75)(84 \text{ in})(20.625 \text{ in})\sqrt{3000 \text{ psi}} = \underline{\underline{142 \text{ k}}} >> 4 \text{ k}$ ✓ ok

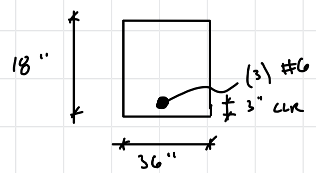
∴ Use min. reinf. for shear

Grade Beam / Piles

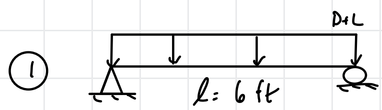
GB1

$P_{ALLOW} = 30{,}000\ lb$ (6" DIA. PIN PILE)

6 ft SPACING → CAN SUPPORT 30,000 lb / 6 ft = 5.0 klf > 2.51 klf (FROM S/W S CALCS) ✓ ok



$f'_c = 3000\ psi$



$D = 2.51\ klf\ (1.2) = 3.1\ klf$

$L = 0.4\ klf\ (1.6) = 0.64\ klf$

(1) $M_{MAX} = \dfrac{w\ell^2}{8} = 16.9\ k\cdot ft$

$V_{MAX} = \dfrac{w\ell}{2} = 11.3^k$

MOMENT:

$a = \dfrac{(3)\,0.44\ in^2\ (60{,}000\ psi)}{0.85\ (3000\ psi)\ (36\ in)} = 0.87\ in$

$\phi M_n = 0.9\ (60{,}000\ psi)\ (1.32\ in^2)\ \left(14.625\ in - \dfrac{0.87\ in}{2}\right) = \underline{\underline{84.2\ k\cdot ft}} >> 16.9\ k\cdot ft$ ✓ ok

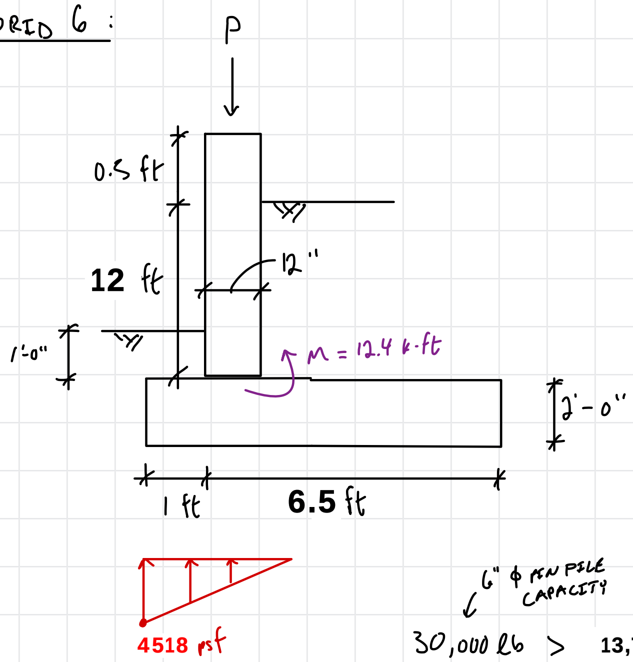
SHEAR:

$\phi V_n = 2\ (1.0)\ (0.75)\ (36\ in)\ (14.625\ in)\sqrt{3000\ psi} = \underline{\underline{43.2^k}} >> 11.3^k$ ✓ ok

∴ USE MIN. REINF. FOR SHEAR

Retaining Walls (see RetainPro)

Grid 6:



Backslope = Flat

E = 18H

H = 45 pcf (Active)

P_D = 120 plf + 240 plf = 360 plf + 110 plf = 460 plf (wood wall)

P_L = 320 plf + 480 plf = 800 plf

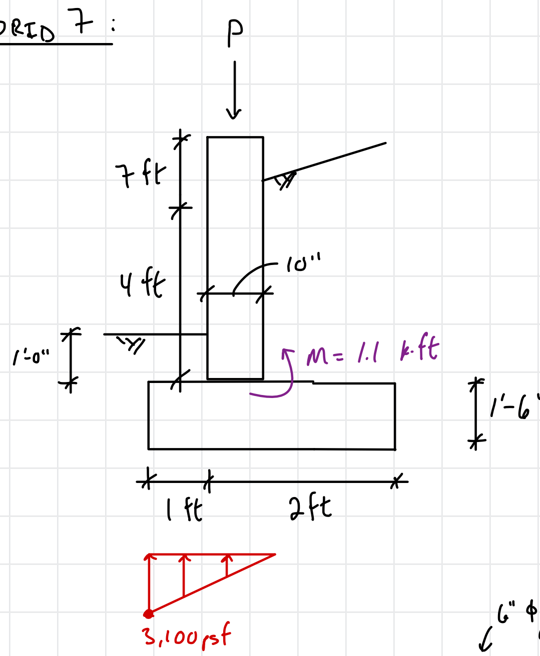
USE #9 @ 12" O.C. VERT
(9) #6 T & B LONG (FTG.)
#5 @ 18" O.C. TRANS. (FTG.)

6" φ pin pile capacity

30,000 lb > 13,775 lb/ft (x) → $\underline{\underline{x < 2.18 \text{ ft}}}$

(x = spacing; 13,775 lb/ft = total bearing load from RetainPro)

Grid 7:



Backslope = 2H : 1V

E = 18H

H = 45 pcf (Active)

P_D = 60 plf + 110 plf = 170 plf

P_L = 160 plf

USE #6 @ 18" O.C. VERT
(3) #6 T & B LONG (FTG.)
#5 @ 18" O.C. TRANS. (FTG.)

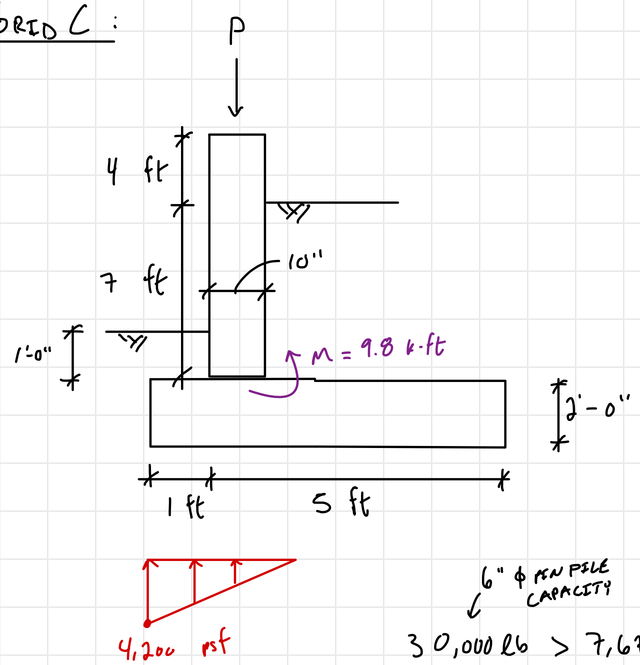
6" φ pin pile capacity

30,000 lb > 3,440 psf (x) → $\underline{\underline{x < 8.72 \text{ ft}}}$

(x = spacing; 3,440 psf = total bearing load from RetainPro)

Retaining Walls

Grid C:



Backslope = 2H:1V

E = 18H

H = 45 pcf (Active)

P_D = 60 plf + 302 plf = 362 plf + 220 plf = 582 plf (wood wall)
P_L = 160 plf

USE #6 @ 12" O.C. VERT
(5) #6 T & B LONG (FTG.)
#5 @ 18" O.C. TRANS. (FTG.)

30,000 lb (6" ϕ PIN PILE CAPACITY) > 7,670 lb/ft (TOTAL BEARING LOAD FROM RETAINPRO) (x) (SPACING) ⟶ $\underline{\underline{x < 3.92 \text{ ft}}}$

CLOSE TO 4' AND SOIL HEIGHT RETAINED DROPS QUICKLY ALONG GRID C SO 4' ✓OK

Grid 6:

Deflection @ Top of Wall -

$$E_c = 57{,}000\sqrt{f'_c} = 57{,}000\sqrt{4000\text{ psi}} = 3.6\text{E}6 \text{ psi}$$

$$I = 0.7 I_g = 0.7\left(\frac{12\text{in}\,(12\text{in})^3}{12}\right) = 1210 \text{ in}^4$$

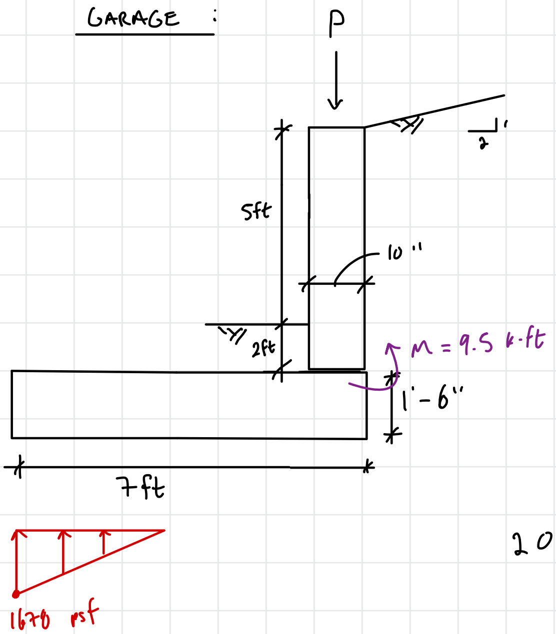
$$M_{MAX} = 12.4 \text{ k·ft} = \frac{WL}{3}$$

$$\Delta_{MAX} = \frac{WL^3}{15EI} = M_{max}\frac{L^2}{5EI} = 12.4 \text{ k·ft}\left(\frac{(11\text{ft})^2}{5\,(3.6\text{E}6\text{ psi})(1210\text{ in}^4)}\right) = \underline{\underline{0.12 \text{ in}}}$$

Project: Mercer Island Residence Job No: 21-201
Subject: Gravity Sheet Site Walls Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland Date: 6-10-21

Concrete Site Walls

South of Garage :



Backslope = 2H:1V

E = 18H

H = 45 pcf (Active)

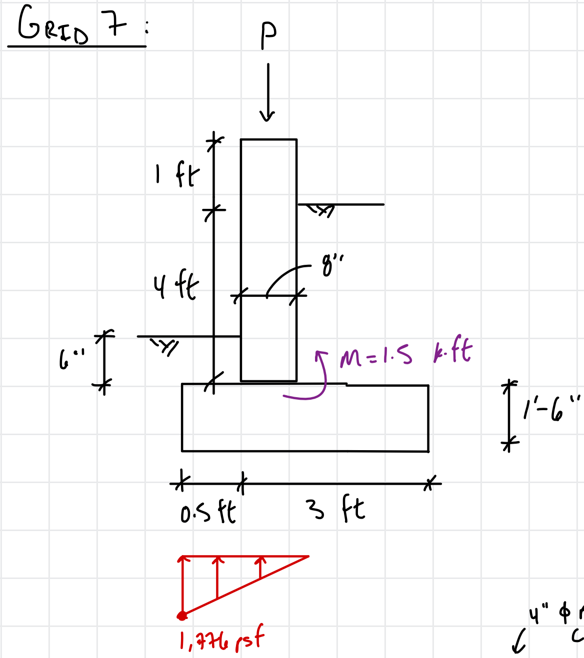
USE #6 @ 12" O.C. VERT
(5) #6 T & B LONG (FTG.)
#5 @ 18" O.C. TRANS. (FTG.)

4" φ pin pile capacity

20,000 lb > 1678 lb/ft (x) → $\underline{\underline{x < 11.9 \text{ ft}}}$

(x) = spacing; 1678 = total bearing load from RetainPro

Grid 7 :



Backslope = Flat
E = 18H
H = 45 pcf (Active)

USE #6 @ 18" O.C. VERT
(3) #5 T & B LONG (FTG.)
#5 @ 16" O.C. TRANS. (FTG.)

4" φ pin pile capacity

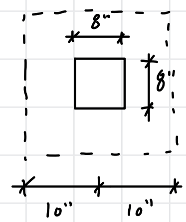
20,000 lb > 2322 psf (x) → $\underline{\underline{x < 8.62 \text{ ft}}}$

(x) = spacing; 2322 = total bearing load from RetainPro

CONCRETE RET. WALLS

PUNCHING SHEAR CHECK:

WORST CASE FOR ALL PILES + GRADE BEAMS



$$b_o = 4(\underbrace{8\text{ in}}_{\text{PILE ℄ WIDTH}} + \underbrace{12\text{ in}}_{d}) = 80\text{ in}$$

$$V_c = 4(1.0)\sqrt{3000\text{ psi}} = 219\text{ psi} \longleftarrow \text{CONTROLS}$$

$$\text{OR} \quad = \left(2 + \frac{4}{1}\right)(1.0)\sqrt{3000\text{ psi}} = 328\text{ psi}$$

$$\text{OR} \quad = \left(\frac{20(12\text{ in})}{80\text{ in}} + 2\right)(1.0)\sqrt{3000\text{ psi}} = 273\text{ psi}$$

$$\phi V_c = \frac{219\text{ psi}\,(80\text{ in})(12\text{ in})}{1000\text{ lb}/\text{k}} = 210.24^k\,(0.75) = 157.68^k \gg 30^k \quad \therefore \checkmark_{\text{OK}}$$

This Wall in File: \\PCS-FILESERVER\data\2021 Jobs\21201 Mercer Island Residence\Calcs\RetainPro\212

Cantilevered Retaining Wall

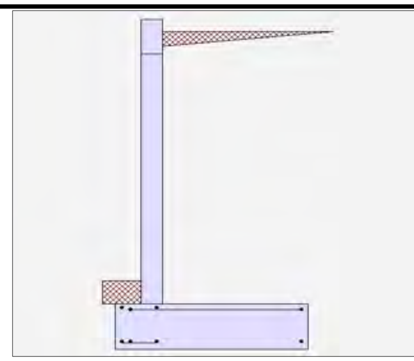
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	12.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	460.0 lbs
Axial Live Load	=	800.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	2.62	OK
Sliding	=	1.85	OK
Total Bearing Load	=	13,775 lbs	
...resultant ecc.	=	18.27 in	
Soil Pressure @ Toe	=	4,123 psf	NG
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	3,000 psf	

Soil Pressure Exceeds Allowable!

ACI Factored @ Toe	=	5,437 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	1.4 psi	OK
Footing Shear @ Heel	=	5.9 psi	OK
Allowable	=	82.2 psi	

Sliding Calcs

Lateral Sliding Force	=	3,920.0 lbs	
less 100% Passive Force	= -	1,400.0 lbs	
less 100% Friction Force	= -	5,838.8 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	0.0 lbs	OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing pressures.

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

		2nd	Bottom
		Stem OK	Stem OK
Design Height Above Ftg	ft =	11.00	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Design Method	=	LRFD	LRFD
Thickness	=	10.00	10.00
Rebar Size	=	# 9	# 9
Rebar Spacing	=	12.00	12.00
Rebar Placed at	=	Edge	Edge
Design Data			
fb/FB + fa/Fa	=	**-0.001**	**0.610**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	32.0	4,608.0
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =	10.7	18,432.0
Moment.....Allowable	ft-# =	30,150.0	30,150.0
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =	0.4	51.6
Shear.....Allowable	psi =	94.9	94.9
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	7.44	7.44
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	150.0	150.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	4,000.0	4,000.0
Fy	psi =	60,000.0	60,000.0

BEARING PRESSURE RESISTED BY PIN PILES. SEE HAND CALCS.

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0003 in2/ft		
(4/3) * As :	0.0004 in2/ft	Min Stem T&S Reinf Area 0.360 in2	
200bd/fy : 200(12)(7.4375)/60000 :	0.2975 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.216 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	1 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.6121 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.5754 in2/ft		
(4/3) * As :	0.7672 in2/ft	Min Stem T&S Reinf Area 2.640 in2	
200bd/fy : 200(12)(7.4375)/60000 :	0.2975 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.5754 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	1 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.6121 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	6.50
Total Footing Width	=	7.50
Footing Thickness	=	24.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	2.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 3.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	5,437	0	psf
Mu' : Upward	=	2,583	15,457	ft-#
Mu' : Downward	=	246	31,212	ft-#
Mu: Design	=	2,337	15,755	ft-#
Actual 1-Way Shear	=	1.44	5.90	psi
Allow 1-Way Shear	=	43.82	82.16	psi
Toe Reinforcing	=	# 6 @ 9.99 in		
Heel Reinforcing	=	# 6 @ 9.99 in		
Key Reinforcing	=	None Spec'd		

Other Acceptable Sizes & Spacings

Toe: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Heel: #4@ 4.62 in, #5@ 7.17 in, #6@ 10.18 in, #7@ 13.88 in, #8@ 18.28 in, #9@ 23.
Key: No key defined

Min footing T&S reinf Area 3.89 in2
Min footing T&S reinf Area per foot 0.52 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 4.63 in	#4@ 9.26 in
#5@ 7.18 in	#5@ 14.35 in
#6@ 10.19 in	#6@ 20.37 in

Summary of Overturning & Resisting Forces & Moments

.....OVERTURNING.....

Item		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	3,920.0	4.67	18,293.3
Surcharge over Heel	=			
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=			
Load @ Stem Above Soil	=			
	=			
Total		3,920.0	**O.T.M.**	18,293.3
	=		=	

Resisting/Overturning Ratio = **2.62**
Vertical Loads used for Soil Pressure = 13,775.0 lbs

.....RESISTING.....

		Force lbs	Distance ft	Moment ft-#
Soil Over Heel	=	7,480.0	4.67	34,906.7
Sloped Soil Over Heel	=			
Surcharge Over Heel	=			
Adjacent Footing Load	=			
Axial Dead Load on Stem	=	1,260.0	1.42	1,785.0
* Axial Live Load on Stem	=	800.0	1.42	1,133.3
Soil Over Toe	=	110.0	0.50	55.0
Surcharge Over Toe	=			
Stem Weight(s)	=	1,875.0	1.42	2,656.3
Earth @ Stem Transitions	=			
Footing Weight	=	2,250.0	3.75	8,437.5
Key Weight	=		2.00	
Vert. Component	=			
Total =		12,975.0 lbs	**R.M.=**	47,840.4

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.191	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

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Cantilevered Retaining Wall

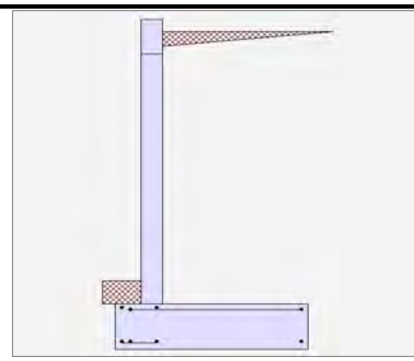
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	12.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	460.0 lbs
Axial Live Load	=	800.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	2.62	OK
Sliding	=	1.85	OK
Total Bearing Load	=	13,775 lbs	
...resultant ecc.	=	18.27 in	
Soil Pressure @ Toe	=	4,123 psf	NG
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	3,000 psf	

Soil Pressure Exceeds Allowable!

ACI Factored @ Toe	=	5,437 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	1.4 psi	OK
Footing Shear @ Heel	=	5.9 psi	OK
Allowable	=	82.2 psi	

Sliding Calcs

Lateral Sliding Force	=	3,920.0 lbs	
less 100% Passive Force	= -	1,400.0 lbs	
less 100% Friction Force	= -	5,838.8 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	0.0 lbs	OK

BEARING PRESSURE RESISTED BY PIN PILES. SEE HAND CALCS.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing pressures.

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

		2nd	Bottom
		Stem OK	Stem OK
Design Height Above Ftg	ft =	11.00	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Design Method	=	LRFD	LRFD
Thickness	=	10.00	10.00
Rebar Size	=	# 9	# 9
Rebar Spacing	=	12.00	12.00
Rebar Placed at	=	Edge	Edge
Design Data			
fb/FB + fa/Fa	=	**-0.001**	**0.610**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	32.0	4,608.0
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =	10.7	18,432.0
Moment.....Allowable	ft-# =	30,150.0	30,150.0
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =	0.4	51.6
Shear.....Allowable	psi =	94.9	94.9
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	7.44	7.44
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	150.0	150.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	4,000.0	4,000.0
Fy	psi =	60,000.0	60,000.0

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0003 in2/ft		
(4/3) * As :	0.0004 in2/ft	Min Stem T&S Reinf Area 0.360 in2	
200bd/fy : 200(12)(7.4375)/60000 :	0.2975 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.216 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	1 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.6121 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.5754 in2/ft		
(4/3) * As :	0.7672 in2/ft	Min Stem T&S Reinf Area 2.640 in2	
200bd/fy : 200(12)(7.4375)/60000 :	0.2975 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.5754 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	1 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.6121 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	6.50
Total Footing Width	=	7.50
Footing Thickness	=	24.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	2.00 ft
f'c = 3,000 psi	Fy =	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top 3.00	@ Btm.=	3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	5,437	0	psf
Mu' : Upward	=	2,583	15,457	ft-#
Mu' : Downward	=	246	31,212	ft-#
Mu: Design	=	2,337	15,755	ft-#
Actual 1-Way Shear	=	1.44	5.90	psi
Allow 1-Way Shear	=	43.82	82.16	psi
Toe Reinforcing	=	# 6 @ 9.99 in		
Heel Reinforcing	=	# 6 @ 9.99 in		
Key Reinforcing	=	None Spec'd		

Other Acceptable Sizes & Spacings

Toe: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Heel: #4@ 4.62 in, #5@ 7.17 in, #6@ 10.18 in, #7@ 13.88 in, #8@ 18.28 in, #9@ 23.
Key: No key defined

Min footing T&S reinf Area	3.89	in2
Min footing T&S reinf Area per foot	0.52	in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 4.63 in	#4@ 9.26 in
#5@ 7.18 in	#5@ 14.35 in
#6@ 10.19 in	#6@ 20.37 in

Summary of Overturning & Resisting Forces & Moments

.....OVERTURNING.....

Item		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	3,920.0	4.67	18,293.3
Surcharge over Heel	=			
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=			
Load @ Stem Above Soil	=			
	=			
Total		3,920.0	**O.T.M.**	18,293.3
	=		=	

Resisting/Overturning Ratio = **2.62**
Vertical Loads used for Soil Pressure = 13,775.0 lbs

.....RESISTING.....

Item		Force lbs	Distance ft	Moment ft-#
Soil Over Heel	=	7,480.0	4.67	34,906.7
Sloped Soil Over Heel	=			
Surcharge Over Heel	=			
Adjacent Footing Load	=			
Axial Dead Load on Stem	=	1,260.0	1.42	1,785.0
* Axial Live Load on Stem	=	800.0	1.42	1,133.3
Soil Over Toe	=	110.0	0.50	55.0
Surcharge Over Toe	=			
Stem Weight(s)	=	1,875.0	1.42	2,656.3
Earth @ Stem Transitions	=			
Footing Weight	=	2,250.0	3.75	8,437.5
Key Weight	=		2.00	
Vert. Component	=			
Total =		12,975.0 lbs	**R.M.=**	47,840.4

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci

Horizontal Defl @ Top of Wall (approximate only) 0.191 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

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Cantilevered Retaining Wall

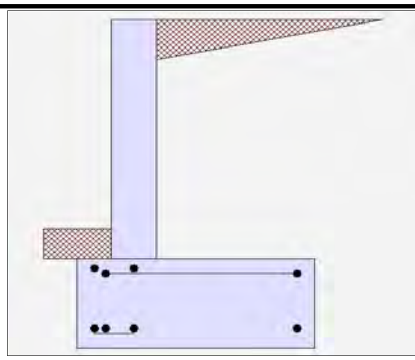
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Earth Pressure Seismic Load

Method : Uniform
Multiplier Used = 18.000
(Multiplier used on soil density)

Uniform Seismic Force = 99.000
Total Seismic Force = 544.500

Design Summary

Wall Stability Ratios

Overturning	=	1.94 OK
Sliding	=	1.59 OK
Total Bearing Load	=	2,322 lbs
...resultant ecc.	=	10.54 in
Soil Pressure @ Toe	=	1,776 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	3,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,487 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	1.3 psi OK
Footing Shear @ Heel	=	4.5 psi OK
Allowable	=	82.2 psi

Sliding Calcs

Lateral Sliding Force	=	986.2 lbs
less 100% Passive Force	= -	525.0 lbs
less 100% Friction Force	= -	1,044.8 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000

Stem Construction

			2nd	Bottom
			Stem OK	Stem OK
Design Height Above Ftg	ft	=	4.00	0.00
Wall Material Above "Ht"		=	Concrete	Concrete
Design Method		=	LRFD	LRFD
Thickness		=	8.00	8.00
Rebar Size		=	# 6	# 6
Rebar Spacing		=	18.00	18.00
Rebar Placed at		=	Center	Center
Design Data				
fb/FB + fa/Fa		=	**-0.001**	**0.294**
Total Force @ Section				
Service Level	lbs	=		
Strength Level	lbs	=		908.0
Moment....Actual				
Service Level	ft-#	=		
Strength Level	ft-#	=		1,474.7
Moment.....Allowable	ft-#	=	4,994.4	4,994.4
Shear.....Actual				
Service Level	psi	=		
Strength Level	psi	=		18.9
Shear.....Allowable	psi	=	94.9	94.9
Anet (Masonry)	in2	=		
Rebar Depth 'd'	in	=	4.00	4.00
Masonry Data				
f'm	psi	=		
Fs	psi	=		
Solid Grouting		=		
Modular Ratio 'n'		=		
Wall Weight	psf	=	120.0	120.0
Short Term Factor		=		
Equiv. Solid Thick.		=		
Masonry Block Type		=	Medium Weight	
Masonry Design Method		=	ASD	
Concrete Data				
f'c	psi	=	4,000.0	4,000.0

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0 in2/ft		
(4/3) * As :	0 in2/ft	Min Stem T&S Reinf Area 0.000 in2	
200bd/fy : 200(12)(4)/60000 :	0.16 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.000 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 0.00 in	#4@ 0.00 in
Provided Area :	0.2933 in2/ft	#5@ 0.00 in	#5@ 0.00 in
Maximum Area :	0.867 in2/ft	#6@ 0.00 in	#6@ 0.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.089 in2/ft		
(4/3) * As :	0.1187 in2/ft	Min Stem T&S Reinf Area 0.768 in2	
200bd/fy : 200(12)(4)/60000 :	0.16 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2933 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.867 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Dimensions & Strengths

Toe Width	=	0.50 ft
Heel Width	=	3.00
Total Footing Width	=	3.50
Footing Thickness	=	18.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	2.00 ft
f'c = 3,000 psi	Fy =	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top 3.00	@ Btm.=	3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	2,487	0 psf
Mu' : Upward	=	291	481 ft-#
Mu' : Downward	=	42	2,172 ft-#
Mu: Design	=	249	1,691 ft-#
Actual 1-Way Shear	=	1.32	4.51 psi
Allow 1-Way Shear	=	43.82	43.82 psi
Toe Reinforcing	=	# 6 @ 17.99 in	
Heel Reinforcing	=	# 5 @ 15.99 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area	1.36	in2
Min footing T&S reinf Area per foot	0.39	in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	605.0	1.83	1,109.2
Surcharge over Heel	=			
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=			
Load @ Stem Above Soil	=			
Seismic Earth Load	=	381.2	2.75	1,048.2
	=			
Total		986.2	**O.T.M.**	2,157.3
	=		=	

Resisting/Overturning Ratio = **1.94**
Vertical Loads used for Soil Pressure = 2,321.7 lbs

		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
Soil Over Heel	=	1,026.7	2.33	2,395.6
Sloped Soil Over Heel	=			
Surcharge Over Heel	=			
Adjacent Footing Load	=			
Axial Dead Load on Stem	=			
* Axial Live Load on Stem	=			
Soil Over Toe	=	27.5	0.25	6.9
Surcharge Over Toe	=			
Stem Weight(s)	=	480.0	0.83	400.0
Earth @ Stem Transitions	=			
Footing Weight	=	787.5	1.75	1,378.1
Key Weight	=		2.00	
Vert. Component	=			
Total =		2,321.7 lbs	**R.M.=**	4,180.6

If seismic is included, the OTM and sliding ratios
be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.056	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

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Cantilevered Retaining Wall

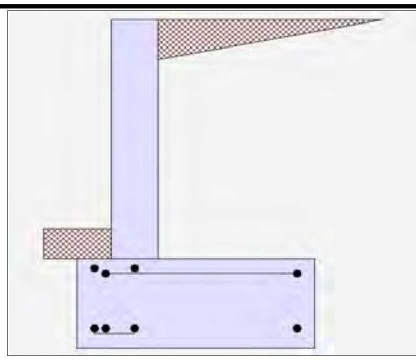
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	3.78	OK
Sliding	=	2.60	OK
Total Bearing Load	=	2,328 lbs	
...resultant ecc.	=	5.13 in	
Soil Pressure @ Toe	=	1,152 psf	OK
Soil Pressure @ Heel	=	178 psf	OK
Allowable	=	3,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	1,613 psf	
ACI Factored @ Heel	=	249 psf	
Footing Shear @ Toe	=	1.3 psi	OK
Footing Shear @ Heel	=	1.2 psi	OK
Allowable	=	82.2 psi	

Sliding Calcs

Lateral Sliding Force	=	605.0 lbs	
less 100% Passive Force	= -	525.0 lbs	
less 100% Friction Force	= -	1,047.4 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	0.0 lbs	OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

		2nd	Bottom
		Stem OK	Stem OK
Design Height Above Ftg	ft =	4.00	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Design Method	=	LRFD	LRFD
Thickness	=	8.00	8.25
Rebar Size	=	# 6	# 6
Rebar Spacing	=	18.00	18.00
Rebar Placed at	=	Center	Center
Design Data			
fb/FB + fa/Fa	=	**-0.001**	**0.131**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =		512.0
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =		682.7
Moment.....Allowable	ft-# =	4,994.4	5,159.4
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =		10.3
Shear.....Allowable	psi =	94.9	94.9
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	4.00	4.13
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	120.0	123.8
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	4,000.0	4,000.0
Fy	psi =	60,000.0	60,000.0

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0 in2/ft		
(4/3) * As :	0 in2/ft	Min Stem T&S Reinf Area 0.000 in2	
200bd/fy : 200(12)(4)/60000 :	0.16 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.000 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 0.00 in	#4@ 0.00 in
Provided Area :	0.2933 in2/ft	#5@ 0.00 in	#5@ 0.00 in
Maximum Area :	0.867 in2/ft	#6@ 0.00 in	#6@ 0.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0399 in2/ft		
(4/3) * As :	0.0531 in2/ft	Min Stem T&S Reinf Area 0.792 in2	
200bd/fy : 200(12)(4.125)/60000 :	0.165 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.198 in2/ft	
0.0018bh : 0.0018(12)(8.25) :	0.1782 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.1782 in2/ft	#4@ 12.12 in	#4@ 24.24 in
Provided Area :	0.2933 in2/ft	#5@ 18.79 in	#5@ 37.58 in
Maximum Area :	0.8941 in2/ft	#6@ 26.67 in	#6@ 53.33 in

Footing Dimensions & Strengths

Toe Width	=	0.50 ft
Heel Width	=	3.00
Total Footing Width	=	3.50
Footing Thickness	=	18.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	2.00 ft

f'c = 3,000 psi   Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 3.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,613	249 psf
Mu' : Upward	=	194	1,469 ft-#
Mu' : Downward	=	42	2,134 ft-#
Mu: Design	=	152	665 ft-#
Actual 1-Way Shear	=	1.32	1.19 psi
Allow 1-Way Shear	=	43.82	43.82 psi
Toe Reinforcing	=	# 6 @ 17.99 in	
Heel Reinforcing	=	# 5 @ 15.99 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area 1.36 in2
Min footing T&S reinf Area per foot 0.39 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

.....OVERTURNING.....

Item		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	605.0	1.83	1,109.2
Surcharge over Heel	=			
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=			
Load @ Stem Above Soil	=			
	=			
Total		605.0	**O.T.M.**	1,109.2
	=		=	

Resisting/Overturning Ratio = **3.78**
Vertical Loads used for Soil Pressure = 2,327.5 lbs

.....RESISTING.....

Item		Force lbs	Distance ft	Moment ft-#
Soil Over Heel	=	1,017.5	2.34	2,384.8
Sloped Soil Over Heel	=			
Surcharge Over Heel	=			
Adjacent Footing Load	=			
Axial Dead Load on Stem	=			
* Axial Live Load on Stem	=			
Soil Over Toe	=	27.5	0.25	6.9
Surcharge Over Toe	=			
Stem Weight(s)	=	495.0	0.84	417.7
Earth @ Stem Transitions	=			
Footing Weight	=	787.5	1.75	1,378.1
Key Weight	=		2.00	
Vert. Component	=			
Total =		2,327.5 lbs	**R.M.=**	4,187.4

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.037	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

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Cantilevered Retaining Wall

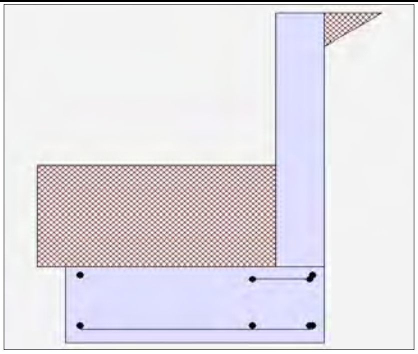
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	5.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	24.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	63.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Design Summary

Wall Stability Ratios

Overturning	=	2.37	OK
Sliding	=	2.35	OK
Total Bearing Load	=	2,571 lbs	
...resultant ecc.	=	8.61 in	
Soil Pressure @ Toe	=	1,116 psf	OK
Soil Pressure @ Heel	=	25 psf	OK
Allowable	=	3,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	1,563 psf	
ACI Factored @ Heel	=	35 psf	
Footing Shear @ Toe	=	6.7 psi	OK
Footing Shear @ Heel	=	4.5 psi	OK
Allowable	=	82.2 psi	

Sliding Calcs

Lateral Sliding Force	=	1,330.9 lbs	
less 100% Passive Force	= -	1,968.8 lbs	
less 100% Friction Force	= -	1,156.8 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	0.0 lbs	OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

		2nd Stem OK	Bottom Stem OK
Design Height Above Ftg	ft =	5.00	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Design Method	=	LRFD	LRFD
Thickness	=	10.00	10.00
Rebar Size	=	# 6	# 6
Rebar Spacing	=	12.00	12.00
Rebar Placed at	=	Edge	Edge
Design Data			
fb/FB + fa/Fa	=	**-0.001**	**0.144**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =		1,260.0
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =		2,100.0
Moment.....Allowable	ft-# =	14,455.0	14,455.0
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =		13.8
Shear.....Allowable	psi =	94.9	94.9
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	7.63	7.63
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	150.0	150.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	4,000.0	4,000.0
Fy	psi =	60,000.0	60,000.0

Cantilevered Retaining Wall Code: IBC 2018,ACI 318-14,TMS 402-16

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0 in2/ft		
(4/3) * As :	0 in2/ft	Min Stem T&S Reinf Area 0.000 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.000 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.216 in2/ft	#4@ 0.00 in	#4@ 0.00 in
Provided Area :	0.44 in2/ft	#5@ 0.00 in	#5@ 0.00 in
Maximum Area :	1.6527 in2/ft	#6@ 0.00 in	#6@ 0.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0639 in2/ft		
(4/3) * As :	0.0852 in2/ft	Min Stem T&S Reinf Area 1.200 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.216 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.44 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.6527 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Dimensions & Strengths

Toe Width	=	3.67 ft
Heel Width	=	0.83
Total Footing Width	=	4.50
Footing Thickness	=	18.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 3.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,563	35 psf
Mu' : Upward	=	7,731	0 ft-#
Mu' : Downward	=	3,596	0 ft-#
Mu: Design	=	4,135	0 ft-#
Actual 1-Way Shear	=	6.71	4.51 psi
Allow 1-Way Shear	=	43.82	43.82 psi
Toe Reinforcing	=	# 6 @ 11.99 in	
Heel Reinforcing	=	# 6 @ 11.99 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area	1.75	in2
Min footing T&S reinf Area per foot	0.39	in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

Summary of Overturning & Resisting Forces & Moments

.....OVERTURNING.....				
Item		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,330.9	2.17	2,883.6
Surcharge over Heel	=			
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=			
Load @ Stem Above Soil	=			
	=			
Total		1,330.9	**O.T.M.**	2,883.6

Resisting/Overturning Ratio	=	**2.37**	
Vertical Loads used for Soil Pressure	=	2,570.7	lbs

.....RESISTING.....				
		Force lbs	Distance ft	Moment ft-#
Soil Over Heel	=		4.50	
Sloped Soil Over Heel	=			
Surcharge Over Heel	=			
Adjacent Footing Load	=			
Axial Dead Load on Stem	=			
* Axial Live Load on Stem	=			
Soil Over Toe	=	807.4	1.84	1,481.6
Surcharge Over Toe	=			
Stem Weight(s)	=	750.0	4.09	3,065.0
Earth @ Stem Transitions	=			
Footing Weight	=	1,013.3	2.25	2,281.5
Key Weight	=			
Vert. Component	=			
Total =		2,570.7 lbs	**R.M.=**	6,828.1

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.034	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

Use menu item Settings > Printing & Title Block
to set these five lines of information
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Project Name/Number : 21201 retaini
Title **Site Retaining Wall (3ft) - Seismic**
Dsgnr: **BRT**
Description....

Page : 1
Date: 23 APR 2021

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Cantilevered Retaining Wall

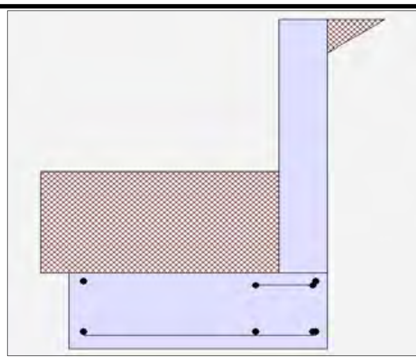
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	5.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	24.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	63.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform
Multiplier Used = 18.000
(Multiplier used on soil density)

Uniform Seismic Force = 117.000
Total Seismic Force = 760.500

FACTOR OF SAFETY = 1.1 FOR SEISMIC, OK.

Design Summary

Wall Stability Ratios

Overturning	=	1.48 Ratio < 1.5!
Sliding	=	1.68 OK
Total Bearing Load	=	2,571 lbs
...resultant ecc.	=	16.68 in
Soil Pressure @ Toe	=	1,989 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	3,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,785 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	10.7 psi OK
Footing Shear @ Heel	=	1.2 psi OK
Allowable	=	82.2 psi

Sliding Calcs

Lateral Sliding Force	=	1,863.2 lbs
less 100% Passive Force	= -	1,968.8 lbs
less 100% Friction Force	= -	1,156.8 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000

Stem Construction

		2nd	Bottom
		Stem OK	Stem OK
Design Height Above Ftg	ft =	5.00	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Design Method	=	LRFD	LRFD
Thickness	=	10.00	10.00
Rebar Size	=	# 6	# 6
Rebar Spacing	=	12.00	12.00
Rebar Placed at	=	Edge	Edge
Design Data			
fb/FB + fa/Fa	=	**-0.001**	**0.245**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =		1,845.0
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =		3,562.5
Moment.....Allowable	ft-# =	14,455.0	14,455.0
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =		20.2
Shear.....Allowable	psi =	94.9	94.9
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	7.63	7.63
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	150.0	150.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	4,000.0	4,000.0

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0 in2/ft		
(4/3) * As :	0 in2/ft	Min Stem T&S Reinf Area 0.000 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.000 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.216 in2/ft	#4@ 0.00 in	#4@ 0.00 in
Provided Area :	0.44 in2/ft	#5@ 0.00 in	#5@ 0.00 in
Maximum Area :	1.6527 in2/ft	#6@ 0.00 in	#6@ 0.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1084 in2/ft		
(4/3) * As :	0.1445 in2/ft	Min Stem T&S Reinf Area 1.200 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.216 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.44 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.6527 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Dimensions & Strengths

Toe Width	=	3.67 ft
Heel Width	=	0.83
Total Footing Width	=	4.50
Footing Thickness	=	18.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 3.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	2,785	0 psf
Mu' : Upward	=	10,108	0 ft-#
Mu' : Downward	=	3,596	0 ft-#
Mu: Design	=	6,512	0 ft-#
Actual 1-Way Shear	=	10.73	1.19 psi
Allow 1-Way Shear	=	43.82	43.82 psi
Toe Reinforcing	=	# 6 @ 11.99 in	
Heel Reinforcing	=	# 6 @ 11.99 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area 1.75 in2
Min footing T&S reinf Area per foot 0.39 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

.....OVERTURNING.....

Item		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,330.9	2.17	2,883.6
Surcharge over Heel	=			
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=			
Load @ Stem Above Soil	=			
Seismic Earth Load	=	532.4	3.25	1,730.1
	=			
Total		1,863.2	**O.T.M.**	4,613.7
	=		=	

Resisting/Overturning Ratio = **1.48**

Vertical Loads used for Soil Pressure = 2,570.7 lbs

.....RESISTING.....

Item		Force lbs	Distance ft	Moment ft-#
Soil Over Heel	=		4.50	
Sloped Soil Over Heel	=			
Surcharge Over Heel	=			
Adjacent Footing Load	=			
Axial Dead Load on Stem	=			
* Axial Live Load on Stem	=			
Soil Over Toe	=	807.4	1.84	1,481.6
Surcharge Over Toe	=			
Stem Weight(s)	=	750.0	4.09	3,065.0
Earth @ Stem Transitions	=			
Footing Weight	=	1,013.3	2.25	2,281.5
Key Weight	=			
Vert. Component	=			
Total =		2,570.7 lbs	**R.M.=**	6,828.1

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.061	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

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Cantilevered Retaining Wall

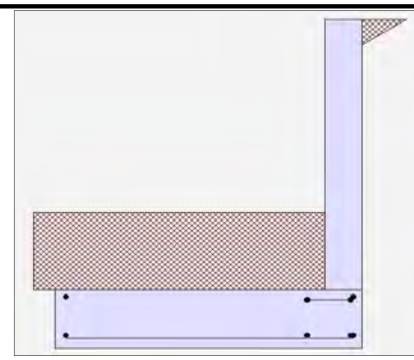
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	7.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	24.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	63.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform
Multiplier Used = 18.000
(Multiplier used on soil density)

Uniform Seismic Force = 153.000
Total Seismic Force = 1,300.500

FACTOR OF SAFETY = 1.1 FOR SEISMIC, OK.

Design Summary

Wall Stability Ratios

Overturning	=	1.61 OK
Sliding	=	1.18 Ratio < 1.5!
Total Bearing Load	=	3,983 lbs
...resultant ecc.	=	23.03 in
Soil Pressure @ Toe	=	1,678 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	3,000 psf

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	2,349 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	14.3 psi OK
Footing Shear @ Heel	=	14.1 psi OK
Allowable	=	82.2 psi

Sliding Calcs

Lateral Sliding Force	=	3,186.2 lbs
less 100% Passive Force	= -	1,968.8 lbs
less 100% Friction Force	= -	1,792.4 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	1,018.2 lbs NG

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

			2nd	Bottom
			Stem OK	Stem OK
Design Height Above Ftg	ft	=	7.00	0.00
Wall Material Above "Ht"		=	Concrete	Concrete
Design Method		=	LRFD	LRFD
Thickness		=	10.00	10.00
Rebar Size		=	# 6	# 6
Rebar Spacing		=	12.00	12.00
Rebar Placed at		=	Edge	Edge
Design Data				
fb/FB + fa/Fa		=	**-0.001**	**0.657**
Total Force @ Section				
Service Level	lbs	=		
Strength Level	lbs	=		3,540.6
Moment....Actual				
Service Level	ft-#	=		
Strength Level	ft-#	=		9,510.9
Moment.....Allowable	ft-#	=	14,455.0	14,455.0
Shear.....Actual				
Service Level	psi	=		
Strength Level	psi	=		38.7
Shear.....Allowable	psi	=	94.9	94.9
Anet (Masonry)	in2	=		
Rebar Depth 'd'	in	=	7.63	7.63
Masonry Data				
f'm	psi	=		
Fs	psi	=		
Solid Grouting		=		
Modular Ratio 'n'		=		
Wall Weight	psf	=	150.0	150.0
Short Term Factor		=		
Equiv. Solid Thick.		=		
Masonry Block Type		=	Medium Weight	
Masonry Design Method		=	ASD	
Concrete Data				
f'c	psi	=	4,000.0	4,000.0
Fy	psi	=	60,000.0	60,000.0

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0 in2/ft		
(4/3) * As :	0 in2/ft	Min Stem T&S Reinf Area 0.000 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.000 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.216 in2/ft	#4@ 0.00 in	#4@ 0.00 in
Provided Area :	0.44 in2/ft	#5@ 0.00 in	#5@ 0.00 in
Maximum Area :	1.6527 in2/ft	#6@ 0.00 in	#6@ 0.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.2893 in2/ft		
(4/3) * As :	0.3857 in2/ft	Min Stem T&S Reinf Area 1.680 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.305 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.44 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.6527 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Dimensions & Strengths

Toe Width	=	6.17 ft
Heel Width	=	0.83
Total Footing Width	=	7.00
Footing Thickness	=	18.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 3.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	2,349	0	psf
Mu' : Upward	=	25,581	0	ft-#
Mu' : Downward	=	10,164	0	ft-#
Mu: Design	=	15,416	0	ft-#
Actual 1-Way Shear	=	14.31	14.13	psi
Allow 1-Way Shear	=	82.16	43.82	psi
Toe Reinforcing	=	# 6 @ 11.99 in		
Heel Reinforcing	=	# 6 @ 11.99 in		
Key Reinforcing	=	None Spec'd		

Other Acceptable Sizes & Spacings

Toe: #4@ 6.16 in, #5@ 9.56 in, #6@ 13.57 in, #7@ 18.51 in, #8@ 24.37 in, #9@ 30.
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area	2.72	in2
Min footing T&S reinf Area per foot	0.39	in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

.....OVERTURNING.....

Item		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	2,275.9	2.83	6,448.3
Surcharge over Heel	=			
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=			
Load @ Stem Above Soil	=			
Seismic Earth Load	=	910.4	4.25	3,869.0
	=			
Total		3,186.2	**O.T.M.**	10,317.3
	=		=	

Resisting/Overturning Ratio = **1.61**
Vertical Loads used for Soil Pressure = 3,983.2 lbs

.....RESISTING.....

		Force lbs	Distance ft	Moment ft-#
Soil Over Heel	=		7.00	
Sloped Soil Over Heel	=			
Surcharge Over Heel	=			
Adjacent Footing Load	=			
Axial Dead Load on Stem	=			
* Axial Live Load on Stem	=			
Soil Over Toe	=	1,357.4	3.09	4,187.6
Surcharge Over Toe	=			
Stem Weight(s)	=	1,050.0	6.59	6,916.0
Earth @ Stem Transitions	=			
Footing Weight	=	1,575.8	3.50	5,517.8
Key Weight	=			
Vert. Component	=			
Total =		3,983.2 lbs	**R.M.=**	16,621.3

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

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.047	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

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Cantilevered Retaining Wall

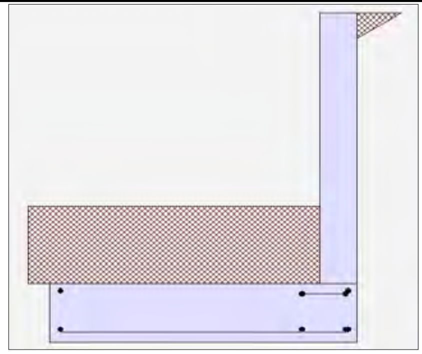
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	7.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	24.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	63.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	2.58	OK
Sliding	=	1.65	OK
Total Bearing Load	=	3,983 lbs	
...resultant ecc.	=	11.37 in	
Soil Pressure @ Toe	=	1,031 psf	OK
Soil Pressure @ Heel	=	107 psf	OK
Allowable	=	3,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	1,443 psf	
ACI Factored @ Heel	=	150 psf	
Footing Shear @ Toe	=	10.3 psi	OK
Footing Shear @ Heel	=	14.1 psi	OK
Allowable	=	82.2 psi	

Sliding Calcs

Lateral Sliding Force	=	2,275.9 lbs	
less 100% Passive Force	= -	1,968.8 lbs	
less 100% Friction Force	= -	1,792.4 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	0.0 lbs	OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

			2nd	Bottom
			Stem OK	Stem OK
Design Height Above Ftg	ft	=	7.00	0.00
Wall Material Above "Ht"		=	Concrete	Concrete
Design Method		=	LRFD	LRFD
Thickness		=	10.00	10.00
Rebar Size		=	# 6	# 6
Rebar Spacing		=	12.00	12.00
Rebar Placed at		=	Edge	Edge
Design Data				
fb/FB + fa/Fa		=	**-0.001**	**0.398**
Total Force @ Section				
Service Level	lbs	=		
Strength Level	lbs	=		2,469.6
Moment....Actual				
Service Level	ft-#	=		
Strength Level	ft-#	=		5,762.4
Moment.....Allowable	ft-#	=	14,455.0	14,455.0
Shear.....Actual				
Service Level	psi	=		
Strength Level	psi	=		27.0
Shear.....Allowable	psi	=	94.9	94.9
Anet (Masonry)	in2	=		
Rebar Depth 'd'	in	=	7.63	7.63
Masonry Data				
f'm	psi	=		
Fs	psi	=		
Solid Grouting		=		
Modular Ratio 'n'		=		
Wall Weight	psf	=	150.0	150.0
Short Term Factor		=		
Equiv. Solid Thick.		=		
Masonry Block Type		=	Medium Weight	
Masonry Design Method		=	ASD	
Concrete Data				
f'c	psi	=	4,000.0	4,000.0
Fy	psi	=	60,000.0	60,000.0

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0 in2/ft		
(4/3) * As :	0 in2/ft	Min Stem T&S Reinf Area 0.000 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.000 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.216 in2/ft	#4@ 0.00 in	#4@ 0.00 in
Provided Area :	0.44 in2/ft	#5@ 0.00 in	#5@ 0.00 in
Maximum Area :	1.6527 in2/ft	#6@ 0.00 in	#6@ 0.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1753 in2/ft		
(4/3) * As :	0.2337 in2/ft	Min Stem T&S Reinf Area 1.680 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.2337 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.44 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.6527 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Dimensions & Strengths

Toe Width	=	6.17 ft
Heel Width	=	0.83
Total Footing Width	=	7.00
Footing Thickness	=	18.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 3.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,443	150 psf
Mu' : Upward	=	20,234	0 ft-#
Mu' : Downward	=	10,164	0 ft-#
Mu: Design	=	10,070	0 ft-#
Actual 1-Way Shear	=	10.34	14.13 psi
Allow 1-Way Shear	=	82.16	43.82 psi
Toe Reinforcing	=	# 6 @ 11.99 in	
Heel Reinforcing	=	# 6 @ 11.99 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: #4@ 6.16 in, #5@ 9.56 in, #6@ 13.57 in, #7@ 18.51 in, #8@ 24.37 in, #9@ 30.
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area	2.72	in2
Min footing T&S reinf Area per foot	0.39	in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

Cantilevered Retaining Wall Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

.....OVERTURNING.....

Item		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	2,275.9	2.83	6,448.3
Surcharge over Heel	=			
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=			
Load @ Stem Above Soil	=			
	=			
Total		2,275.9	**O.T.M.**	6,448.3
	=		=	

Resisting/Overturning Ratio = **2.58**
Vertical Loads used for Soil Pressure = 3,983.2 lbs

.....RESISTING.....

Item		Force lbs	Distance ft	Moment ft-#
Soil Over Heel	=		7.00	
Sloped Soil Over Heel	=			
Surcharge Over Heel	=			
Adjacent Footing Load	=			
Axial Dead Load on Stem	=			
* Axial Live Load on Stem	=			
Soil Over Toe	=	1,357.4	3.09	4,187.6
Surcharge Over Toe	=			
Stem Weight(s)	=	1,050.0	6.59	6,916.0
Earth @ Stem Transitions	=			
Footing Weight	=	1,575.8	3.50	5,517.8
Key Weight	=			
Vert. Component	=			
Total =		3,983.2 lbs	**R.M.=**	16,621.3

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.029	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,
because the wall would then tend to rotate into the retained soil.

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Cantilevered Retaining Wall

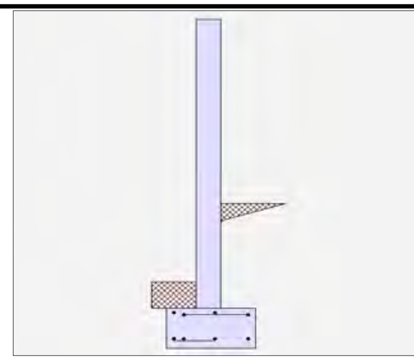
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	7.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	63.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	170.0 lbs
Axial Live Load	=	160.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	2.93	OK
Sliding	=	2.51	OK
Total Bearing Load	=	3,438 lbs	
...resultant ecc.	=	5.46 in	
Soil Pressure @ Toe	=	2,189 psf	OK
Soil Pressure @ Heel	=	103 psf	OK
Allowable	=	3,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	2,922 psf	
ACI Factored @ Heel	=	137 psf	
Footing Shear @ Toe	=	0.5 psi	OK
Footing Shear @ Heel	=	0.7 psi	OK
Allowable	=	82.2 psi	

Sliding Calcs

Lateral Sliding Force	=	952.9 lbs	
less 100% Passive Force	= -	918.8 lbs	
less 100% Friction Force	= -	1,475.3 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	0.0 lbs	OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

			2nd	Bottom
			Stem OK	Stem OK
Design Height Above Ftg	ft	=	11.00	0.00
Wall Material Above "Ht"		=	Concrete	Concrete
Design Method		=	LRFD	LRFD
Thickness		=	10.00	10.00
Rebar Size		=	# 6	# 6
Rebar Spacing		=	18.00	18.00
Rebar Placed at		=	Edge	Edge
Design Data				
fb/FB + fa/Fa		=	**-0.001**	**0.109**
Total Force @ Section				
Service Level	lbs	=		
Strength Level	lbs	=		806.4
Moment....Actual				
Service Level	ft-#	=		
Strength Level	ft-#	=		1,075.2
Moment.....Allowable	ft-#	=	9,779.4	9,779.4
Shear.....Actual				
Service Level	psi	=		
Strength Level	psi	=		8.8
Shear.....Allowable	psi	=	94.9	94.9
Anet (Masonry)	in2	=		
Rebar Depth 'd'	in	=	7.63	7.63
Masonry Data				
f'm	psi	=		
Fs	psi	=		
Solid Grouting		=		
Modular Ratio 'n'		=		
Wall Weight	psf	=	150.0	150.0
Short Term Factor		=		
Equiv. Solid Thick.		=		
Masonry Block Type		=	Medium Weight	
Masonry Design Method		=	ASD	
Concrete Data				
f'c	psi	=	4,000.0	4,000.0
Fy	psi	=	60,000.0	60,000.0

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0 in2/ft		
(4/3) * As :	0 in2/ft	Min Stem T&S Reinf Area 0.000 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.000 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.216 in2/ft	#4@ 0.00 in	#4@ 0.00 in
Provided Area :	0.2933 in2/ft	#5@ 0.00 in	#5@ 0.00 in
Maximum Area :	1.6527 in2/ft	#6@ 0.00 in	#6@ 0.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0327 in2/ft		
(4/3) * As :	0.0436 in2/ft	Min Stem T&S Reinf Area 2.640 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.216 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.2933 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.6527 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	2.00
Total Footing Width	=	3.00
Footing Thickness	=	18.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	2.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 3.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	2,922	137 psf
Mu' : Upward	=	1,306	339 ft-#
Mu' : Downward	=	201	543 ft-#
Mu: Design	=	1,105	204 ft-#
Actual 1-Way Shear	=	0.48	0.72 psi
Allow 1-Way Shear	=	43.82	43.82 psi
Toe Reinforcing	=	# 6 @ 17.99 in	
Heel Reinforcing	=	# 6 @ 17.99 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: #4@ 6.16 in, #5@ 9.56 in, #6@ 13.57 in, #7@ 18.51 in, #8@ 24.37 in, #9@ 30.
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area 1.17 in2
Min footing T&S reinf Area per foot 0.39 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

Cantilevered Retaining Wall Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

.....OVERTURNING.....

Item		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	952.9	1.83	1,746.9
Surcharge over Heel	=			
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=			
Load @ Stem Above Soil	=			
	=			
Total		952.9	**O.T.M.**	1,746.9
	=		=	

Resisting/Overturning Ratio = **2.93**
Vertical Loads used for Soil Pressure = 3,438.3 lbs

.....RESISTING.....

		Force lbs	Distance ft	Moment ft-#
Soil Over Heel	=	513.3	2.42	1,240.6
Sloped Soil Over Heel	=			
Surcharge Over Heel	=			
Adjacent Footing Load	=			
Axial Dead Load on Stem	=	330.0	1.42	467.5
* Axial Live Load on Stem	=	160.0	1.42	226.7
Soil Over Toe	=	110.0	0.50	55.0
Surcharge Over Toe	=			
Stem Weight(s)	=	1,650.0	1.42	2,337.5
Earth @ Stem Transitions	=			
Footing Weight	=	675.0	1.50	1,012.5
Key Weight	=		2.00	
Vert. Component	=			
Total =		3,278.3 lbs	**R.M.=**	5,113.1

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci

Horizontal Defl @ Top of Wall (approximate only) 0.223 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

Use menu item Settings > Printing & Title Block
to set these five lines of information
for your program.

Project Name/Number : 21201 retaini

Title	**Retaining Wall (Grid 7) - Seismic**	Page :	1
Dsgnr:	**BRT**	Date:	23 APR 2021
Description....			

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Cantilevered Retaining Wall

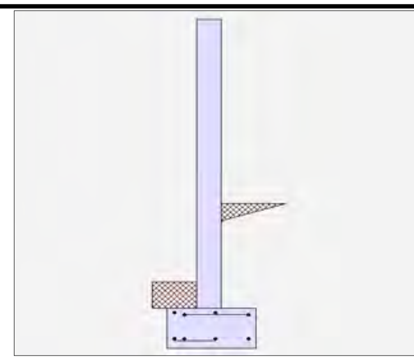
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	7.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	63.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	170.0 lbs
Axial Live Load	=	160.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used = 18.000

(Multiplier used on soil density)

Uniform Seismic Force	=	99.000
Total Seismic Force	=	544.500

Design Summary

Wall Stability Ratios

Overturning	=	1.83	OK
Sliding	=	1.79	OK
Total Bearing Load	=	3,438 lbs	
...resultant ecc.	=	9.12 in	
Soil Pressure @ Toe	=	3,097 psf	NG
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	3,000 psf	

Soil Pressure Exceeds Allowable!

ACI Factored @ Toe	=	4,134 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	0.5 psi	OK
Footing Shear @ Heel	=	4.1 psi	OK
Allowable	=	82.2 psi	

Sliding Calcs

Lateral Sliding Force	=	1,334.0 lbs	
less 100% Passive Force	= -	918.8 lbs	
less 100% Friction Force	= -	1,475.3 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	0.0 lbs	OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

			2nd	Bottom
			Stem OK	Stem OK
Design Height Above Ftg	ft	=	11.00	0.00
Wall Material Above "Ht"		=	Concrete	Concrete
Design Method		=	LRFD	LRFD
Thickness		=	10.00	10.00
Rebar Size		=	# 6	# 6
Rebar Spacing		=	18.00	18.00
Rebar Placed at		=	Edge	Edge
Design Data				
fb/FB + fa/Fa		=	**-0.001**	**0.190**
Total Force @ Section				
Service Level	lbs	=		
Strength Level	lbs	=		1,202.4
Moment....Actual				
Service Level	ft-#	=		
Strength Level	ft-#	=		1,867.2
Moment.....Allowable	ft-#	=	9,779.4	9,779.4
Shear.....Actual				
Service Level	psi	=		
Strength Level	psi	=		13.1
Shear.....Allowable	psi	=	94.9	94.9
Anet (Masonry)	in2	=		
Rebar Depth 'd'	in	=	7.63	7.63
Masonry Data				
f'm	psi	=		
Fs	psi	=		
Solid Grouting		=		
Modular Ratio 'n'		=		
Wall Weight	psf	=	150.0	150.0
Short Term Factor		=		
Equiv. Solid Thick.		=		
Masonry Block Type		=	Medium Weight	
Masonry Design Method		=	ASD	
Concrete Data				
f'c	psi	=	4,000.0	4,000.0
Fy	psi	=	60,000.0	60,000.0

BEARING PRESSURE RESISTED BY PIN PILES. SEE HAND CALCS.

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0 in2/ft		
(4/3) * As :	0 in2/ft	Min Stem T&S Reinf Area 0.000 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.000 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.216 in2/ft	#4@ 0.00 in	#4@ 0.00 in
Provided Area :	0.2933 in2/ft	#5@ 0.00 in	#5@ 0.00 in
Maximum Area :	1.6527 in2/ft	#6@ 0.00 in	#6@ 0.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0568 in2/ft		
(4/3) * As :	0.0757 in2/ft	Min Stem T&S Reinf Area 2.640 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.216 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.2933 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.6527 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	2.00
Total Footing Width	=	3.00
Footing Thickness	=	18.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	2.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 3.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	4,134	0 psf
Mu' : Upward	=	1,757	18 ft-#
Mu' : Downward	=	201	543 ft-#
Mu: Design	=	1,556	525 ft-#
Actual 1-Way Shear	=	0.48	4.12 psi
Allow 1-Way Shear	=	43.82	43.82 psi

Toe Reinforcing = # 6 @ 17.99 in
Heel Reinforcing = # 6 @ 17.99 in
Key Reinforcing = None Spec'd

Other Acceptable Sizes & Spacings

Toe: #4@ 6.16 in, #5@ 9.56 in, #6@ 13.57 in, #7@ 18.51 in, #8@ 24.37 in, #9@ 30.
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area 1.17 in2
Min footing T&S reinf Area per foot 0.39 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

.....OVERTURNING.....

Item		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	952.9	1.83	1,746.9
Surcharge over Heel	=			
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=			
Load @ Stem Above Soil	=			
Seismic Earth Load	=	381.2	2.75	1,048.2
	=			
Total		1,334.0	**O.T.M.**	2,795.1
	=		=	

Resisting/Overturning Ratio = **1.83**
Vertical Loads used for Soil Pressure = 3,438.3 lbs

.....RESISTING.....

Item		Force lbs	Distance ft	Moment ft-#
Soil Over Heel	=	513.3	2.42	1,240.6
Sloped Soil Over Heel	=			
Surcharge Over Heel	=			
Adjacent Footing Load	=			
Axial Dead Load on Stem	=	330.0	1.42	467.5
* Axial Live Load on Stem	=	160.0	1.42	226.7
Soil Over Toe	=	110.0	0.50	55.0
Surcharge Over Toe	=			
Stem Weight(s)	=	1,650.0	1.42	2,337.5
Earth @ Stem Transitions	=			
Footing Weight	=	675.0	1.50	1,012.5
Key Weight	=		2.00	
Vert. Component	=			
Total =		3,278.3 lbs	**R.M.=**	5,113.1

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

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.315	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

Use menu item Settings > Printing & Title Block
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Project Name/Number : 21201 retaini
Title **Retaining Wall (Grid C) - Seismic**
Dsgnr: **BRT**
Description....

Page : 1
Date: 23 APR 2021

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Cantilevered Retaining Wall

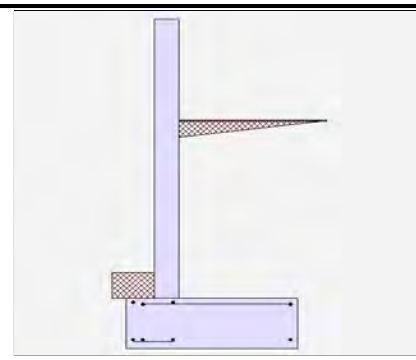
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	7.00 ft
Wall height above soil	=	4.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	63.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	582.0 lbs
Axial Live Load	=	160.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform
Multiplier Used = 18.000
(Multiplier used on soil density)

Uniform Seismic Force = 162.000
Total Seismic Force = 1,458.000

FACTOR OF
SAFETY = 1.1 FOR
SEISMIC, OK.

Design Summary

Wall Stability Ratios

Overturning	=	1.75 OK
Sliding	=	1.34 Ratio < 1.5!
Total Bearing Load	=	7,670 lbs
...resultant ecc.	=	21.31 in
Soil Pressure @ Toe	=	4,177 psf NG
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	3,000 psf
Soil Pressure Exceeds Allowable!		
ACI Factored @ Toe	=	5,726 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	1.4 psi OK
Footing Shear @ Heel	=	10.3 psi OK
Allowable	=	82.2 psi

Sliding Calcs

Lateral Sliding Force	=	3,572.1 lbs
less 100% Passive Force	= -	1,400.0 lbs
less 100% Friction Force	= -	3,379.7 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	578.5 lbs NG

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

		2nd	Bottom
		Stem OK	Stem OK
Design Height Above Ftg	ft =	11.00	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Design Method	=	LRFD	LRFD
Thickness	=	10.00	10.00
Rebar Size	=	# 6	# 6
Rebar Spacing	=	12.00	12.00
Rebar Placed at	=	Edge	Edge
Design Data			
fb/FB + fa/Fa	=	**-0.001**	**0.672**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =		3,603.6
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =		9,731.4
Moment.....Allowable	ft-# =	14,455.0	14,455.0
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =		39.4
Shear.....Allowable	psi =	94.9	94.9
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	7.63	7.63
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	150.0	150.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	4,000.0	4,000.0
Fy	psi =	60,000.0	60,000.0

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0 in2/ft		
(4/3) * As :	0 in2/ft	Min Stem T&S Reinf Area 0.000 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.000 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.216 in2/ft	#4@ 0.00 in	#4@ 0.00 in
Provided Area :	0.44 in2/ft	#5@ 0.00 in	#5@ 0.00 in
Maximum Area :	1.6527 in2/ft	#6@ 0.00 in	#6@ 0.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.296 in2/ft		
(4/3) * As :	0.3946 in2/ft	Min Stem T&S Reinf Area 2.640 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.305 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.44 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.6527 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	5.00
Total Footing Width	=	6.00
Footing Thickness	=	24.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	2.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 3.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	5,726	0	psf
Mu' : Upward	=	2,603	1,616	ft-#
Mu' : Downward	=	246	11,146	ft-#
Mu: Design	=	2,357	9,530	ft-#
Actual 1-Way Shear	=	1.44	10.28	psi
Allow 1-Way Shear	=	43.82	43.82	psi
Toe Reinforcing	=	# 6 @ 17.99 in		
Heel Reinforcing	=	# 6 @ 17.99 in		
Key Reinforcing	=	None Spec'd		

Other Acceptable Sizes & Spacings

Toe: #4@ 4.62 in, #5@ 7.17 in, #6@ 10.18 in, #7@ 13.88 in, #8@ 18.28 in, #9@ 23.
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area	3.11	in2
Min footing T&S reinf Area per foot	0.52	in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 4.63 in	#4@ 9.26 in
#5@ 7.18 in	#5@ 14.35 in
#6@ 10.19 in	#6@ 20.37 in

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

.....OVERTURNING.....

Item		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	2,551.5	3.00	7,654.5
Surcharge over Heel	=			
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=			
Load @ Stem Above Soil	=			
Seismic Earth Load	=	1,020.6	4.50	4,592.7
	=			
Total		3,572.1	**O.T.M.**	12,247.2
	=		=	

Resisting/Overturning Ratio = **1.75**
Vertical Loads used for Soil Pressure = 7,670.3 lbs

.....RESISTING.....

		Force lbs	Distance ft	Moment ft-#
Soil Over Heel	=	3,208.3	3.92	12,566.0
Sloped Soil Over Heel	=			
Surcharge Over Heel	=			
Adjacent Footing Load	=			
Axial Dead Load on Stem	=	742.0	1.42	1,051.2
* Axial Live Load on Stem	=	160.0	1.42	226.7
Soil Over Toe	=	110.0	0.50	55.0
Surcharge Over Toe	=			
Stem Weight(s)	=	1,650.0	1.42	2,337.5
Earth @ Stem Transitions	=			
Footing Weight	=	1,800.0	3.00	5,400.0
Key Weight	=		2.00	
Vert. Component	=			
Total =		7,510.3 lbs	**R.M.=**	21,409.6

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.213	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

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Cantilevered Retaining Wall

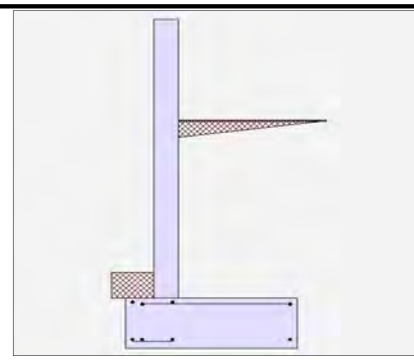
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	7.00 ft
Wall height above soil	=	4.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	63.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	582.0 lbs
Axial Live Load	=	160.0 lbs
Axial Load Eccentricity	=	0.0 in

Design Summary

Wall Stability Ratios

Overturning	=	2.80 OK
Sliding	=	1.87 OK
Total Bearing Load	=	7,670 lbs
...resultant ecc.	=	14.13 in
Soil Pressure @ Toe	=	2,805 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	3,000 psf

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	3,845 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	1.4 psi OK
Footing Shear @ Heel	=	2.7 psi OK
Allowable	=	82.2 psi

Sliding Calcs

Lateral Sliding Force	=	2,551.5 lbs
less 100% Passive Force	= -	1,400.0 lbs
less 100% Friction Force	= -	3,379.7 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	0.0 lbs OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

		2nd	Bottom
		Stem OK	Stem OK
Design Height Above Ftg	ft =	11.00	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Design Method	=	LRFD	LRFD
Thickness	=	10.00	10.00
Rebar Size	=	# 6	# 6
Rebar Spacing	=	12.00	12.00
Rebar Placed at	=	Edge	Edge
Design Data			
fb/FB + fa/Fa	=	**-0.001**	**0.398**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =		2,469.6
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =		5,762.4
Moment.....Allowable	ft-# =	14,455.0	14,455.0
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =		27.0
Shear.....Allowable	psi =	94.9	94.9
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	7.63	7.63
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	150.0	150.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	4,000.0	4,000.0
Fy	psi =	60,000.0	60,000.0

Cantilevered Retaining Wall Code: IBC 2018,ACI 318-14,TMS 402-16

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0 in2/ft		
(4/3) * As :	0 in2/ft	Min Stem T&S Reinf Area 0.000 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.000 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.216 in2/ft	#4@ 0.00 in	#4@ 0.00 in
Provided Area :	0.44 in2/ft	#5@ 0.00 in	#5@ 0.00 in
Maximum Area :	1.6527 in2/ft	#6@ 0.00 in	#6@ 0.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1753 in2/ft		
(4/3) * As :	0.2337 in2/ft	Min Stem T&S Reinf Area 2.640 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.2337 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.44 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.6527 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	5.00
Total Footing Width	=	6.00
Footing Thickness	=	24.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	2.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 3.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	3,845	0	psf
Mu' : Upward	=	1,806	5,630	ft-#
Mu' : Downward	=	246	11,146	ft-#
Mu: Design	=	1,560	5,516	ft-#
Actual 1-Way Shear	=	1.44	2.67	psi
Allow 1-Way Shear	=	43.82	43.82	psi
Toe Reinforcing	=	# 6 @ 17.99 in		
Heel Reinforcing	=	# 6 @ 17.99 in		
Key Reinforcing	=	None Spec'd		

Other Acceptable Sizes & Spacings

Toe: #4@ 4.62 in, #5@ 7.17 in, #6@ 10.18 in, #7@ 13.88 in, #8@ 18.28 in, #9@ 23.
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area	3.11	in2
Min footing T&S reinf Area per foot	0.52	in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 4.63 in	#4@ 9.26 in
#5@ 7.18 in	#5@ 14.35 in
#6@ 10.19 in	#6@ 20.37 in

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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

.....OVERTURNING.....

Item		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	2,551.5	3.00	7,654.5
Surcharge over Heel	=			
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=			
Load @ Stem Above Soil	=			
	=			
Total		2,551.5	**O.T.M.**	7,654.5
	=		=	

Resisting/Overturning Ratio = **2.80**

Vertical Loads used for Soil Pressure = 7,670.3 lbs

.....RESISTING.....

		Force lbs	Distance ft	Moment ft-#
Soil Over Heel	=	3,208.3	3.92	12,566.0
Sloped Soil Over Heel	=			
Surcharge Over Heel	=			
Adjacent Footing Load	=			
Axial Dead Load on Stem	=	742.0	1.42	1,051.2
* Axial Live Load on Stem	=	160.0	1.42	226.7
Soil Over Toe	=	110.0	0.50	55.0
Surcharge Over Toe	=			
Stem Weight(s)	=	1,650.0	1.42	2,337.5
Earth @ Stem Transitions	=			
Footing Weight	=	1,800.0	3.00	5,400.0
Key Weight	=		2.00	
Vert. Component	=			
	Total =	7,510.3 lbs	**R.M.=**	21,409.6

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

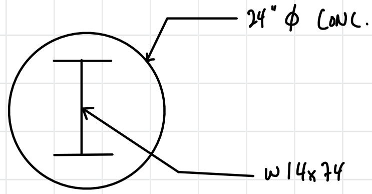
(Deflection due to wall bending not considered)

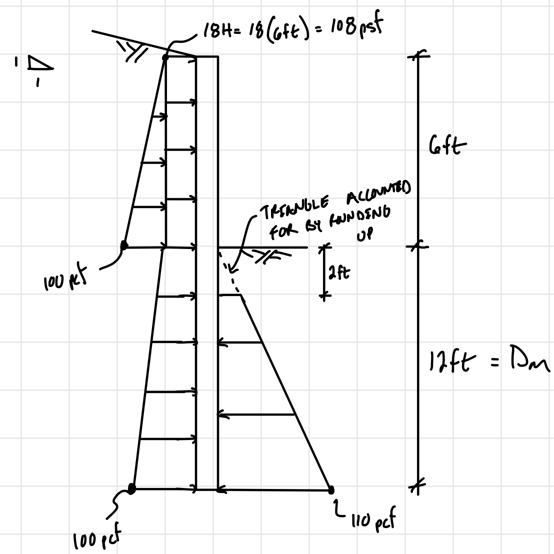
Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.143	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

SOLDIER PILE WALL

NORTH END:





SEE SPREADSHEET FOR DESIGN RESULTS...

$\Delta_{ALLOW} = 2L/180 = \frac{2(6ft \times 12in/ft)}{180} = 0.8'' <$ DEFLECTION @ TOP ✓OK

OR 0.75"

FROM SPREADSHEET, $D_m = 9.3ft$ ∴ USE 12ft MIN. PROVIDED BY GEOTECH.

CHECK ULTIMATE PILE SHEAR STRENGTH, PER GLOBAL STABILITY ANALYSIS

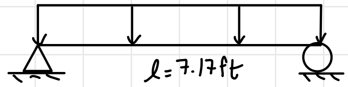
PER GEOTECH → $180^k < 0.6(50ksi)(0.45in)(14.2in) = \underline{\underline{191.7^k}} > 180^k$ ✓OK

$\boxed{\text{USE W14x74}}$

SHOTCRETE LAGGING:

$\boxed{\text{USE 6" THICK w/ \#5 @ 12" O.C.}}$

$H = (1ft)(100pcf)(6ft) = 600\ plf$



$a = \frac{0.31in^2(60ksi)}{0.85(3ksi)(12in)} = 0.61in$

$M_u = \left(\frac{600plf\,(7.17ft)^2}{8}\right)(1.6) = 6.17\ k\cdot ft$

$\phi M_n = 0.9(60ksi)\left(3in - \frac{0.61in}{2}\right) = \underline{12.1\ k\cdot ft} > 6.17\ k\cdot ft$ ✓OK

SOLDIER PILE WALL

CONCRETE CATCHMENT FEATURE:

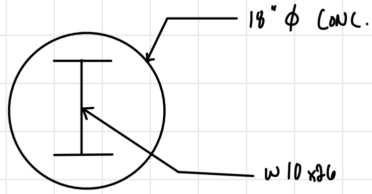
$M_u = 1.6\,(75psf)(1ft)(1.5ft)^2/2 = 270\ lb\cdot ft$

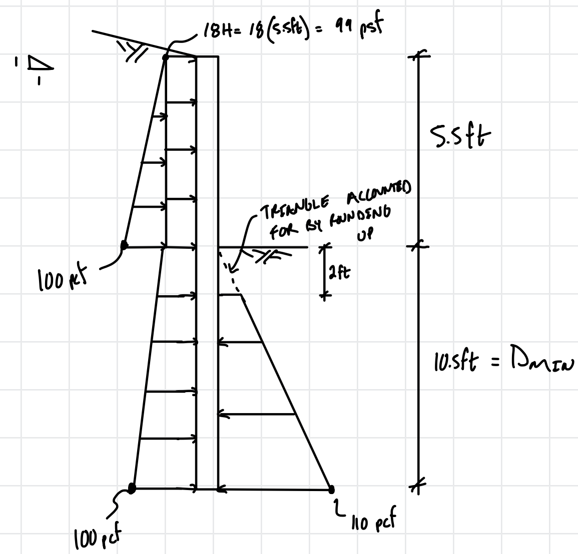
$a = \dfrac{0.31in^2\,(60{,}000psi)}{0.85\,(4000psi)(12in)} = 0.46in$

$\phi M_n = 0.9\,(0.31in^2)(60{,}000psi)\left(3in - \dfrac{0.46in}{2}\right) = 3864\ lb\cdot ft$
$> 270\ lb\cdot ft$ ✓OK

SOLDIER PILE WALLS

SOUTH END:





SEE SPREADSHEET FOR DESIGN RESULTS...

$$\Delta_{ALLOW} = 2L/180 = \frac{2\,(5.5ft \times 12in/ft)}{180} = 0.74'' \text{ (or } 0.75'') < \text{DEFLECTION @ TOP} = 0.433\text{ in} \quad \checkmark_{OK}$$

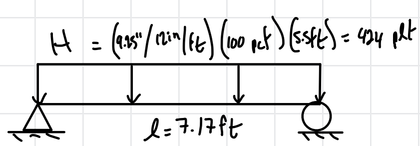
FROM SPREADSHEET, $D_m = -2.2\,ft$ ∴ USE 10.5 FT MIN. PROVIDED BY GEOTECH.

CHECK ULTIMATE PILE SHEAR STRENGTH, PER GLOBAL STABILITY ANALYSIS

PER GEOTECH → $25^k < 0.6\,(50ksi)(0.45in)(14.2in) = \underline{\underline{191.7^k}} > 180^k$ ✓OK

$\boxed{\text{USE W 8x58}}$

TIMBER LAGGING:



$\boxed{\text{USE 6x10 LAGGING}}$

FLAT USE, WET, TREATED LUMBER

SEE ENERCALC FOR DESIGN...

CANTILEVERED SOLDIER PILE RETAINING WALL

General equation for moment balance to determine pile embedment:

0=PaLL*H*S*(H/2+Dm)+Pa*H^2*0.5*S*(H/3+Dm)+Pa*Dia*Wa*H*Dm^2/2+Pa*Dia*Wa*Dm^3/6-Pp*DIA*Wp*Dm^3/6

General equation for shear balance to determine maximum moment height:

0=PaLL*H*S+Pa*H^2/2*S+Pa*Dia*Wa*H*Ds+Pa*Dia*Wa*Ds^2/2-Pp*Dia*Wp*Ds^2/2

Active pressure on wall:	100	pcf	
Active pressure on pile:	100	pcf	(below wall)
L or E surcharge on wall:	108	psf	(live load or earthquake)
Passive pressure at pile:	350	pcf	
Spacing of Piles:	8.00	ft oc	
concrete pile diameter:	2.00	ft	
passive width on pile:	3.00	x pile diameter	
active width on pile:	1.00	x pile diameter	

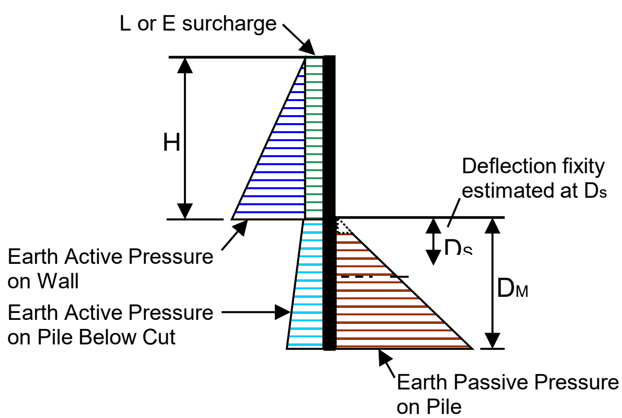
F_y = 50,000 psi

F_b = 30,000 psi $F_b = 0.6\,F_y$

S pile = M/F_b

Total drilling depth = H+Dm

	Moment			Shear		Steel Pile Demand		Steel Pile Selection				
H ft	equation set to 0	**Dm** feet	H+Dm feet	equation set to 0	**Ds** feet	M ft-k	S in^3	**Steel Section**	S in^3	I in^4	deflection at top (in)	pile diag. dim. (in)
6.0	0	9.7	**15.7**	9184	4.0	112	45	**W10X45**	49	248	0.231	



CANTILEVERED SOLDIER PILE RETAINING WALL

General equation for moment balance to determine pile embedment:

0=PaLL*H*S*(H/2+Dm)+Pa*H^2*0.5*S*(H/3+Dm)+Pa*Dia*Wa*H*Dm^2/2+Pa*Dia*Wa*Dm^3/6-Pp*DIA*Wp*Dm^3/6

General equation for shear balance to determine maximum moment height:

0=PaLL*H*S+Pa*H^2/2*S+Pa*Dia*Wa*H*Ds+Pa*Dia*Wa*Ds^2/2-Pp*Dia*Wp*Ds^2/2

Active pressure on wall:	100	pcf	
Active pressure on pile:	100	pcf	(below wall)
L or E surcharge on wall:	99	psf	(live load or earthquake)
Passive pressure at pile:	350	pcf	
Spacing of Piles:	8.00	ft oc	
concrete pile diameter:	1.50	ft	
passive width on pile:	3.00	x pile diameter	
active width on pile:	1.00	x pile diameter	

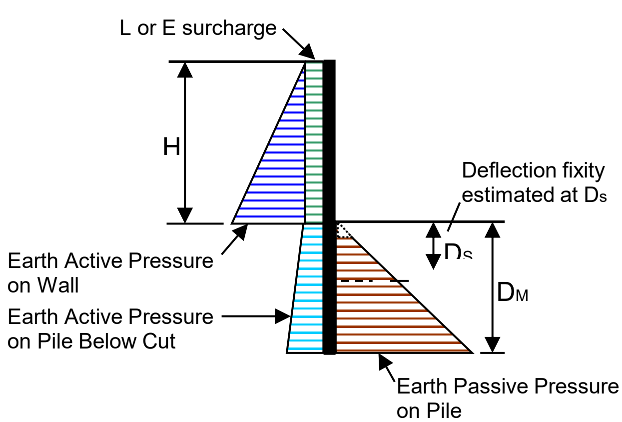
F_y = 50,000 psi

F_b = 30,000 psi $F_b = 0.6\ F_y$

S pile = M/F_b

Total drilling depth = H+Dm

	Moment			Shear		Steel Pile Demand		Steel Pile Selection				
H ft	equation set to 0	**Dm** feet	H+Dm feet	equation set to 0	**Ds** feet	M ft-k	S in^3	**Steel Section**	S in^3	I in^4	deflection at top (in)	pile diag. dim. (in)
5.5	0	10.1	**15.6**	0	5.4	98	39	**W10X39**	42	248	0.252	
5.5	0	10.1	**15.6**	0	5.4	98	39	**W8X48**	43	184	0.340	



Wood Beam

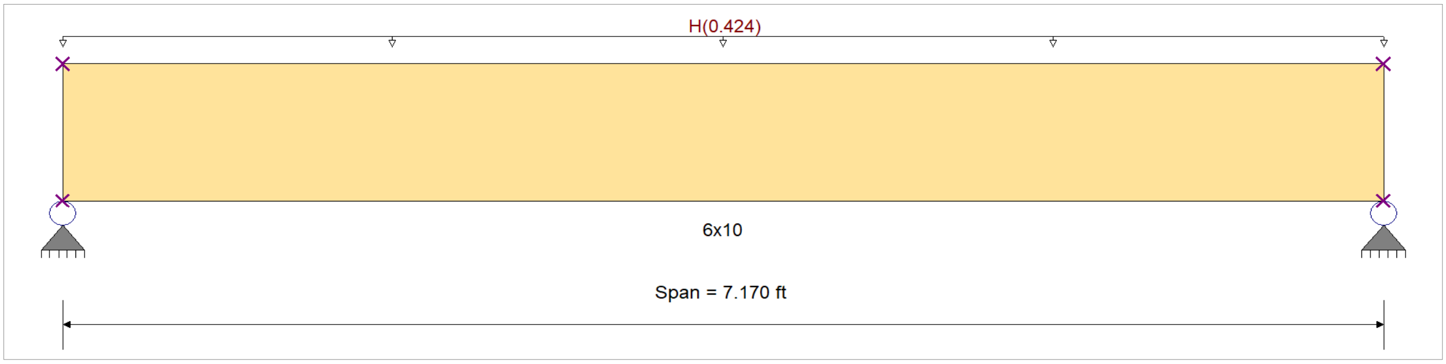
DESCRIPTION: Soldier Piles - Wood Lagging

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	1,350.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	1,350.0 psi	Ebend- xx	1,600.0 ksi
		Fc - Prll	925.0 psi	Eminbend - xx	580.0 ksi
Wood Species :	Douglas Fir-Larch	Fc - Perp	625.0 psi		
Wood Grade :	No.1	Fv	170.0 psi		
		Ft	675.0 psi	Density	31.210 pcf
Beam Bracing :	Completely Unbraced				



Applied Loads

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

Beam self weight NOT internally calculated and added
Uniform Load : H = 0.4240 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.949**: 1	Maximum Shear Stress Ratio	=	**0.278** : 1
Section used for this span		**6x10**	Section used for this span		**6x10**
fb: Actual	=	682.65 psi	fv: Actual	=	34.08 psi
Fb: Allowable	=	719.28 psi	Fv: Allowable	=	122.40 psi
Load Combination		H Only	Load Combination		H Only
Location of maximum on span	=	3.585 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.139 in	Ratio =	618 >=240	Span: 1 : H Only
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
H Only													0.00	0.00	0.00	0.00
Length = 7.170 ft	1	0.949	0.278	0.90	1.000	0.80	1.00	1.00	1.00	1.00	2.72	682.65	719.28	1.19	34.08	122.40
+0.60H					1.000	0.80	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 7.170 ft	1	0.320	0.094	1.60	1.000	0.80	1.00	1.00	1.00	1.00	1.63	409.59	1278.72	0.71	20.45	217.60

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
H Only	1	0.1392	3.611		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.520	1.520
Overall MINimum	0.912	0.912

Wood Beam

Project File: 21201enercalc_brt.ec6

DESCRIPTION: Soldier Piles - Wood Lagging

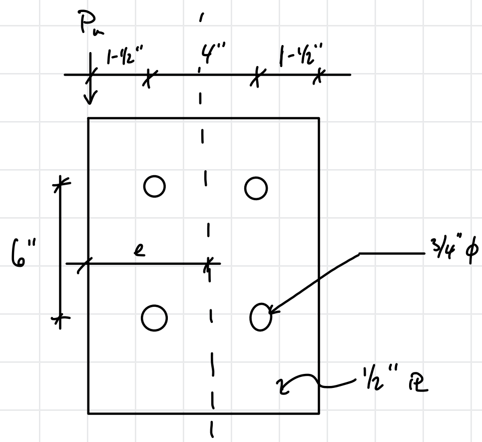
Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
H Only	1.520	1.520
+0.60H	0.912	0.912

STAIR DETAILS

STRINGER – GLB:



$P_{ASD} = 0.68^k + 0.95^k = 1.63^k$

$e = 3.5"$

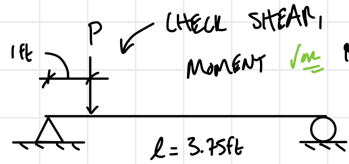
$C = 2.6$

$C Z_{11}' = 2.6 (940 \text{ lb}) = \underline{2.45^k} > 1.63^k$ ✓ OK

Project: Mercer Island Residence   Job No: 21-201
Subject: Horiz. Mullion   Sheet
Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland   Date: 1-20-22

$\boxed{\text{Horiz. Mullion}}$

Mullion -



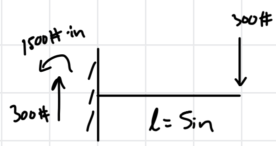
Check shear, moment ✓ by inspection

$P = 300\#$ See Enercalc...

$\boxed{\text{USE } 3\tfrac{1}{8}" \times 12" \text{ GLB (FLAT)}}$

Connection:

Kerf PL -



$M_{MAX} = 1500$ #·in
$V_{MAX} = 300\#$

$\phi M_n = 0.9\,(36ksi)\left(\frac{8in\,(^3/_8in)^2}{4}\right) = \underline{\underline{9112\ \#\cdot in}} > 1500\ \#\cdot in$

Beam Brg - $F_{c\perp} = 560\,psi\,(5in \times 8in) = \underline{\underline{22.4^k}} \gg 0.3^k$

Embed PL - (3) $^1/_4 \times 3"$ SDS $\longrightarrow$ 420 #/screw (3) = $\underline{\underline{1.26^k}} > 0.3^k$ (Shear)

Moment Connection

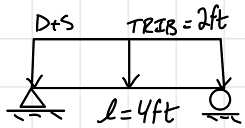
Tension Force = 1500 lb·in / 1.5in = 1000 lb / screw pair

Tension Capacity = 172 lb/in (3 in) (2 screws) = $\underline{\underline{1032\#}} > 1000\#$

Seattle | 1011 Western Avenue, Suite 810 | Seattle, WA 98104 | 206.292.5076
Tacoma | 1250 Pacific Avenue, Suite 701 | Tacoma, WA 98402 | 253.383.2797
Portland | 101 SW Main Street, Suite 280 | Portland, OR 97204 | 503.232.3746
www.pcs-structural.com

ALUMINUM CANOPY (SOUTH SIDE)

FLAT PL



$D = 6\,psf\,(1.2) = 7.2\,psf$

$S = 25\,psf\,(1.6) = 40\,psf$

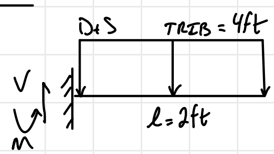
$$M_u = \frac{wl^2}{8} = \frac{(47.2\,psf \times 2ft)(4ft)^2}{8} = 189\ lb\cdot ft$$

$$\phi M_n = 0.9\,(11\,ksi)(0.375\,in)^2(24\,in)(1/4) = 8.36\ k\cdot in = \underline{\underline{696\ lb\cdot ft}}$$ ✓ OK

↑ MIN. WELDED YIELD STRENGTH

USE 3/8" PL

STIFFENER PL



$D = 6\,psf\,(1.2) = 7.2\,psf$

$S = 25\,psf\,(1.6) = 40\,psf$

$$M_u = \frac{wl^2}{2} = \frac{(47.2\,psf \times 4ft)(2ft)^2}{2} = 378\ lb\cdot ft = 4.536\ k\cdot in$$

$$\phi M_n = 0.9\,(11\,ksi)(2\,in)^2(t)(1/4) = 9.9t \geq 4.536\ k\cdot in$$

$$t \geq 0.46\ in$$

USE PL 1/2" x 2" @ 4'-0" o.c.

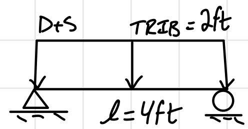
$$V = wl = (47.2\,psf \times 4ft)(2ft) = 378\ lb$$

PCS Structural Solutions

Project: MERCER ISLAND RESIDENCE | Job No: 21-201
Subject: CANOPY | Sheet ______ | Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland | Date: 1-20-22

$\boxed{\text{ALUMINUM CANOPY}}$ (EAST SIDE)

FLAT PL



$D = 6\,psf\,(1.2) = 7.2\,psf$

$S = 25\,psf\,(1.6) = 40\,psf$

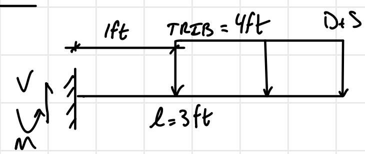
$$M_u = \frac{wl^2}{8} = \frac{(47.2\,psf \times 2ft)(4ft)^2}{8} = 189\ lb\cdot ft$$

$$\phi M_n = 0.9\,(11\,ksi)\,(0.375\,in)^2\,(24\,in)\,(1/4) = 8.36\ k\cdot in = \underline{\underline{696\ lb\cdot ft}}$$ ✓ OK

↑ MIN. WELDED YIELD STRENGTH

$\boxed{\text{USE } 3/8\text{" PL}}$

STIFFENER PL



$D = 6\,psf\,(1.2) = 7.2\,psf$

$S = 25\,psf\,(1.6) = 40\,psf$

$$M_u = 0.566\ k\cdot ft = 6.792\ k\cdot in$$

$$\phi M_n = 0.9\,(11\,ksi)\,(3\,in)^2\,(t)\,(1/4) = 22.3t \geq 10.2\ k\cdot in$$

$$t \geq 0.46\ in$$

$\boxed{\text{USE PL } 1/2\text{"} \times 2\text{" @ } 3'\text{-}0\text{" o.c.}}$

$\boxed{\text{ALUMINUM CANOPY}}$

PL - STUD
CONNECTION:

$M_{ASD} = 2.98\ k\cdot in\ /\ 4ft = 0.75\ k\cdot in\ /\ ft$

STUD SPACING

$0.75\ k\cdot in/ft\ (1.33ft) = 990\ k\cdot in$

$1/4"\phi \times 3\tfrac{1}{2}"$ SDS $\longrightarrow$ $172\ lb/in\ (3in) = 516\ lb$ (ALLOWABLE WITHDRAWAL)

$990\ lb\cdot in\ /\ 516\ lb = 1.92\ in \approx 2\ in$ $\boxed{\text{USE 4" SPACING}}$

PL - PL
CONNECTION:

TRY 5/16" WELD -

3ft CANOPY CONTROLS

$Z = \frac{d^2}{3}$ $D = \frac{M_u}{Z}\left(\frac{1}{0.928}\right) = \frac{6.792\ k\cdot in}{d^2}\left(\frac{3}{0.928}\right) = 5$

$d = 2.1" \approx 3"$

USING STIFFENERS @ 3ft O.C.
ALLOWS FOR ONLY 2" OF 5/16" WELD

General Beam Analysis

Project File: 21201enercalc_brt.ec6

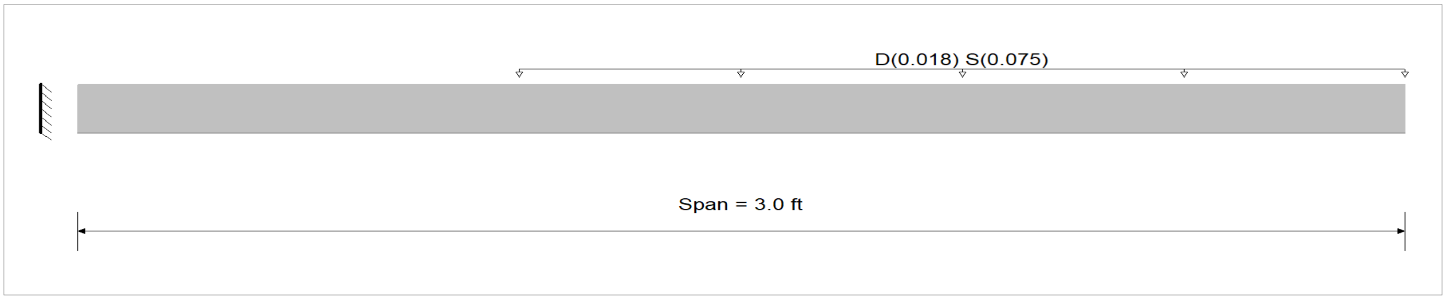
LIC# : KW-06014122, Build:20.22.4.16 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2022

DESCRIPTION: 3 FT CANOPY

General Beam Properties

Elastic Modulus 29,000.0 ksi

Span #1 Span Length = 3.0 ft Area = 10.0 in^2 Moment of Inertia = 100.0 in^4



Applied Loads

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

Load for Span Number 1

Uniform Load : D = 0.0060, S = 0.0250 ksf, Extent = 1.0 -->> 3.0 ft, Tributary Width = 3.0 ft

DESIGN SUMMARY

Maximum Bending =	0.566 k-ft	Maximum Shear =	0.2832 k
Load Combination	+1.20D+1.60S	Load Combination	+1.20D+1.60S
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1
Location of maximum on span	0.000 ft	Location of maximum on span	0.000 ft

Maximum Deflection

Max Downward Transient Deflection	0.000 in	0
Max Upward Transient Deflection	0.000 in	0
Max Downward Total Deflection	0.001 in	134862
Max Upward Total Deflection	0.000 in	7125608

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	Summary of Moment Values (k-ft) Mmax +	Mmax -	Ma - Max	Mnx	Mnx/Omega	Cb	Rm	Shear Values (k) Va Max	Vnx	Vnx/Omega
Overall MAXimum Envelope													
Dsgn. L = 3.00 ft	1				-0.57	0.57					0.28		
+1.40D													
Dsgn. L = 3.00 ft	1				-0.10	0.10					0.05		
+1.20D													
Dsgn. L = 3.00 ft	1				-0.09	0.09					0.04		
+1.20D+0.50S													
Dsgn. L = 3.00 ft	1				-0.24	0.24					0.12		
+1.20D+1.60S													
Dsgn. L = 3.00 ft	1				-0.57	0.57					0.28		
+1.20D+0.70S													
Dsgn. L = 3.00 ft	1				-0.30	0.30					0.15		
+0.90D													
Dsgn. L = 3.00 ft	1				-0.06	0.06					0.03		

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.0005	3.000		0.0000	0.000

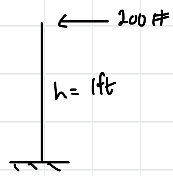
Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.186	
Overall MINimum		
D Only	0.036	
+D+S	0.186	
+D+0.750S	0.149	
+0.60D	0.022	
S Only	0.150	

Drink Rail

Aluminum Bar



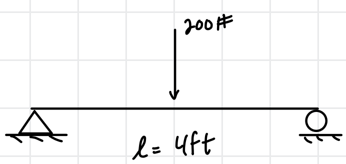
$V_u = 200\,lb\,(1.6) = 320\,lb$

$M_u = 200\,lb\cdot ft\,(1.6) = 320\,lb\cdot ft$

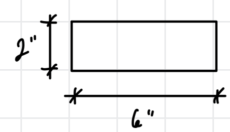
$\phi M_n = 0.9\,(35ksi)\left(2.0\ in\right)^2(0.25in) = 31.5\ k\cdot in = 2625\ lb\cdot ft > 320\,lb\cdot ft$ ✓ok

$\phi V_n = 0.6\,(35ksi)\,(0.25in)\,(2in) = 10.5^k > 0.32^k$ ✓ok

Wood Handrail



$M_{max} = \dfrac{200lb\,(4ft)}{4} = 200\ lb\cdot ft$



$I_x = 4\ in^4$

$S_x = 4\ in^3$

$M/S = \dfrac{2400\,lb\cdot in}{4\ in^3} = 600\ psi\,(3) = 1800\ psi \ll 5330\ psi$ ✓ok

SF

$\Delta = \dfrac{P\,l^3}{48\,EI} = \dfrac{(200lb)\,(4\,ft \times 12in/ft)^3}{48\,(1.012e6\,psi)\,(4\ in^4)} = 0.07\ in \ll 0.125\,in$ ✓ok ✓ok

Wood Beam

Project File: 21201 enercalc - brt.ec6

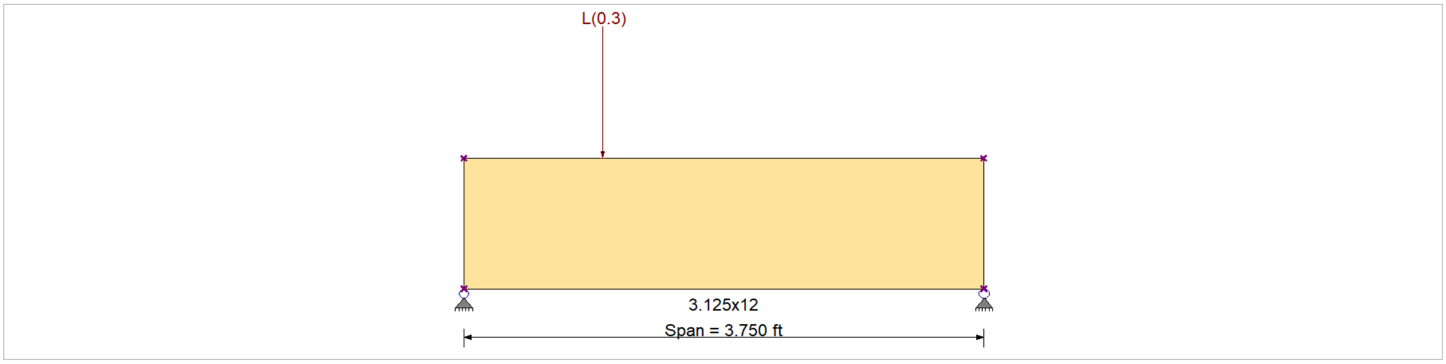
DESCRIPTION: Horiz. Mullion

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	1,450.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	1,450.0 psi	Ebend- xx	1,600.0 ksi
		Fc - Prll	1,600.0 psi	Eminbend - xx	850.0 ksi
Wood Species :	DF/DF	Fc - Perp	560.0 psi	Ebend- yy	1,600.0 ksi
Wood Grade :	24F-V4	Fv	230.0 psi	Eminbend - yy	850.0 ksi
		Ft	1,100.0 psi	Density	31.210 pcf
Beam Bracing :	Completely Unbraced				



Applied Loads

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

Point Load : L = 0.30 k @ 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.024** : 1	Maximum Shear Stress Ratio	=	**0.038** : 1
Section used for this span		**3.125x12**	Section used for this span		**3.125x12**
fb: Actual	=	35.17 psi	fv: Actual	=	8.80 psi
Fb: Allowable	=	1,436.28 psi	Fv: Allowable	=	230.00 psi
Load Combination		L Only	Load Combination		L Only
Location of maximum on span	=	0.999 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0 in	Ratio =	0 <480	n/a
Max Upward Transient Deflection	0 in	Ratio =	0 <480	n/a
Max Downward Total Deflection	0.001 in	Ratio =	76870 >=360	Span: 1 : L Only
Max Upward Total Deflection	0 in	Ratio =	0 <360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
													0.00	0.00	0.00	0.00
Length = 3.750 ft	1			0.90	1.000	1.00	1.00	1.00	1.00	0.99			1294.07	0.00	0.00	207.00
L Only					1.000	1.00	1.00	1.00	1.00	0.99			0.00	0.00	0.00	0.00
Length = 3.750 ft	1	0.024	0.038	1.00	1.000	1.00	1.00	1.00	1.00	0.99	0.22	35.17	1436.28	0.22	8.80	230.00
+0.750L					1.000	1.00	1.00	1.00	1.00	0.99			0.00	0.00	0.00	0.00
Length = 3.750 ft	1	0.015	0.023	1.25	1.000	1.00	1.00	1.00	1.00	0.99	0.16	26.38	1790.14	0.17	6.60	287.50

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
L Only	1	0.0006	1.670		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.220	0.080

Wood Beam

Project File: 21201 enercalc - brt.ec6

DESCRIPTION: Horiz. Mullion

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MINimum	0.165	0.060
L Only	0.220	0.080
+0.750L	0.165	0.060

Wood Beam

Project File: 21201 enercalc - brt.ec6

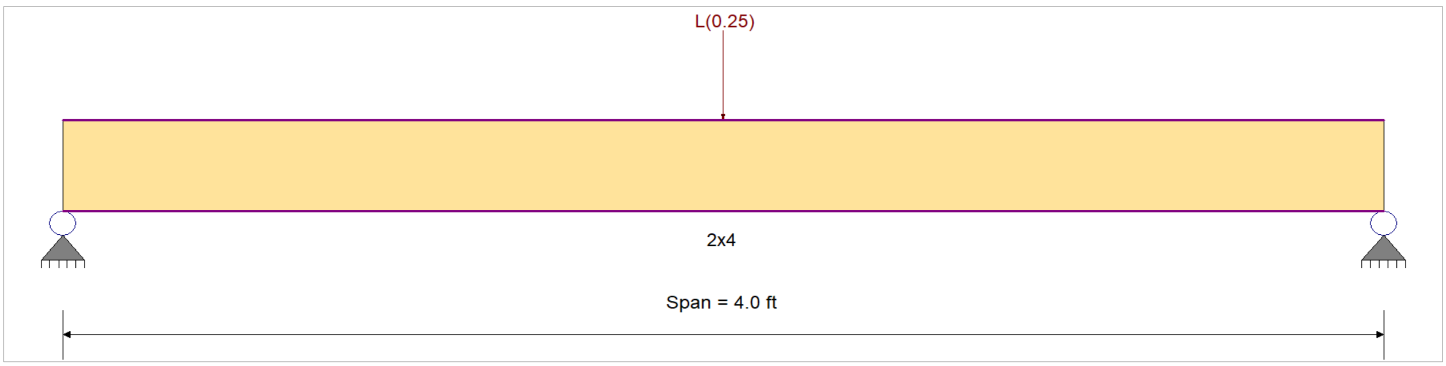
DESCRIPTION: Wood Handrail

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	900 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	900 psi	Ebend- xx	1600 ksi
		Fc - Prll	1350 psi	Eminbend - xx	580 ksi
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.

Point Load : L = 0.250 k @ 2.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.726** : 1	Maximum Shear Stress Ratio	=	**0.198** : 1
Section used for this span		**2x4**	Section used for this span		**2x4**
fb: Actual	=	979.59 psi	fv: Actual	=	35.71 psi
Fb: Allowable	=	1,350.00 psi	Fv: Allowable	=	180.00 psi
Load Combination		L Only	Load Combination		L Only
Location of maximum on span	=	2.000ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.068 in	Ratio =	710 >=180	Span: 1 : L Only
Max Upward Total Deflection	0 in	Ratio =	0 <180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
													0.00	0.00	0.00	0.00
Length = 4.0 ft	1			0.90	1.500	1.00	1.00	1.00	1.00	1.00			1215.00	0.00	0.00	162.00
L Only					1.500	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 4.0 ft	1	0.726	0.198	1.00	1.500	1.00	1.00	1.00	1.00	1.00	0.25	979.59	1350.00	0.13	35.71	180.00
+0.750L					1.500	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 4.0 ft	1	0.435	0.119	1.25	1.500	1.00	1.00	1.00	1.00	1.00	0.19	734.69	1687.50	0.09	26.79	225.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
L Only	1	0.0675	2.000		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.125	0.125

Wood Beam

DESCRIPTION: Wood Handrail

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MINimum	0.094	0.094
L Only	0.125	0.125
+0.750L	0.094	0.094

COVERED WALKWAY

PCS Structural Solutions

Project:	MERCER ISLAND RESIDENCE	Job Number:	21-201
Sheet:	of	Name:	BRT
Originating Office:	Tacoma	Date:	5/25/2021

DESIGN CRITERIA CHECKLIST

CODE: IBC 2018, ASCE 7-16 LOCATION: MERCER ISLAND, WA

VERTICAL DESIGN CRITERIA

	DEAD	LIVE	PARTITION	CONCENTRATED
BRIDGE FLOOR:	10 PSF	40 PSF		
BRIDGE ROOF:	6 PSF	25 PSF		

WIND DESIGN CRITERIA

BASIC WIND SPEED (V) =	97 MPH	(Per ASCE 7-16 Sec. 26.5.1, Fig. 26.5-1A; 1B; 1C & 1D, or as required by Bld'g Dept.)
RISK CATEGORY:	II	(Per ASCE 7-16 Table 1.5-1 & IBC Table 1604.5)
EXPOSURE CATEGORY:	D	(Per ACSE 7-16 Section 26.7.3)
DIRECTIONALITY FACTOR (K_d):	0.85	(Per ASCE 7-16 Table 26.6-1)
GUST EFFECT FACTOR (G):	0.85	(Per ASCE 7-16 Section 26.11)
TOPOGRAPHIC FACTOR (K_{zt}):	1.00	(Per ASCE 7-16 Section 26.8.2)
MEAN ROOF HEIGHT:	25 FT	(See ASCE 7-16 Section 26.2 - Definitions)
ELEVATION:	0 FT	(See ASCE 7-16 Section 26.9)
ENCLOSURE CLASSIFICATION:	Enclosed	(See ASCE 7-16 Secion 26.2 & Table 26.13-1)
ROOF TYPE:	Monoslope	(See ASCE 7-16 Figure 27.3-1)
ROOF SLOPE (__:12):	0.00:12	(Enter vertical rise in 12 horizontal units)
θ (degrees):	0.00	

SEISMIC DESIGN CRITERIA

RISK CATEGORY:	I & II	(Per ASCE 7-16 Table 1.5-1 & IBC Table 1604.5)
SITE CLASS:	D	(Per IBC Section 1613.2.2, Assumed as "D" or per Geotech.)
IMPORTANCE FACTOR (I_E):	1	(Per ASCE 7-16 Table 1.5-2)
STRUCTURAL SYSTEM (R):	3	(Per ASCE 7-16 Table 12.2-1)
OVERSTRENGTH FACTOR (Ω_o):	3.0	(Per ASCE 7-16 Table 12.2-1)

INFORMATION BELOW FROM "EARTHQUAKE SPECTRAL RESPONSE ACCELERATION MAPS" PER USGS

LATITUDE:	47.541	S_S =	1.449	F_a =	1.000
LONGITUDE:	-122.209	S_1 =	0.501	F_v =	1.800

DEFLECTION CRITERIA

FLOOR (LIVE):	L/ 480	ROOF (LIVE):	L/ 360
FLOOR (TOTAL):	L/ 360	ROOF (TOTAL):	L/ 240
WALLS:	L/ 360	SPECIAL:	L/

SOIL DESIGN CRITERIA

REPORT: YES

SEE SOILS REPORT FOR ACTIVE, PASSIVE PRESSURES AND FRICTION COEFFICIENT

BEARING:	1500 PSF
ACTIVE:	VARIES
PASSIVE:	350 PCF
COEFFICIENT OF FRICTION:	0.30

MINIMUM FOOTING DIMENSIONS:

CONTINUOUS:	1'-4"
SPREAD:	1'-6"
FROST DEPTH:	1'-6"

PILE TYPE:	NONE		
VERTICAL CAPACITY :	N/A	LATERAL CAPACITY:	N/A
UPLIFT CAPACITY:	N/A	SIZE:	N/A

Project:	MERCER ISLAND RESIDENCE	Job Number:	21-201
Sheet:	of	Name:	BRT
Originating Office:	Tacoma	Date:	05/25/21

MATERIALS

CONCRETE

Footings/Piles:	3000 PSI	Columns:	4000 PSI
Slabs/Walls:	4000 PSI	Beams:	4000 PSI
-	-	-	-

REINFORCING

Steel Grade = 60 f_y = 60 KSI

STRUCTURAL STEEL

W-Flange Beams	ASTM A992	f_y =	50 KSI
Shapes & Plates	ASTM A36	f_y =	36 KSI
Pipes	ASTM A53, Grade B	f_y =	35 KSI
HSS Rect.	ASTM A500, Grade C	f_y =	50 KSI
HSS Round	ASTM A500, Grade C	f_y =	46 KSI

MASONRY

ASTM C90 f'_m = 1900 PSI SOLID GROUTED

GLULAM BEAMS

Simple Spans		Cantilevers
24F-V4	Grade =	24F-V8
1.80E+06 PSI	E =	1.80E+06 PSI
2400 PSI	$F_{b\,(BOTTOM)}$ =	2400 PSI
1850 PSI	$F_{b\,(TOP)}$ =	2400 PSI
240 PSI	F_v =	240 PSI

SCL PRODUCTS

	2x SCL	1¾" SCL	3½, 5¼ SCL
E =	1.30E+06 PSI	1.80E+06 PSI	2.00E+06 PSI
F_b =	1700 PSI	2600 PSI	2900 PSI
F_v =	285 PSI	285 PSI	285 PSI
F_c =	1400 PSI	2400 PSI	2600 PSI

FRAMING LUMBER

Joists & Studs	2x DF #2	2x HF #1	-
E =	1.60E+06 PSI	1.50E+06 PSI	-
F_b =	900 PSI	975 PSI	-
F_v =	180 PSI	150 PSI	-
F_c =	1350 PSI	1350 PSI	-
Beams & Headers	4x DF #2	4x HF #1	6x DF #1
E =	1.60E+06 PSI	1.50E+06 PSI	1.60E+06 PSI
F_b =	900 PSI	975 PSI	1350 PSI
F_v =	180 PSI	150 PSI	170 PSI
Posts & Timbers	6x DF #1	-	-
E =	1.60E+06 PSI	-	-
F_c =	1000 PSI	-	-

Project: MERCER ISLAND RESIDENCE Job Number: 21-201

Sheet: ____ of ____ Name: BRT

Originating Office: Tacoma Date: 05/25/21

DESIGN CRITERIA - WIND

BASIC WIND SPEED (V):	97 MPH	MEAN ROOF HEIGHT:	25 FT
RISK CATEGORY:	II	GROUND ELEVATION FACTOR (Ke):	1.00
EXPOSURE CATEGORY:	D	ENCLOSURE CLASSIFICATION:	Enclosed
DIRECTIONALITY FACTOR (K_d):	0.85	ROOF TYPE:	Monoslope
GUST EFFECT FACTOR (G):	0.85	ROOF SLOPE (__:12):	0.0:12
TOPOGRAPHIC FACTOR (K_{zt}):	1.00	θ (degrees):	0.00

ASCE 7-16 CHAPTER 27: WIND LOADS ON BUILDINGS: MWFRS (DIRECTIONAL PROCEDURE)
PART 1: ENCLOSED AND PARTIALLY ENCLOSED BUILDINGS OF ALL HEIGHTS

NOTE: q_z and q_i have conservatively been taken equal to q_h.

HORIZONTAL WALL PRESSURES (Figure 27.3-1)

	External Pressures ($q*(GC_p)$):			Internal Pressures ($\pm q_i*(GC_{pi})$)
L/B:	Windward wall	Leeward wall	Sidewall	All walls
0-1	15.6	-9.7	-13.6	4.1
2		-5.8		
≥4		-3.9		

ROOF PRESSURES (Figure 27.3-1)

		External Pressures ($q*(GC_p)$):			Internal Pressures ($\pm q_i*(GC_{pi})$)
Wind Direction:	h/L:	Windward (Positive)	Windward (Negative)	Leeward	All Roofs
Normal to Ridge for θ ≥ 10°	≤0.25	N/A	N/A	N/A	4.1
	0.50	N/A	N/A	N/A	
	≥1.0	N/A	N/A	N/A	

	h/L:	Horizontal Distance from Windward Edge	External Pressures ($q*(GC_p)$): Positive Pressure	External Pressures ($q*(GC_p)$): Negative Pressure	Internal Pressures ($\pm q_i*(GC_{pi})$) All Roofs
Normal to Ridge for θ < 10° and Parallel to Ridge for All θ	≤0.5	0 to h	-3.5	-17.5	4.1
		h to 2h		-9.7	
		>2h		-5.8	
	≥1.0	0 to h/2	-3.5	-25.3	
		>h/2		-13.6	

ASCE 7-16 27.1.5: Minimum Design Wind Loads: The wind load used for design of the MWFRS shall not be less than 16 PSF multiplied by the wall area of the building, and 8 PSF multiplied by the roof area of the building projected on a vertical plane normal to the assumed wind direction. Wall and roof loads shall be applied simultaneously.

ASCE 7-16 CHAPTER 30: WIND LOADS: COMPONENTS AND CLADDING
PART 1: LOW-RISE BUILDINGS (h≤60 ft)

ROOF SURFACES

Effective Wind Area	POSITIVE PRESSURES	NEGATIVE PRESSURES					
	ZONE						
	ALL ZONES	1'	1	2	3	N/A	N/A
10 SF	16.0	-24.8	-43.1	-56.9	-77.5	N/A	N/A
20 SF	16.0	-24.8	-40.3	-53.2	-70.2	N/A	N/A
50 SF	16.0	-24.8	-36.5	-48.4	-60.5	N/A	N/A
100 SF	16.0	-24.8	-33.7	-44.7	-53.2	N/A	N/A

WALL SURFACES & ROOF OVERHANGS

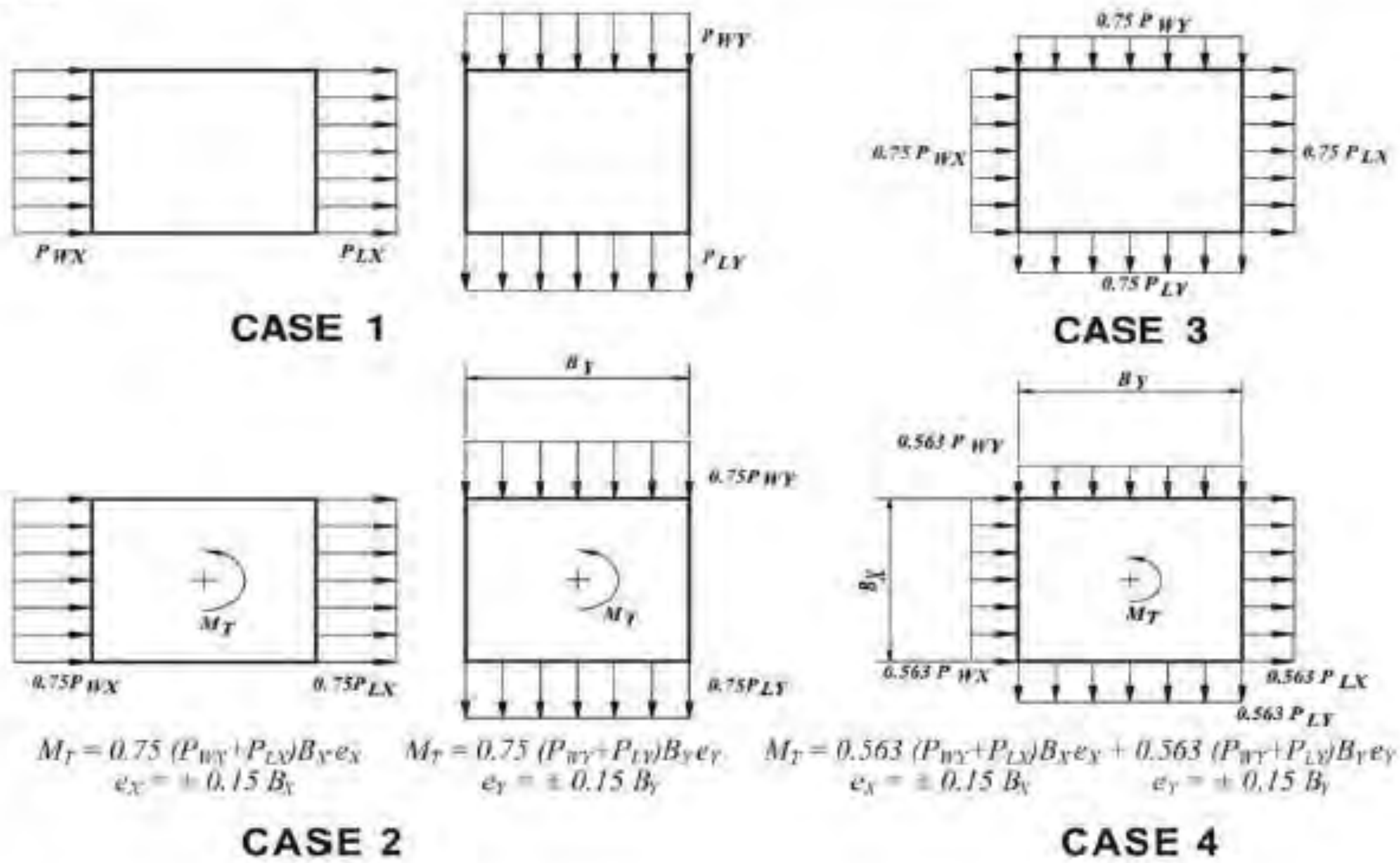
Effective Wind Area	WALL ZONES				ROOF OVERHANG ZONES					
	POSITIVE PRESSURES		NEGATIVE PRESSURES		NEGATIVE PRESSURES					
	4	5	4	5	1'	1	2	3	N/A	N/A
10 SF	27.1	27.1	-29.4	-36.2	-43.1	-43.1	-56.9	-77.5	N/A	N/A
20 SF	25.8	25.8	-28.1	-33.8	-42.4	-42.4	-52.0	-69.0	N/A	N/A
50 SF	24.2	24.2	-26.5	-30.6	-41.5	-41.5	-45.5	-57.7	N/A	N/A
100 SF	23.0	23.0	-25.3	-28.1	-40.8	-40.8	-40.7	-49.2	N/A	N/A
500 SF	20.2	20.2	-22.5	-22.5	-39.2	-39.2	-29.4	-29.4	N/A	N/A

ASCE 7-16 30.2.2: Minimum Design Wind Loads: The design wind pressure for C&C of buildings shall not be less than a net pressure of 16 PSF acting in either direction normal to the surface.

DESIGN CRITERIA - WIND

FIGURE 27.3-8: Main Wind Force Resisting System, Part 1 (All Heights): Design Wind Load Cases per ASCE 7-16

Diagrams



Notation

P_{WX}, P_{WY} = Windward face design pressure acting in the x, y principal axis, respectively.
P_{LX}, P_{LY} = Leeward face design pressure acting in the x, y principal axis, respectively.
$e(e_X, e_Y)$ = Eccentricity for the x, y principal axis of the structure, respectively.
M_T = Torsional moment per unit height acting about a vertical axis of the building.

Case 1. Full design wind pressure acting on the projected area perpendicular to each principal axis of the structure, considered separately along each principal axis.
Case 2. Three-quarters of the design wind pressure acting on the projected area perpendicular to each principal axis of the structure in conjunction with a torsional moment as shown, considered separately for each principal axis.
Case 3. Wind loading as defined in Case 1, but considered to act simultaneously at 75% of the specified value.
Case 4. Wind loading as defined in Case 2, but considered to act simultaneously at 75% of the specified value.

Notes

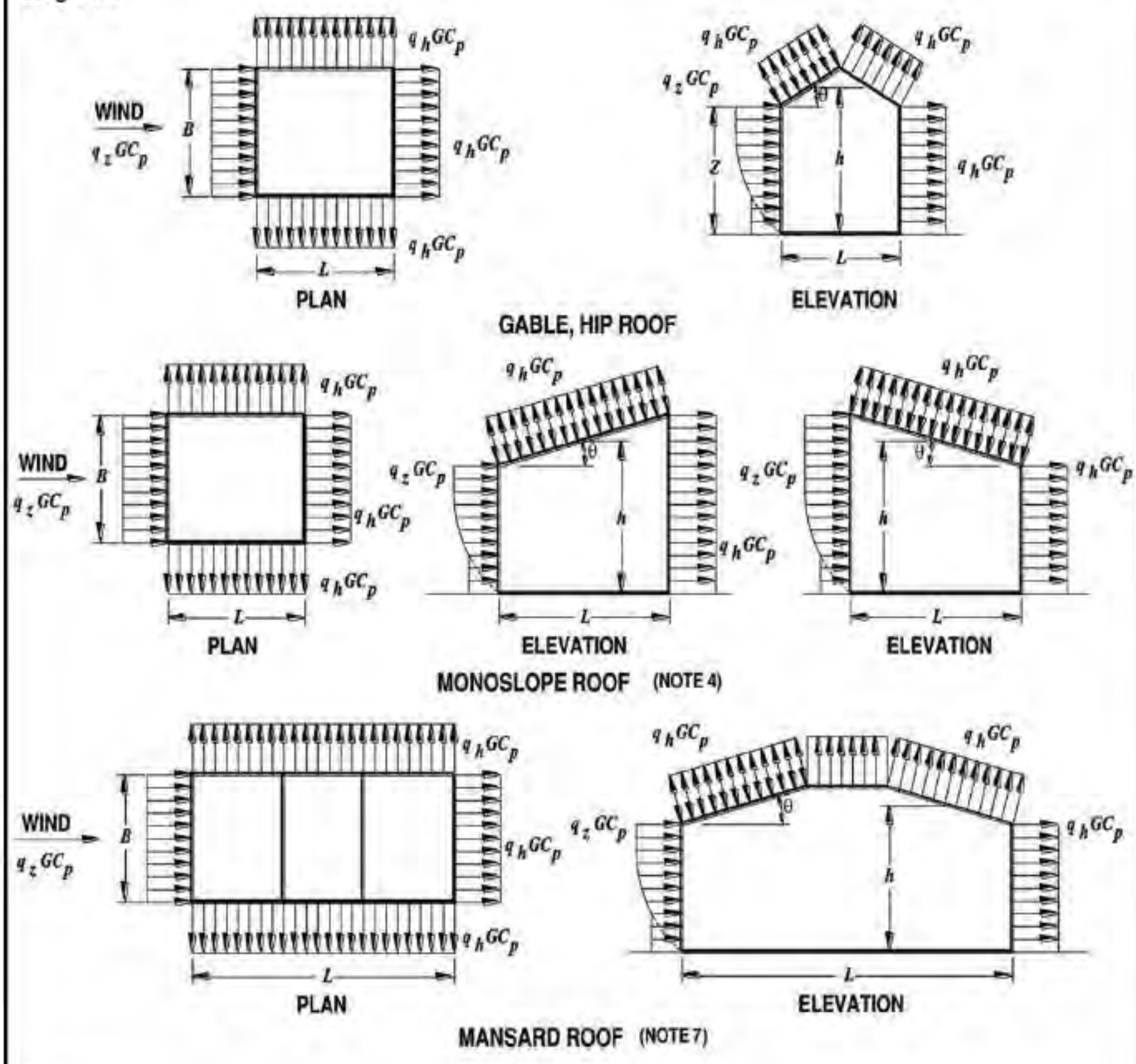
1. Design wind pressures for windward and leeward faces shall be determined in accordance with the provisions of Sections 27.3.1 and 27.3.2 as applicable for buildings of all heights.
2. Diagrams show plan views of buildings.

FIGURE 27.3-8 Main Wind Force Resisting System, Part 1 (All Heights): Design Wind Load Cases

DESIGN CRITERIA - WIND

FIGURE 27.3-1 Main Wind Force Resisting System, Part 1 (All Heights): External Pressure Coefficients, Cp, for Enclosed and Partially Enclosed Buildings - Walls and Roofs per ASCE 7-16

Diagrams



Notation

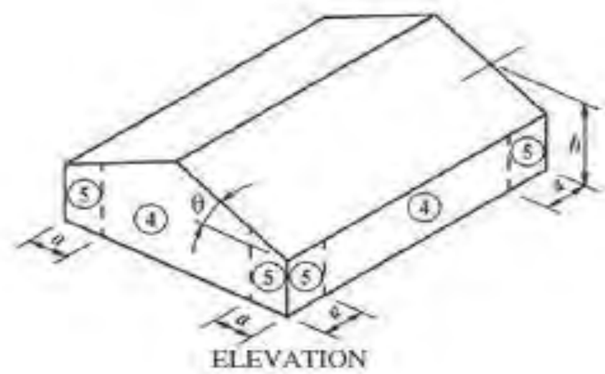
B = Horizontal dimension of building, in ft (m), measured normal to wind direction.
L = Horizontal dimension of building, in ft (m), measured parallel to wind direction.
h = Mean roof height, in ft (m), except that eave height shall be used for $\theta \le 10$ degrees.
z = Height above ground, in ft (m).
G = Gust-effect factor.
q_z, q_h = Velocity pressure, in lb/ft^2 (N/m^2), evaluated at respective height.
θ = Angle of plane of roof from horizontal, in degrees.

FIGURE 27.3-1 Main Wind Force Resisting System, Part 1 (All Heights): External Pressure Coefficients, C_p, for Enclosed and Partially Enclosed Buildings—Walls and Roofs

DESIGN CRITERIA - WIND

FIGURE 30.3-1: Components and Cladding [h ≤ 60 ft]: External Pressure Coefficients, (GCp), for Enclosed and Partially Enclosed Buildings - Walls

Diagram



Notation

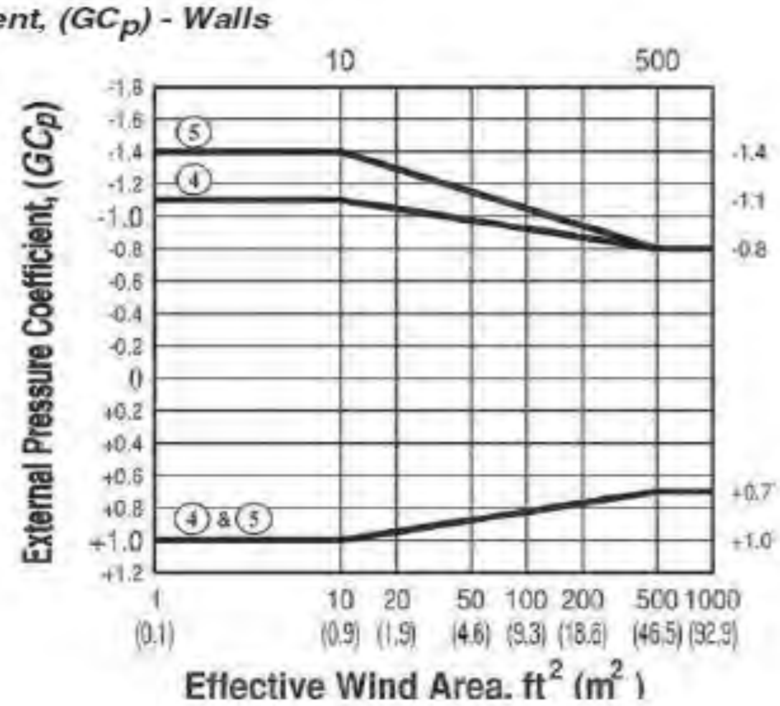
a = 10% of least horizontal dimension or $0.4h$, whichever is smaller, but not less than either 4% of least horizontal dimension or 3 ft (0.9 m).

Exception: For buildings with $\theta = 0°$ to $7°$ and a least horizontal dimension greater than 300 ft (90 m), dimension a shall be limited to a maximum of $0.8h$.

h = Mean roof height, in ft (m), except that eave height shall be used for $\theta \leq 10°$.

θ = Angle of plane of roof from horizontal, in degrees.

External Pressure Coefficient, (GC_p) - Walls



Notes

1. Vertical scale denotes (GCp) to be used with qh.
2. Horizontal scale denotes effective wind area, in ft^2 (m^2).
3. Plus and minus signs signify pressures acting toward and away from the surfaces, respectively.
4. Each component shall be designed for maximum positive and negative pressures.
5. Values of (GCp) for walls shall be reduced by 10% when $\theta \leq 10°$.

FIGURE 30.3-1 Components and Cladding [$h \leq 60$ ft ($h \leq 18.3$ m)]: External Pressure Coefficients, (GC_p), for Enclosed and Partially Enclosed Buildings—Walls

DESIGN CRITERIA - SEISMIC

ASCE 7-16 SECTION 12.8 - EQUIVALENT LATERAL FORCE PROCEDURE

OCCUPANCY CATEGORY:	I & II	LATITUDE:	47.541
SITE CLASS:	D	LONGITUDE:	-122.209
IMPORTANCE FACTOR (I_E):	1	S_S =	1.449
STRUCTURAL SYSTEM (R):	3	S_1 =	0.501
OVERSTRENGTH FACTOR (Ω_o):	3	F_a =	1.000
		F_v =	1.800

ASCE 7-16 SECTION 11.4 SEISMIC GROUND MOTION VALUES

Section 11.4.4 - Coefficients and Risk-Targeted Maximum Considered Earthquake (MCER) Spectral Response Acceleration Parameters

$S_{MS} = F_a*S_S =$ 1.449 $S_{M1} = F_v*S_1 =$ 0.902

Section 11.4.5 - Design Spectral Response Acceleration Parameters

$S_{DS} = 2/3*S_{MS} =$ 0.966 $S_{D1} = 2/3*S_{M1} =$ 0.601

ASCE 7-16 SECTION 11.6 - SEISMIC DESIGN CATEGORY - SECTION 12.8.2 - PERIOD DETERMINATION

ASCE 7-16 TABLE 11.6-1

SEISMIC DESIGN CATEGORY BASED ON S_{DS}

	RISK CATEGORY:		
	I & II	III	IV
< 0.167g	A	A	A
< 0.33g	B	B	C
< 0.50g	C	C	D
>= 0.50g	D	D	D
	D		

ASCE 7-16 TABLE 11.6-2

SEISMIC DESIGN CATEGORY BASED ON S_{D1}

	RISK CATEGORY:		
	I & II	III	IV
< 0.067g	A	A	A
< 0.133g	B	B	C
< 0.20g	C	C	D
>= 0.20g	D	D	D
	D		

Each building and structure shall be assigned to the most severe Seismic Design Category in accordance with Table 11.6-1 or Table 11.6-2, irrespective of the fundamental period of vibration of the structure.

PERIOD DETERMINATION:	
C_t =	0.02
h_n =	22 FT
x =	0.75
$T_a = C_t*h_n^x$ =	0.203

ASCE 7-16 SECTION 12.8.1.1 - SEISMIC RESPONSE COEFFICIENT

GENERAL EQUATION:	$C_S = S_{DS}/(R/I) =$	0.322	<--CONTROLS	EQ. 12.8-2
MAXIMUM:	CS = 1.5*SD1/(T*(R/I)) =	1.480		EQ. 12.8-3
MINIMUM:	$C_S = 0.044*S_{DS}*I > 0.01 =$	0.043		EQ. 12.8-5
For structures located where S1 > 0.6g	$C_S = 0.5*S_1/(R/I) =$	0.000		EQ. 12.8-6

ASCE 7-10 SECTION 12.8.1 - SEISMIC BASE SHEAR

$V = C_S*W =$ **0.322*W**

W = the total dead load and applicable portion of other loads as indicated in Section 12.7.2

Vertical and Horizontal Diaphragm Force Distributions
Mercer Island Residence (Entry Bridge) - 21201
BRT

VERTICAL DISTRIBUTION OF SEISMIC FORCES

Level	h_x (ft)	w_x(k)	$w_x h_x^k$ (k-ft)	$w_x h_x^k / \Sigma w_i h_i^k$ (%)	F_x (k)	F_{tot} (k)	F_{asd} (k)
Roof	22	13.5	297.00	44%	13.6	13.55	0.31
Floor	11	34.2	376.20	56%	17.2	30.72	0.39
Sum Σ		47.7	673.20		30.72		

k= 1
C_s= 0.644

INPUTS
OUTPUTS

S_{DS}= 0.966
I= 1

DIAPHRAGM DESIGN SEISMIC FORCES

Level	w_{px} (k)	Σw_i (k)	F_x (k)	ΣF_i (k)	$\Sigma F_x / \Sigma w_{px}$	Max Code Diaphragm Force $\Sigma F_x / \Sigma w_{px}$, MIN, or MAX	F_{px} (k)	$\gamma = F_{px}/F_x$
Roof	13.5	13.5	13.55	13.55	1.00	0.39	5.22	0.38
Floor	34.2	47.7	17.17	30.72	0.64	0.39	13.21	0.77
Sum Σ	47.7		30.72					

MAX	F_{px} (k)=	$0.4 S_{DS} I w_{px}$=	0.3864 $*w_{px}$
MIN	F_{px} (k)=	$0.2 S_{DS} I w_{px}$=	0.1932 $*w_{px}$

ENTRY BRIDGE

LATERAL

(G6) CANT. COL: TIMBER FRAMES $\begin{cases} R = 3 \\ \Omega = 3 \end{cases}$

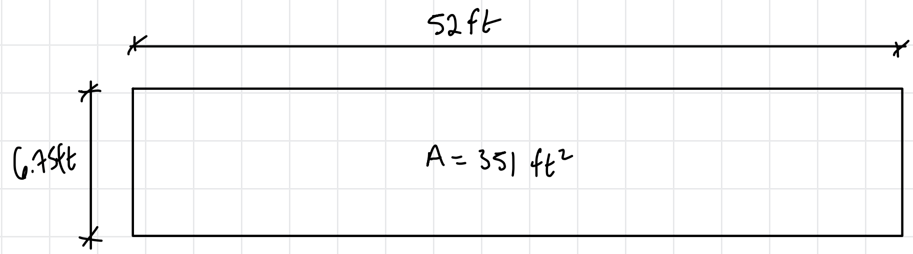
SEE DESIGN CRITERIA SPREADSHEET FOR CALCS

$C_s = 0.322$

$h_{FLOOR} = 11ft$

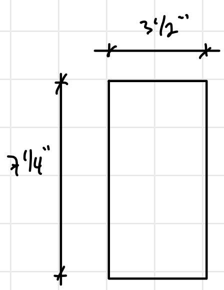
$h_{ROOF} = 22ft$

ROOF -



$W_{ROOF} = 351ft^2\,(16psf) = 5.62^k$

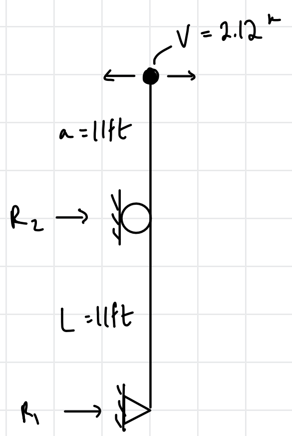
DECKING + ROOFING + PV ARRAY



$W_{COL} = (3.5in/12in/ft)(3.5in/12in/ft)(5.5\,ft)(31.8\,pcf)(30\ col's) = 0.96^k$

$W_{TOT} = 5.62^k + 0.96^k = 6.58^k$

$V_{TOT} = 6.58^k\,(0.322) = 2.12^k$



$R_2 = V_1 + V_2 = P/L\,(L + a) = (2.12^k/11ft)(11ft + 11ft)$

$R_2 = \underline{\underline{4.24^k}}$

Project: MERCER ISLAND RESIDENCE | Job No: 21-201
Subject: ENTRY BRIDGE | Sheet LATERAL | Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland | Date: 6-10-21

ENTRY BRIDGE

LATERAL

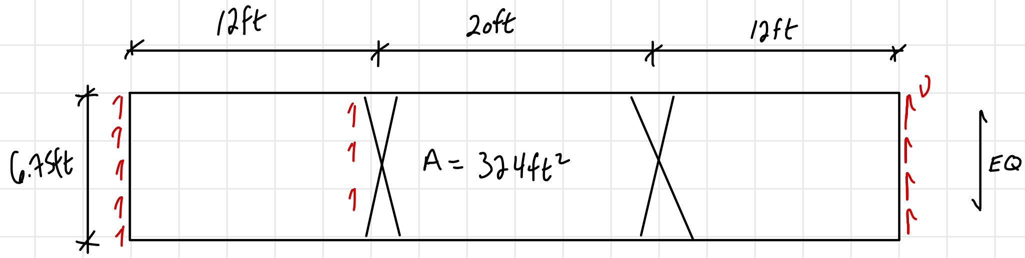
(66) CANT. COL: TIMBER FRAMES $\left\{ \begin{array}{l} R = 3 \\ \Omega = 3 \end{array} \right.$

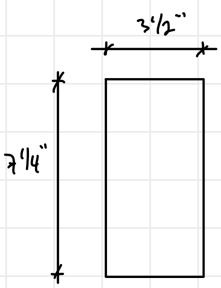
SEE DESIGN CRITERIA SPREADSHEET FOR CALCS

$C_s = 0.322$

$h_{FLOOR} = 11ft$
$h_{ROOF} = 22ft$

FLOOR -





DECKING + FRAMING

$W_{FLOOR} = 324ft^2 \left(10_{PSF}\right) = 3.24^k$

$W_{COL} = \left(3.5in / 12in/ft\right)\left(7.5in / 12in/ft\right)\left(11\ ft\right)\left(31.8_{PCF}\right)\left(26\ COL'S\right) = 1.66^k$

$W_{TOT} = 3.24^k + 1.66^k = 4.90^k$

RXN FROM ROOF

$V = C_s W = 0.322\left(4.90^k\right) = 1.58^k + 4.24^k = 5.82^k$

RXN'S @ BRACES $= 5.82^k\left(\frac{16ft}{48ft}\right) = \underline{\underline{1.94^k \text{ EA. BRACE}}}$

$v = 1.94^k / 6.75ft = 0.288\ klf\ (0.7) = 0.201\ klf$

RXN'S @ ENDS $= 5.82^k\left(\frac{6ft}{48ft}\right) = \underline{\underline{0.73^k \text{ @ EA END}}}$

E-W DIRECTION

RXN'S @ ENDS $= 5.82^k / 2 = \underline{\underline{2.91^k \text{ @ EA END}}}$

SLIDING @ WEST END

μ

$150_{PCF}\left[\underbrace{(4ft)(6ft)(8/12)}_{\text{STEM WALL WT.}} + \underbrace{(2ft)(1.5ft)(6ft)}_{\text{GB WT.}}\right](0.3) = 3.06^k \geq 2.91^k$ ✓ OK

ENTRY BRIDGE

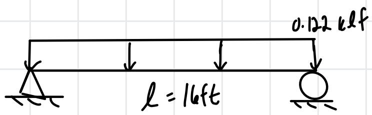
DIAPHRAGM:

COLLECTOR -

$V_c = 0.201\ \text{klf}\ (6.75\text{ft}) / 6\ \text{GLB's} = 0.23^k / \text{BEAM}$ (SHEAR)

BY INSPECTION, HORIZONTAL 3 1/8" x 12" GLB ✓OK TO BE USED AS DIAPHRAGM ELEMENTS

BEAM -



$\Delta_{MAX} = 0.16\ \text{in} < 0.02\,h = 0.02\left(11\ \text{ft} \times \frac{12\text{in}}{\text{ft}}\right) = 2.64\ \text{in}$

SEE ENERCALC...

CHORD:

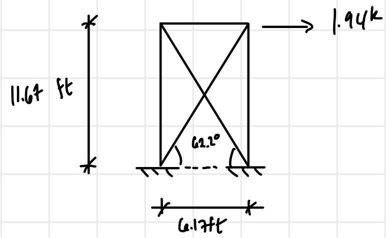
$T/C = M/b = \left(\frac{0.122\text{klf}\,(16\text{ft})^2}{8}\right) / 6.75\text{ft} = 0.58^k$

1/4" ϕ x 3 1/2" SDS w/ 10 GA OR GREATER STL SIDE-PL (SPF-HF)

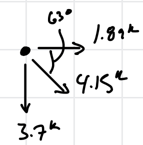
↳ $V = 300\,\text{lb}/\text{screw}\ (1.6) = 480\,\text{lb}/\text{screw}$

$0.58^k / (480\,\text{lb}/\text{screw}) = 1.21\ \text{screws}$ → $\boxed{\text{2 SCREWS NEEDED @ SPLICE CONN.}}$

FRAME



$$c = \sqrt{(11.67ft)^2+(6.17ft)^2} = 13.2ft$$



BRACE:

$$P_{BRACE} = 1.94^k \left(\frac{13.2\ ft}{6.17\ ft}\right) = \underline{\underline{4.15^k}}$$

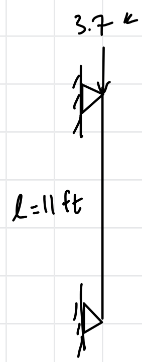
$$\phi T_n = 0.9\ (36ksi) \left(\frac{\pi\ (0.75in)^2}{4}\right) = \underline{\underline{14.3^k}} > 4.15^k$$

$\therefore$ $\boxed{\text{USE } 3/4'' \ \phi \text{ ROD}}$

SEE MAIN BUILDING CALCS FOR CONTROLLING CONNECTION DESIGN

SEE ENERCALC FOR BM + COL DESIGN ...

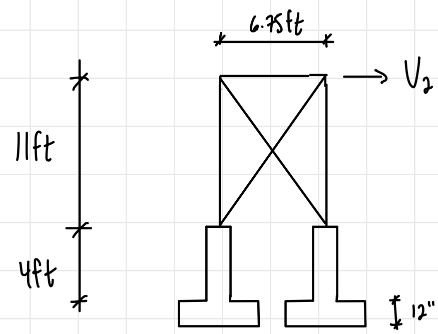
COL. :



$\boxed{\text{USE } 3\text{-}1/2'' \times 7\tfrac{1}{2}'' \text{ GLB}}$ (POC 2)

COL. CONTROLS DESIGN

Foundation



$V_2 = (1.94^k)0.7 = 1.36^k$

$w_{ftg} = 2\,ft\,(12''/12in/ft)\,(150\,pcf)\,(0.6)\,(4ft) = 720\,lb$

$w_{stem} = 4ft\,(8''/12''/ft)(150\,pcf)(0.6)\,(4ft) = 960\,lb$

$w_{soil} = 3.33ft\,(2ft)\,(110\,pcf)\,(0.6)(4ft) = 1,758\,lb$

Overturning.

$1.36^k\,(16\,ft) \leq (720\,lb + 960\,lb + 1,758\,lb)\,(6.75ft)$

$21.8\,kft \leq 23.2\,kft$ ✓ok

Bearing:

$\frac{1.36^k\,(16ft)}{6.75ft} + (720lb + 960lb + 1,758\,lb) = 10,524\,lb$

$3,441\,lb \leq 20,000\,lb$ ✓ok ∴ PLACE (1) PIN PILE DIRECTLY BENEATH FRAME COLUMN

Sliding:

$1.36^k \leq (720\,lb + 960\,lb + 1,758\,lb)\,(0.3) + 250_{pcf}\,(1ft)\,(1/2)\,(4ft)\,(2)$

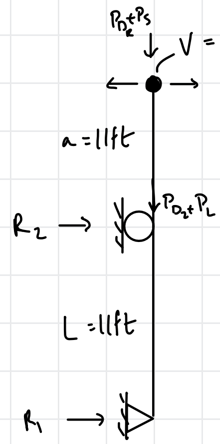
$1.36^k \leq 2.04^k$ ✓ok

Structural Solutions

Project: Mercer Island Residence | Job No: 21-201
Subject: Entry Bridge | Sheet: Columns | Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland | Date: 6-10-21

Entry Bridge

Columns: 3 1/8" x 7 1/2" GLB (L2) ; $I_x = 109.9\ in^4$; $E = 1.7E6\ psi$;



$V = \frac{2.12^k}{26\ col's} = 0.09^k/col$

$P_{D_R} = \left(\frac{6.75ft}{2}\right)(4ft)(16psf) = 216\ lb$

$P_{D_2} = \left(\frac{6.75ft}{2}\right)(4ft)(10psf) = 135\ lb$

$P_s = \left(\frac{6.75ft}{2}\right)(4ft)(25\ psf) = 338\ lb$

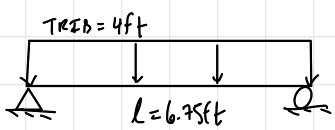
$P_L = \left(\frac{6.75ft}{2}\right)(4ft)(40\ psf) = 540\ lb$

$M_{MAX} = V a = 0.99^k (11ft) = 10.9\ k\cdot ft\ (0.7) = 7.7\ k\cdot ft$

$\Delta_{MAX} = \frac{V a^2}{3EI}(L+a) = \frac{(0.7)\ 40\ lb\ (132in)^2}{3(1.7E6 psi)(109.9 in^4)}(132in + 132in) = 0.52\ in \rightarrow L/254 < 2L/180$ ✓ ok

By engineering judgement, inclusion of gravity loads w/ eccentricity ✓ ok b/c gravity loads are so small and plenty of capacity leftover.

Beams:



D = 10 psf
L = 40 psf } Floor beams control

$\boxed{3\tfrac{1}{8}" \times 7\tfrac{1}{2}"\ GLB}$ ✓ ok

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: Entry Bridge Beam

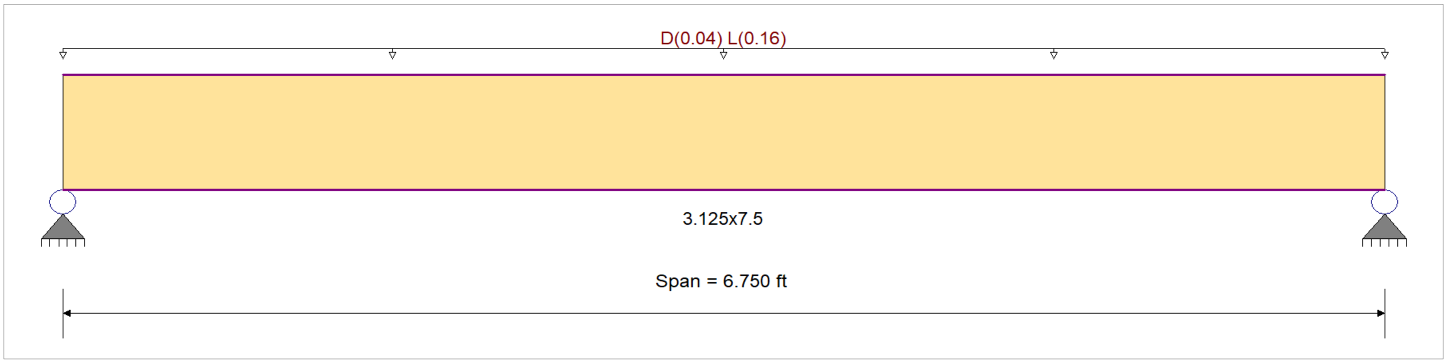
CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,200.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	1,850.0 psi	Ebend- xx	1,800.0 ksi
		Fc - Prll	1,650.0 psi	Eminbend - xx	950.0 ksi
Wood Species	DF/DF	Fc - Perp	650.0 psi	Ebend- yy	1,600.0 ksi
Wood Grade	24F-V4	Fv	265.0 psi	Eminbend - yy	850.0 ksi
		Ft	1,100.0 psi	Density	31.210 pcf

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 loads
Uniform Load : D = 0.010, L = 0.040 ksf, Tributary Width = 4.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.217** : 1	Maximum Shear Stress Ratio	=	**0.137** : 1
Section used for this span		**3.125x7.5**	Section used for this span		**3.125x7.5**
fb: Actual	=	478.41 psi	fv: Actual	=	36.21 psi
Fb: Allowable	=	2,200.00 psi	Fv: Allowable	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	3.375 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.038 in	Ratio =	2130	>=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0	<480	n/a
Max Downward Total Deflection	0.049 in	Ratio =	1662	>=360	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0	<360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 6.725 ft	**1**	0.053	0.033	0.90	1.000	1.00	1.00	1.00	1.00	1.00	0.26	105.16	1980.00	0.12	7.96	238.50
Length = 0.02464 ft	**1**	0.001	0.033	0.90	1.000	1.00	1.00	1.00	1.00	1.00	0.00	1.53	1980.00	0.12	7.96	238.50
+D+L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.725 ft	**1**	0.217	0.137	1.00	1.000	1.00	1.00	1.00	1.00	1.00	1.17	478.41	2200.00	0.57	36.21	265.00
Length = 0.02464 ft	**1**	0.003	0.137	1.00	1.000	1.00	1.00	1.00	1.00	1.00	0.02	6.96	2200.00	0.57	36.21	265.00
+D+0.750L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.725 ft	**1**	0.140	0.088	1.25	1.000	1.00	1.00	1.00	1.00	1.00	0.94	385.10	2750.00	0.46	29.15	331.25
Length = 0.02464 ft	**1**	0.002	0.088	1.25	1.000	1.00	1.00	1.00	1.00	1.00	0.01	5.60	2750.00	0.46	29.15	331.25
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.725 ft	**1**	0.018	0.011	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.15	63.10	3520.00	0.07	4.78	424.00
Length = 0.02464 ft	**1**	0.000	0.011	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.00	0.92	3520.00	0.07	4.78	424.00

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: Entry Bridge Beam

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0487	3.400		0.0000	0.000

Vertical Reactions

Support notation : Far left is #` Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.692	0.692
Overall MINimum	0.540	0.540
D Only	0.152	0.152
+D+L	0.692	0.692
+D+0.750L	0.557	0.557
+0.60D	0.091	0.091
L Only	0.540	0.540

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

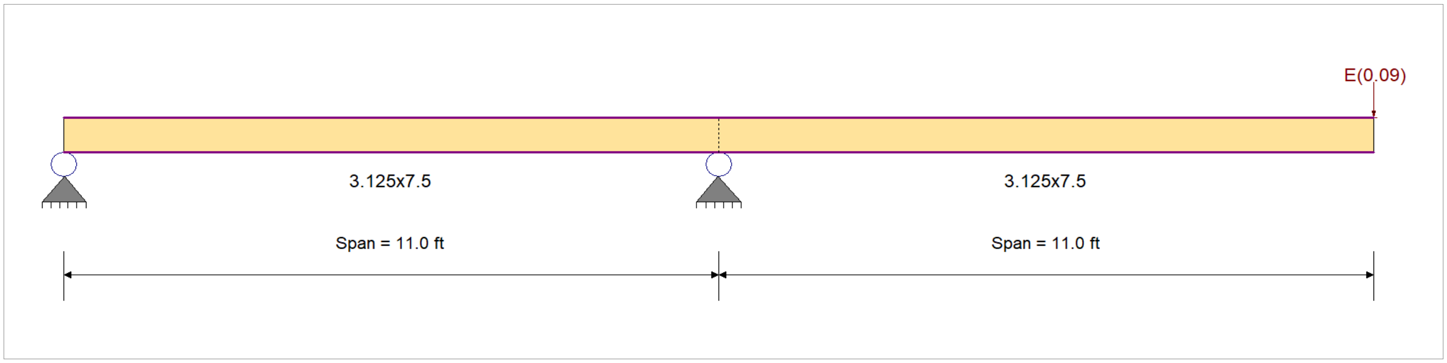
DESCRIPTION: Entry Bridge Col

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	1,400.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	1,400.0 psi	Ebend- xx	1,500.0 ksi
		Fc - Prll	1,900.0 psi	Eminbend - xx	740.0 ksi
Wood Species	DF/DF	Fc - Perp	470.0 psi	Ebend- yy	1,500.0 ksi
Wood Grade	24F-V4	Fv	230.0 psi	Eminbend - yy	740.0 ksi
		Ft	1,050.0 psi	Density	31.210 pcf
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 2
Point Load : E = 0.090 k @ 11.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.127** : 1	Maximum Shear Stress Ratio	=	**0.011** : 1
Section used for this span		**3.125x7.5**	Section used for this span		**3.125x7.5**
fb: Actual	=	283.85 psi	fv: Actual	=	4.03 psi
Fb: Allowable	=	2,240.00 psi	Fv: Allowable	=	368.00 psi
Load Combination		E Only * 0.70	Load Combination		E Only * 0.70
Location of maximum on span	=	11.000 ft	Location of maximum on span	=	11.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.585 in	Ratio =	450 >=180	Span: 2 : E Only * 0.70
Max Upward Total Deflection	-0.057 in	Ratio =	2323 >=180	Span: 1 : E Only * 0.70

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
													0.00	0.00	0.00	0.00
Length = 11.0 ft	1			0.90	1.000	1.00	1.00	1.00	1.00	1.00			1260.00	0.00	0.00	207.00
Length = 11.0 ft	2			0.90	1.000	1.00	1.00	1.00	1.00	1.00			1260.00	0.00	0.00	207.00
E Only * 0.70					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.0 ft	1	0.127	0.011	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.69	283.85	2240.00	0.06	4.03	368.00
Length = 11.0 ft	2	0.127	0.011	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.69	283.85	2240.00	0.06	4.03	368.00
E Only * 0.5250					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.0 ft	1	0.095	0.008	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.52	212.89	2240.00	0.05	3.02	368.00
Length = 11.0 ft	2	0.095	0.008	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.52	212.89	2240.00	0.05	3.02	368.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
	1	0.0000	0.000	E Only * 0.70	-0.0568	6.391

Wood Beam

DESCRIPTION: Entry Bridge Col

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
E Only * 0.70	2	0.5849	11.000		0.0000	6.391

Vertical Reactions

Support notation : Far left is #· Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum	-0.090	0.180	
Overall MINimum	-0.063	0.180	
E Only * 0.70	-0.063	0.126	
E Only * 0.5250	-0.047	0.095	
E Only	-0.090	0.180	

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

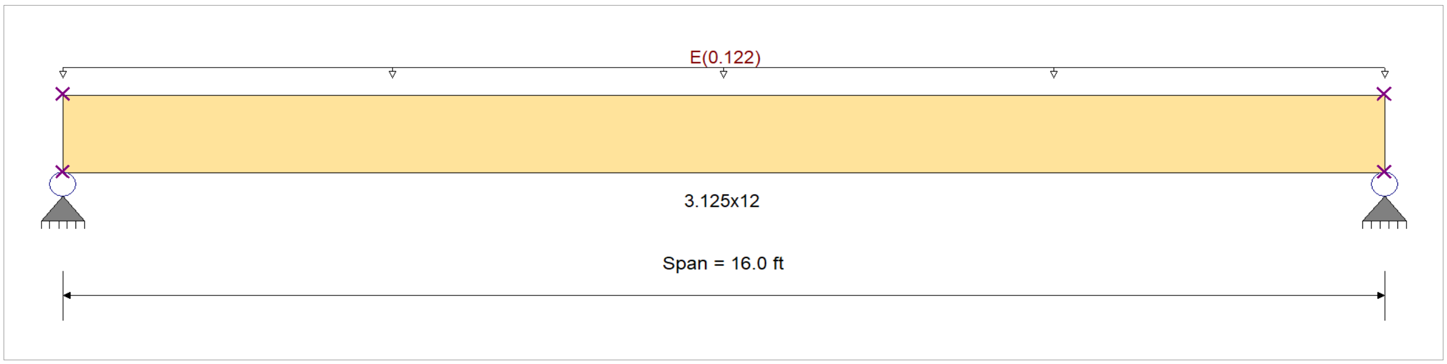
DESCRIPTION: Entry Bridge chord deflection

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,400.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	1,850.0 psi	Ebend- xx	1,800.0 ksi
		Fc - Prll	1,650.0 psi	Eminbend - xx	950.0 ksi
Wood Species	DF/DF	Fc - Perp	650.0 psi	Ebend- yy	1,600.0 ksi
Wood Grade	24F-V4	Fv	265.0 psi	Eminbend - yy	850.0 ksi
		Ft	1,100.0 psi	Density	31.210 pcf
Beam Bracing	Completely Unbraced				



Applied Loads

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

Uniform Load : E = 0.1220 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.181**: 1	Maximum Shear Stress Ratio	=	**0.056** : 1
Section used for this span		**3.125x12**	Section used for this span		**3.125x12**
fb: Actual	=	437.25 psi	fv: Actual	=	23.94 psi
Fb: Allowable	=	2,419.88 psi	Fv: Allowable	=	424.00 psi
Load Combination		E Only * 0.70	Load Combination		E Only * 0.70
Location of maximum on span	=	8.000 ft	Location of maximum on span	=	15.007 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.223 in	Ratio =	859 >=360	Span: 1 : E Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.156 in	Ratio =	1227 >=180	Span: 1 : E Only * 0.70
Max Upward Total Deflection	0 in	Ratio =	0 <180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
													0.00	0.00	0.00	0.00
Length = 16.0 ft	1			0.90	1.000	1.00	1.00	1.00	1.00	0.88			1907.08	0.00	0.00	238.50
E Only * 0.70					1.000	1.00	1.00	1.00	1.00	0.88			0.00	0.00	0.00	0.00
Length = 16.0 ft	1	0.181	0.056	1.60	1.000	1.00	1.00	1.00	1.00	0.63	2.73	437.25	2419.88	0.60	23.94	424.00
E Only * 0.5250					1.000	1.00	1.00	1.00	1.00	0.63			0.00	0.00	0.00	0.00
Length = 16.0 ft	1	0.136	0.042	1.60	1.000	1.00	1.00	1.00	1.00	0.63	2.05	327.94	2419.88	0.45	17.95	424.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
E Only	1	0.2234	8.058		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.976	0.976

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: Entry Bridge chord deflection

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MINimum	0.976	0.976
E Only * 0.70	0.683	0.683
E Only * 0.5250	0.512	0.512
E Only	0.976	0.976

Wood Column

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: Entry Bridge Frame Col.

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Analysis Method	Allowable Stress Design	Wood Section Name	3.125x7.5
End Fixities	Top & Bottom Pinned	Wood Grading/Manuf.	Western
Overall Column Height	11 ft	Wood Member Type	GLB

(Used for non-slender calculations)

Wood Species	GluLam Column, Species: POC		
Wood Grade	L2, >= 4 Laminations		
Fb +	1450 psi	Fv	230 psi
Fb -	87397.8 psi	Ft	1050 psi
Fc - Prll	1900 psi	Density	pcf
Fc - Perp	470 psi		

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1400	1400	1400 ksi
Minimum	740	740	

Exact Width	3.125 in
Exact Depth	7.50 in
Area	23.438 in^2
Ix	109.863 in^4
Iy	19.073 in^4

Allow Stress Modification Factors

Cf or Cv for Bending	1.0
Cf or Cv for Compressio	1.0
Cf or Cv for Tension	1.0
Cm : Wet Use Factor	1.0
Ct : Temperature Fact	1.0
Cfu : Flat Use Factor	1.0
Kf : Built-up columns	1.0 *NDS 15.3.2*
Use Cr : Repetitive ?	No

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 1
Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 11

Applied Loads

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

Column self weight included : 0.0 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 11.0 ft, E = 3.70 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS	Max. Axial+Bending Stress Ratio =	**0.3282 : 1**
	Load Combination	+D+0.70E
	Governing NDS Forumla	Comp Only, fc/Fc'
	Location of max.above base	0.0 ft
	At maximum location values are .	
	Applied Axial	2.590 k
	Applied Mx	0.0 k-ft
	Applied My	0.0 k-ft
	Fc : Allowable	336.728 psi
PASS	Maximum Shear Stress Ratio =	**0.0 : 1**
	Load Combination	+0.60D+0.70E
	Location of max.above base	11.0 ft
	Applied Design Shear	0.0 psi
	Allowable Shear	368.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.0 k	Bottom along Y-Y	0.0 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .

Along Y-Y 0.0 in at 0.0 ft above base
for load combination : n/a
Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

Other Factors used to calculate allowable stresses . . .

Bending	Compression	Tension

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
D Only	1.600	0.111	0.0	PASS	0.0 ft	0.0	PASS	11.0 ft
+D+0.70E	1.600	0.111	0.3282	PASS	0.0 ft	0.0	PASS	11.0 ft
+D+0.5250E	1.600	0.111	0.2461	PASS	0.0 ft	0.0	PASS	11.0 ft
+0.60D	1.600	0.111	0.0	PASS	0.0 ft	0.0	PASS	11.0 ft
+0.60D+0.70E	1.600	0.111	0.3282	PASS	0.0 ft	0.0	PASS	11.0 ft

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction k @ Base	X-X Axis Reaction @ Top	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Axial Reaction @ Base	My - End Moments k-ft @ Base	My - End Moments @ Top	Mx - End Moments @ Base	Mx - End Moments @ Top
D Only									
+D+0.70E					2.590				

Wood Column

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: ENTRY BRIDGE CHORD

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Analysis Method	Allowable Stress Design	
End Fixities	Top & Bottom Pinned	
Overall Column Height		16 ft

(Used for non-slender calculations)

Wood Species	DF/DF		
Wood Grade	24F-V4		
Fb +	2400 psi	Fv	265 psi
Fb -	1850 psi	Ft	1100 psi
Fc - Prll	1650 psi	Density	31.21 pcf
Fc - Perp	650 psi		

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1800	1600	1800 ksi
Minimum	950	850	

Wood Section Name	**3.125x12**
Wood Grading/Manuf.	Western
Wood Member Type	GLB
Exact Width	**3.125** in
Exact Depth	**12.0** in
Area	37.50 in^2
Ix	450.0 in^4
Iy	30.518 in^4

Allow Stress Modification Factors	
Cf or Cv for Bending	1.0
Cf or Cv for Compressio	1.0
Cf or Cv for Tension	1.0
Cm : Wet Use Factor	1.0
Ct : Temperature Fact	1.0
Cfu : Flat Use Factor	1.0
Kf : Built-up columns	1.0 *NDS 15.3.2*
Use Cr : Repetitive ?	No

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Fully braced against buckling ABOUT Y-Y Axis
Y-Y (depth) axis : Fully braced against buckling ABOUT X-X Axis

Applied Loads

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

Column self weight included : 130.042 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 16.0 ft, H = 3.0 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS	Max. Axial+Bending Stress Ratio =	**0.05621 : 1**
	Load Combination	+D+H
	Governing NDS Forumla	Comp Only, fc/Fc'
	Location of max.above base	0.0 ft
	At maximum location values are .	
	Applied Axial	3.130 k
	Applied Mx	0.0 k-ft
	Applied My	0.0 k-ft
	Fc : Allowable	1,485.0 psi
PASS	Maximum Shear Stress Ratio =	**0.0 : 1**
	Load Combination	+0.60D+0.60H
	Location of max.above base	16.0 ft
	Applied Design Shear	0.0 psi
	Allowable Shear	424.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.0 k	Bottom along Y-Y	0.0 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .

Along Y-Y 0.0 in at 0.0 ft above base
for load combination : n/a
Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

Other Factors used to calculate allowable stresses . . .

Bending	Compression	Tension

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
+D+H	0.900	1.000	0.05621	PASS	0.0 ft	0.0	PASS	16.0 ft
+0.60D+0.60H	1.600	1.000	0.01897	PASS	0.0 ft	0.0	PASS	16.0 ft

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction (k) @ Base	@ Top	Y-Y Axis Reaction @ Base	@ Top	Axial Reaction @ Base	My - End Moments (k-ft) @ Base	@ Top	Mx - End Moments @ Base	@ Top
+D+H					3.130				
+0.60D+0.60H					1.878				
D Only					0.130				
H Only					3.000				

GARAGE

Project:	MERCER ISLAND RESIDENCE	Job Number:	21-201
Sheet:	of	Name:	BRT
Originating Office:	Tacoma	Date:	5/25/2021

PCS Structural Solutions

DESIGN CRITERIA CHECKLIST

CODE: IBC 2018, ASCE 7-16 LOCATION: MERCER ISLAND, WA

VERTICAL DESIGN CRITERIA

	DEAD	LIVE	PARTITION	CONCENTRATED
ROOF:	15 PSF	25 PSF		

WIND DESIGN CRITERIA

BASIC WIND SPEED (V) =	97 MPH	(Per ASCE 7-16 Sec. 26.5.1, Fig. 26.5-1A; 1B; 1C & 1D, or as required by Bld'g Dept.)
RISK CATEGORY:	II	(Per ASCE 7-16 Table 1.5-1 & IBC Table 1604.5)
EXPOSURE CATEGORY:	D	(Per ACSE 7-16 Section 26.7.3)
DIRECTIONALITY FACTOR (K_d):	0.85	(Per ASCE 7-16 Table 26.6-1)
GUST EFFECT FACTOR (G):	0.85	(Per ASCE 7-16 Section 26.11)
TOPOGRAPHIC FACTOR (K_{zt}):	1.00	(Per ASCE 7-16 Section 26.8.2)
MEAN ROOF HEIGHT:	0-15 FT	(See ASCE 7-16 Section 26.2 - Definitions)
ELEVATION:	0 FT	(See ASCE 7-16 Section 26.9)
ENCLOSURE CLASSIFICATION:	Enclosed	(See ASCE 7-16 Secion 26.2 & Table 26.13-1)
ROOF TYPE:	Monoslope	(See ASCE 7-16 Figure 27.3-1)
ROOF SLOPE (__:12):	1.10:12	(Enter vertical rise in 12 horizontal units)
θ (degrees):	5.24	

SEISMIC DESIGN CRITERIA

RISK CATEGORY:	I & II	(Per ASCE 7-16 Table 1.5-1 & IBC Table 1604.5)
SITE CLASS:	D	(Per IBC Section 1613.2.2, Assumed as "D" or per Geotech.)
IMPORTANCE FACTOR (I_E):	1	(Per ASCE 7-16 Table 1.5-2)
STRUCTURAL SYSTEM (R):	6.5	(Per ASCE 7-16 Table 12.2-1)
OVERSTRENGTH FACTOR (Ω_o):	2.5	(Per ASCE 7-16 Table 12.2-1)

INFORMATION BELOW FROM "EARTHQUAKE SPECTRAL RESPONSE ACCELERATION MAPS" PER USGS

LATITUDE:	47.541	S_S =	1.449	F_a =	1.000
LONGITUDE:	-122.209	S_1 =	0.501	F_v =	1.800

DEFLECTION CRITERIA

FLOOR (LIVE):	L/ 480	ROOF (LIVE):	L/ 360
FLOOR (TOTAL):	L/ 360	ROOF (TOTAL):	L/ 240
WALLS:	L/ 360	SPECIAL:	L/

SOIL DESIGN CRITERIA

REPORT: YES

SEE SOILS REPORT FOR ACTIVE, PASSIVE PRESSURES AND FRICTION COEFFICIENT

BEARING:	1500 PSF
ACTIVE:	VARIES
PASSIVE:	350 PCF
COEFFICIENT OF FRICTION:	0.30

MINIMUM FOOTING DIMENSIONS:

CONTINUOUS:	1'-4"
SPREAD:	1'-6"
FROST DEPTH:	1'-6"

PILE TYPE:	NONE		
VERTICAL CAPACITY :	N/A	LATERAL CAPACITY:	N/A
UPLIFT CAPACITY:	N/A	SIZE:	N/A

MATERIALS

CONCRETE

Footings/Piles:	3000 PSI	Columns:	4000 PSI
Slabs/Walls:	4000 PSI	Beams:	4000 PSI
-	-	-	-

REINFORCING

Steel Grade = 60 f_y = 60 KSI

STRUCTURAL STEEL

W-Flange Beams	ASTM A992	f_y =	50 KSI
Shapes & Plates	ASTM A36	f_y =	36 KSI
Pipes	ASTM A53, Grade B	f_y =	35 KSI
HSS Rect.	ASTM A500, Grade C	f_y =	50 KSI
HSS Round	ASTM A500, Grade C	f_y =	46 KSI

MASONRY

ASTM C90 f'_m = 1900 PSI SOLID GROUTED

GLULAM BEAMS

Simple Spans		Cantilevers
24F-V4	Grade =	24F-V8
1.80E+06 PSI	E =	1.80E+06 PSI
2400 PSI	$F_{b\,(BOTTOM)}$ =	2400 PSI
1850 PSI	$F_{b\,(TOP)}$ =	2400 PSI
240 PSI	F_v =	240 PSI

SCL PRODUCTS

	2x SCL	1¾" SCL	3½, 5¼ SCL
E =	1.30E+06 PSI	1.80E+06 PSI	2.00E+06 PSI
F_b =	1700 PSI	2600 PSI	2900 PSI
F_v =	285 PSI	285 PSI	285 PSI
F_c =	1400 PSI	2400 PSI	2600 PSI

FRAMING LUMBER

Joists & Studs	2x DF #2	2x HF #1	-
E =	1.60E+06 PSI	1.50E+06 PSI	-
F_b =	900 PSI	975 PSI	-
F_v =	180 PSI	150 PSI	-
F_c =	1350 PSI	1350 PSI	-
Beams & Headers	4x DF #2	4x HF #1	6x DF #1
E =	1.60E+06 PSI	1.50E+06 PSI	1.60E+06 PSI
F_b =	900 PSI	975 PSI	1350 PSI
F_v =	180 PSI	150 PSI	170 PSI
Posts & Timbers	6x DF #1	-	-
E =	1.60E+06 PSI	-	-
F_c =	1000 PSI	-	-

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Project: MERCER ISLAND RESIDENCE | Job Number: 21-201

Sheet: ______ of ______ | Name: BRT

Originating Office: Tacoma | Date: 05/25/21

DESIGN CRITERIA - WIND

BASIC WIND SPEED (V):	97 MPH	MEAN ROOF HEIGHT:	15 FT
RISK CATEGORY:	II	GROUND ELEVATION FACTOR (Ke):	1.00
EXPOSURE CATEGORY:	D	ENCLOSURE CLASSIFICATION:	Enclosed
DIRECTIONALITY FACTOR (K_d):	0.85	ROOF TYPE:	Monoslope
GUST EFFECT FACTOR (G):	0.85	ROOF SLOPE (__:12):	1.1:12
TOPOGRAPHIC FACTOR (K_{zt}):	1.00	θ (degrees):	5.24

ASCE 7-16 CHAPTER 27: WIND LOADS ON BUILDINGS: MWFRS (DIRECTIONAL PROCEDURE)
PART 1: ENCLOSED AND PARTIALLY ENCLOSED BUILDINGS OF ALL HEIGHTS

NOTE: q_z and q_i have conservatively been taken equal to q_h.

HORIZONTAL WALL PRESSURES (Figure 27.3-1)

	External Pressures ($q*(GC_p)$):			Internal Pressures ($\pm q_i*(GC_{pi})$)
L/B:	Windward wall	Leeward wall	Sidewall	All walls
0-1	14.3	-9.0	-12.5	3.8
2		-5.4		
≥4		-3.6		

ROOF PRESSURES (Figure 27.3-1)

		External Pressures ($q*(GC_p)$):			Internal Pressures ($\pm q_i*(GC_{pi})$)
Wind Direction:	h/L:	Windward (Positive)	Windward (Negative)	Leeward	All Roofs
Normal to Ridge for θ ≥ 10°	≤0.25	N/A	N/A	N/A	3.8
	0.50	N/A	N/A	N/A	
	≥1.0	N/A	N/A	N/A	

	h/L:	Horizontal Distance from Windward Edge	External Pressures ($q*(GC_p)$): Positive Pressure	External Pressures ($q*(GC_p)$): Negative Pressure	Internal Pressures ($\pm q_i*(GC_{pi})$) All Roofs
Normal to Ridge for θ < 10° and Parallel to Ridge for All θ	≤0.5	0 to h	-3.2	-16.1	3.8
		h to 2h		-9.0	
		>2h		-5.4	
	≥1.0	0 to h/2	-3.2	-23.3	
		>h/2		-12.5	

ASCE 7-16 27.1.5: Minimum Design Wind Loads: The wind load used for design of the MWFRS shall not be less than 16 PSF multiplied by the wall area of the building, and 8 PSF multiplied by the roof area of the building projected on a vertical plane normal to the assumed wind direction. Wall and roof loads shall be applied simultaneously.

ASCE 7-16 CHAPTER 30: WIND LOADS: COMPONENTS AND CLADDING
PART 1: LOW-RISE BUILDINGS (h≤60 ft)

ROOF SURFACES

Effective Wind Area	POSITIVE PRESSURES	NEGATIVE PRESSURES					
	ZONE						
	ALL ZONES	1	2	2'	3	3'	N/A
10 SF	16.0	-27.0	-31.2	-37.5	-41.8	-58.6	N/A
20 SF	16.0	-27.0	-30.8	-37.1	-37.5	-52.3	N/A
50 SF	16.0	-27.0	-29.5	-36.5	-33.3	-43.9	N/A
100 SF	16.0	-27.0	-29.1	-35.4	-29.1	-37.5	N/A

WALL SURFACES & ROOF OVERHANGS

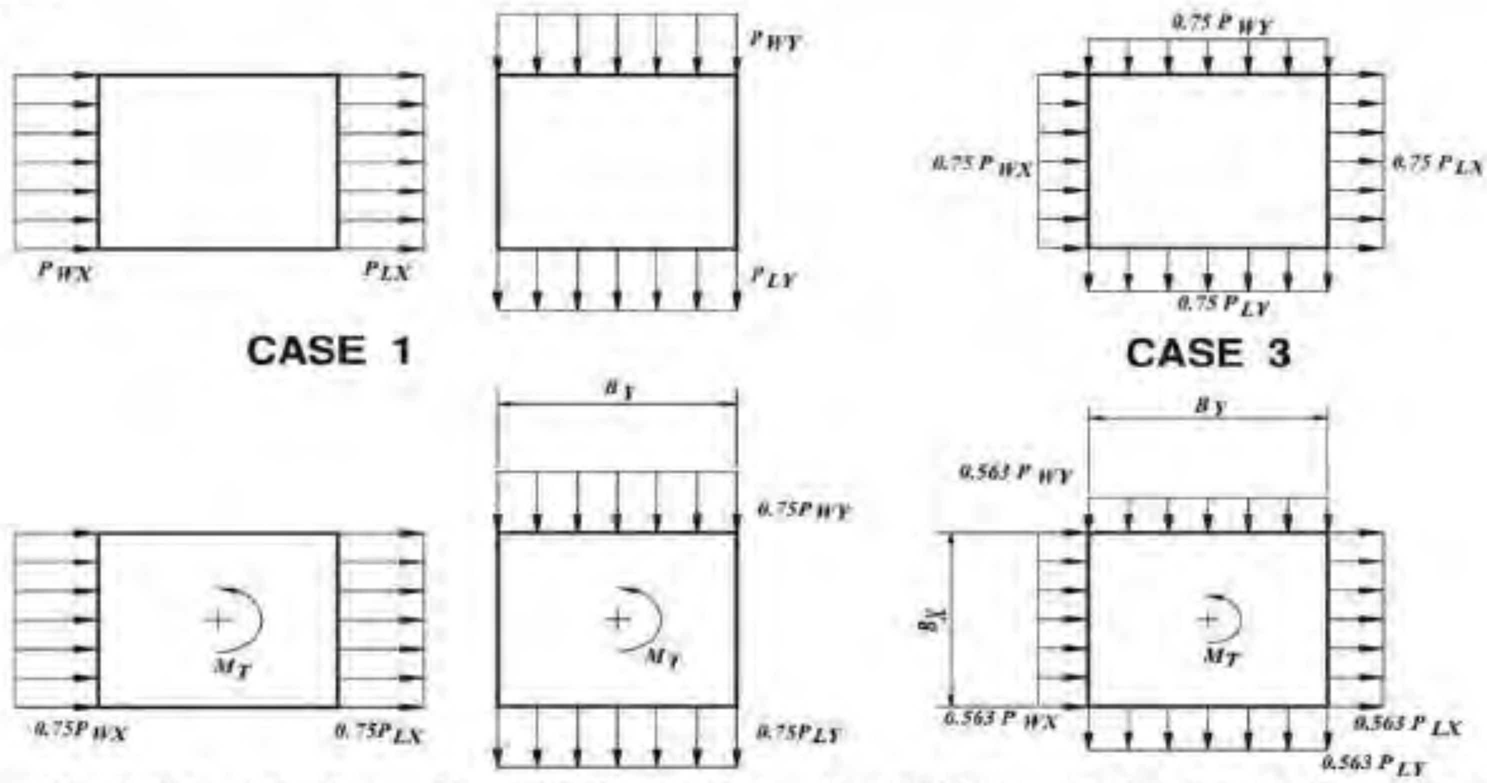
Effective Wind Area	WALL ZONES				ROOF OVERHANG ZONES					
	POSITIVE PRESSURES		NEGATIVE PRESSURES		NEGATIVE PRESSURES					
	4	5	4	5	1	2	2'	3	3'	N/A
10 SF	24.9	24.9	-27.0	-33.3	-48.1	-52.3	-58.6	-62.8	-79.7	N/A
20 SF	23.8	23.8	-25.9	-31.1	-47.0	-50.8	-57.1	-57.5	-72.3	N/A
50 SF	22.3	22.3	-24.4	-28.1	-45.5	-48.0	-55.0	-51.8	-62.3	N/A
100 SF	21.2	21.2	-23.3	-25.9	-44.4	-46.5	-52.8	-46.5	-54.9	N/A
500 SF	18.6	18.6	-20.7	-20.7	-41.8	-43.9	-50.2	-43.9	-52.3	N/A

ASCE 7-16 30.2.2: Minimum Design Wind Loads: The design wind pressure for C&C of buildings shall not be less than a net pressure of 16 PSF acting in either direction normal to the surface.

DESIGN CRITERIA - WIND

FIGURE 27.3-8: Main Wind Force Resisting System, Part 1 (All Heights): Design Wind Load Cases per ASCE 7-16

Diagrams



$M_T = 0.75\ (P_{WX}+P_{LX})B_X e_X$
$e_X = \pm\ 0.15\ B_X$

$M_T = 0.75\ (P_{WY}+P_{LY})B_Y e_Y$
$e_Y = \pm\ 0.15\ B_Y$

$M_T = 0.563\ (P_{WX}+P_{LX})B_X e_X + 0.563\ (P_{WY}+P_{LY})B_Y e_Y$
$e_X = \pm\ 0.15\ B_X$ $e_Y = \pm\ 0.15\ B_Y$

CASE 2 CASE 4

Notation

P_{WX}, P_{WY} = Windward face design pressure acting in the x, y principal axis, respectively.
P_{LX}, P_{LY} = Leeward face design pressure acting in the x, y principal axis, respectively.
$e(e_X, e_Y)$ = Eccentricity for the x, y principal axis of the structure, respectively.
M_T = Torsional moment per unit height acting about a vertical axis of the building.

Case 1. Full design wind pressure acting on the projected area perpendicular to each principal axis of the structure, considered separately along each principal axis.
Case 2. Three-quarters of the design wind pressure acting on the projected area perpendicular to each principal axis of the structure in conjunction with a torsional moment as shown, considered separately for each principal axis.
Case 3. Wind loading as defined in Case 1, but considered to act simultaneously at 75% of the specified value.
Case 4. Wind loading as defined in Case 2, but considered to act simultaneously at 75% of the specified value.

Notes

1. Design wind pressures for windward and leeward faces shall be determined in accordance with the provisions of Sections 27.3.1 and 27.3.2 as applicable for buildings of all heights.
2. Diagrams show plan views of buildings.

FIGURE 27.3-8 Main Wind Force Resisting System, Part 1 (All Heights): Design Wind Load Cases

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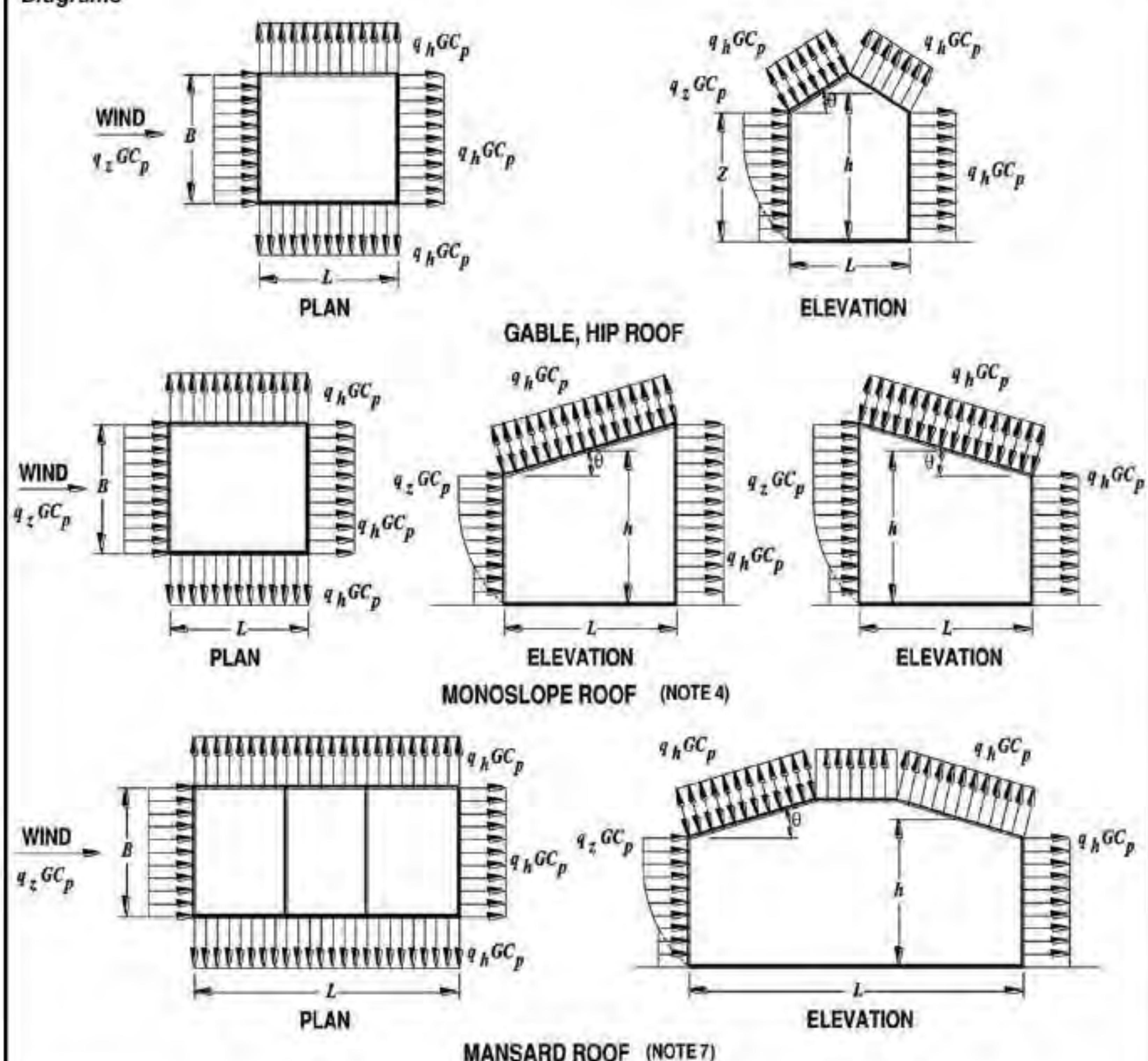
DESIGN CRITERIA - WIND

FIGURE 27.3-1 Main Wind Force Resisting System, Part 1 (All Heights): External Pressure Coefficients, Cp, for Enclosed and Partially Enclosed Buildings - Walls and Roofs per ASCE 7-16

Diagrams



Notation

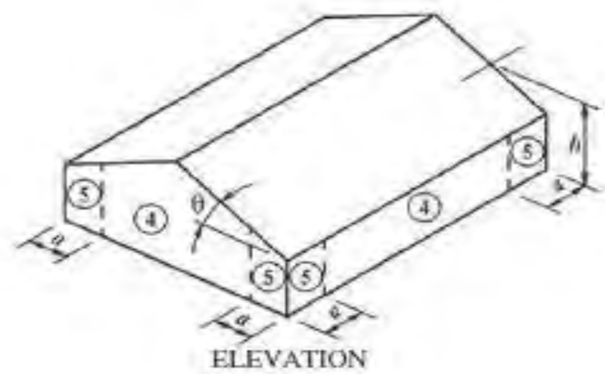
B = Horizontal dimension of building, in ft (m), measured normal to wind direction.
L = Horizontal dimension of building, in ft (m), measured parallel to wind direction.
h = Mean roof height, in ft (m), except that eave height shall be used for $\theta \leq 10$ degrees.
z = Height above ground, in ft (m).
G = Gust-effect factor.
q_z, q_h = Velocity pressure, in lb/ft^2 (N/m^2), evaluated at respective height.
θ = Angle of plane of roof from horizontal, in degrees.

FIGURE 27.3-1 Main Wind Force Resisting System, Part 1 (All Heights): External Pressure Coefficients, C_p, for Enclosed and Partially Enclosed Buildings—Walls and Roofs

DESIGN CRITERIA - WIND

FIGURE 30.3-1: Components and Cladding [h ≤ 60 ft]: External Pressure Coefficients, (GCp), for Enclosed and Partially Enclosed Buildings - Walls

Diagram



Notation

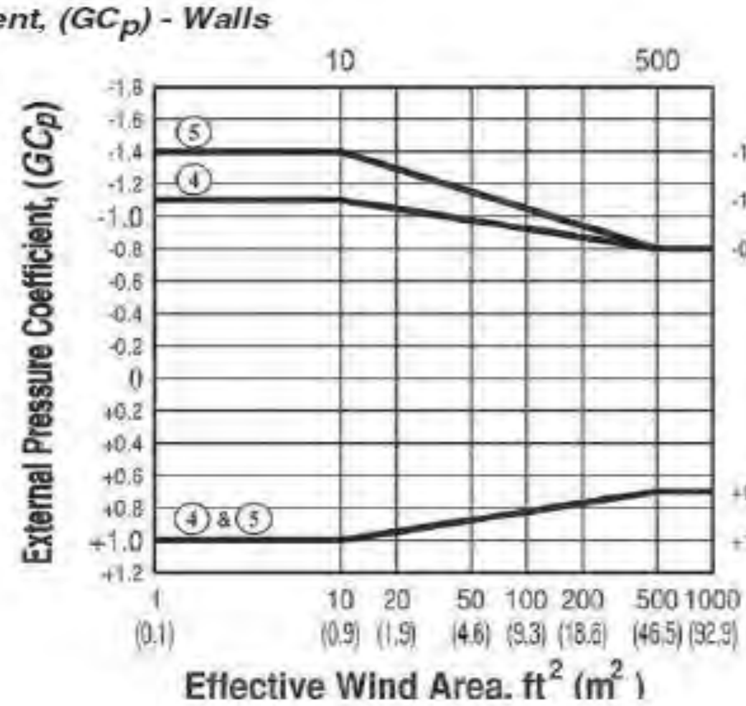
a = 10% of least horizontal dimension or $0.4h$, whichever is smaller, but not less than either 4% of least horizontal dimension or 3 ft (0.9 m).

Exception: For buildings with $\theta = 0°$ to $7°$ and a least horizontal dimension greater than 300 ft (90 m), dimension a shall be limited to a maximum of $0.8h$.

h = Mean roof height, in ft (m), except that eave height shall be used for $\theta \leq 10°$.

θ = Angle of plane of roof from horizontal, in degrees.

External Pressure Coefficient, (GC_p) - Walls



Notes

1. Vertical scale denotes (GCp) to be used with qh.
2. Horizontal scale denotes effective wind area, in ft^2 (m^2).
3. Plus and minus signs signify pressures acting toward and away from the surfaces, respectively.
4. Each component shall be designed for maximum positive and negative pressures.
5. Values of (GCp) for walls shall be reduced by 10% when $\theta \leq 10°$.

FIGURE 30.3-1 Components and Cladding [$h \leq 60$ ft ($h \leq 18.3$ m)]: External Pressure Coefficients, (GC_p), for Enclosed and Partially Enclosed Buildings—Walls

Project:	MERCER ISLAND RESIDENCE	Job Number:	21-201
Sheet:	of	Name:	BRT
Originating Office:	Tacoma	Date:	05/25/21

DESIGN CRITERIA - SEISMIC

ASCE 7-16 SECTION 12.8 - EQUIVALENT LATERAL FORCE PROCEDURE

OCCUPANCY CATEGORY:	I & II	LATITUDE:	47.541
SITE CLASS:	D	LONGITUDE:	-122.209
IMPORTANCE FACTOR (I_E):	1	S_S =	1.449
STRUCTURAL SYSTEM (R):	6.5	S_1 =	0.501
OVERSTRENGTH FACTOR (Ω_o):	2.5	F_a =	1.000
		F_v =	1.800

ASCE 7-16 SECTION 11.4 SEISMIC GROUND MOTION VALUES

Section 11.4.4 - Coefficients and Risk-Targeted Maximum Considered Earthquake (MCER) Spectral Response Acceleration Parameters

$S_{MS} = F_a*S_S =$ 1.449 $S_{M1} = F_v*S_1 =$ 0.902

Section 11.4.5 - Design Spectral Response Acceleration Parameters

$S_{DS} = 2/3*S_{MS} =$ 0.966 $S_{D1} = 2/3*S_{M1} =$ 0.601

ASCE 7-16 SECTION 11.6 - SEISMIC DESIGN CATEGORY - SECTION 12.8.2 - PERIOD DETERMINATION

ASCE 7-16 TABLE 11.6-1

SEISMIC DESIGN CATEGORY BASED ON S_{DS}

	RISK CATEGORY:		
	I & II	III	IV
< 0.167g	A	A	A
< 0.33g	B	B	C
< 0.50g	C	C	D
>= 0.50g	D	D	D
	D		

ASCE 7-16 TABLE 11.6-2

SEISMIC DESIGN CATEGORY BASED ON S_{D1}

	RISK CATEGORY:		
	I & II	III	IV
< 0.067g	A	A	A
< 0.133g	B	B	C
< 0.20g	C	C	D
>= 0.20g	D	D	D
	D		

Each building and structure shall be assigned to the most severe Seismic Design Category in accordance with Table 11.6-1 or Table 11.6-2, irrespective of the fundamental period of vibration of the structure.

PERIOD DETERMINATION:

C_t =	0.02
h_n =	13 FT
x =	0.75
$T_a = C_t*h_n^x$ =	0.133

ASCE 7-16 SECTION 12.8.1.1 - SEISMIC RESPONSE COEFFICIENT

GENERAL EQUATION:	$C_S = S_{DS}/(R/I)$ =	0.149	<--CONTROLS	EQ. 12.8-2
MAXIMUM:	CS = 1.5*SD1/(T*(R/I)) =	1.043		EQ. 12.8-3
MINIMUM:	$C_S = 0.044*S_{DS}*I > 0.01$ =	0.043		EQ. 12.8-5
For structures located where S1 > 0.6g	$C_S = 0.5*S_1/(R/I)$ =	0.000		EQ. 12.8-6

ASCE 7-10 SECTION 12.8.1 - SEISMIC BASE SHEAR

$V = C_S*W =$ **0.149*W**

W = the total dead load and applicable portion of other loads as indicated in Section 12.7.2

$$\boxed{\text{GARAGE}}$$

<u>SEISMIC</u> -

$$C_s = \frac{S_{DS}}{(R/I_e)} = \frac{0.966}{(6.5/1)} = 0.149$$

$$W = (24ft \times 21.67ft)(15\,psf) + (13.5ft/2) \times [(24ft \times 2) + (10.5ft \times 2)](10\,psf) = 12.5^k$$

$$V = C_s W = 0.149(12.5^k) = 1.9^k$$

$$V_{ASD} = 1.9^k(0.7) = \underline{\underline{1.30^k}}$$

Project: MERCER ISLAND RESIDENCE
Job No: 21-201
Subject: GARAGE
Sheet: LATERAL
Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland
Date: 7-12-21

WIND:

SEE DESIGN CRITERIA SPREADSHEET FOR WIND PARAMETERS AND PRESSURE CALCULATIONS...

$h = 13\text{ ft}$

WALL - $L/B = 24\text{ ft}/21.6\text{ft} = 1.1 \longrightarrow$
WINDWARD WALL PRESSURE = 14.3 PSF
LEEWARD WALL PRESSURE = -8.7 PSF
INTERNAL WALL PRESSURE = ± 3.8 PSF

WINDWARD WALL PRESSURE = 14.3 PSF - (-3.8 PSF) = 18.1 PSF

OR = 14.3 PSF - (+3.8 PSF) = 10.5 PSF

LEEWARD WALL PRESSURE = -8.7 PSF - (+3.8 PSF) = -12.5 PSF

OR = -8.7 PSF - (-3.8 PSF) = -4.9 PSF

= 5.6 PSF

= 5.6 PSF

ROOF -

NEG. ROOF PRESSURE = -23.3 PSF - (-3.8 psf) = 20.0 psf

POS. ROOF PRESSURE = -3.2 PSF - (3.8 psf) = 7.0 psf

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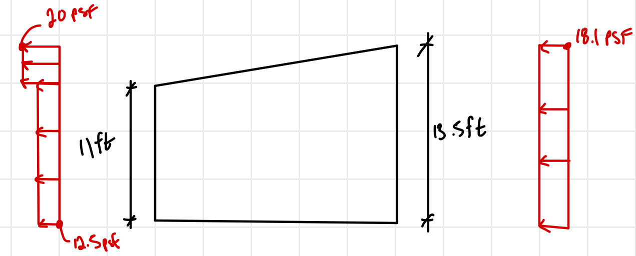
Project: Mercer Island Residence Job No: 21-201
Subject: Garage Sheet Lateral Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland Date: 7-12-21

Wind:

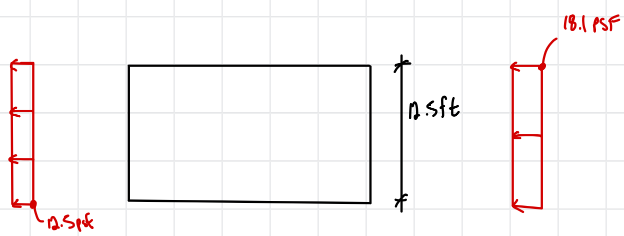
N/S



$$V = (24ft \times 5.5ft)(12.5psf) + (24ft \times 6.75ft)(18.1psf) + (24ft \times 2ft)(20psf) = 5.55^k$$

$$V_{ASD} = 5.55^k(0.6) = \underline{\underline{3.33^k}} > 1.30^k \quad \therefore \text{ WIND CONTROLS}$$

E/W

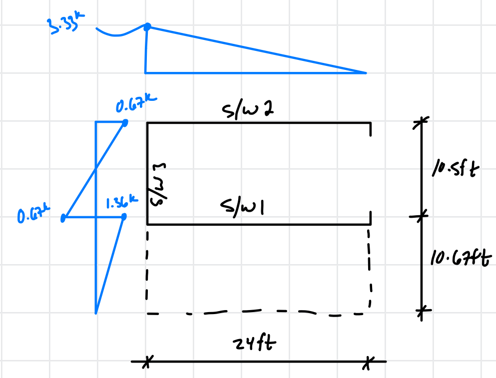


$$V = (12.5psf + 18.1psf)(6.75ft \times 21.67ft) = 4.48^k$$

$$V_{ASD} = 4.48^k(0.6) = \underline{\underline{2.69^k}} > 1.27^k \quad \therefore \text{ WIND CONTROLS}$$

Project: MERCER ISLAND RESIDENCE | Job No: 21-201
Subject: GARAGE | Sheet: LATERAL | Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland | Date: 7-12-21

LATERAL

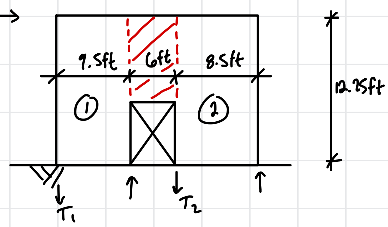


S/W 1

$V = (1.36^k + 0.67^k) = 2.03^k$

$D = (0.104\ klf\ (0.6) = 0.129\ klf$
$+ 0.112\ klf)$

V →



$v = 2.03^k / (9.5ft + 8.5ft) = 0.113\ klf$

USE 10d @ 6" O.C.

OVERTURNING:

2 $\quad 0.113\ klf\ (8.5ft)(12.25ft) - (0.129\ klf)(8.5ft)(8.5ft/2) \leq 8.5ft\ (T_2)$

$T_2 = 0.84^k$

HDU 2 ← CONTROLS FOR 1

FOUNDATION:

TRY 2ft × 1ft CONT. FTG.

$2.03^k\ (13.25ft) \leq (0.129\ klf + 0.300\ klf\ (0.6))\ (24\ ft)\ (12ft)$

$26.9^k \leq 89.0^k$ ✓ OK

SLIDING:

$[(0.129\ klf + 0.180\ klf)\ (24\ ft)\ (0.3)] > 2030\ lb$ ← COEFFICIENT OF FRICTION

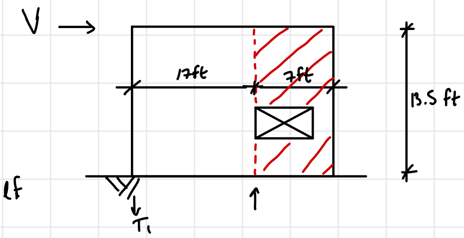
$2{,}224\ lb > 2030\ lb$ ✓ OK

$\boxed{\text{LATERAL}}$

$\boxed{\text{S/W 2}}$

$V = 0.67^k$

$D = (0.052\text{ klf}(0.6) = 0.106\text{ klf}$
$+ 0.125\text{ klf})$



$v = 0.67^k / (17ft) = 0.04\text{ klf}$

$\boxed{\text{USE 10d @ 6" O.C.}}$

OVERTURNING:

(2) $0.04\text{ klf}(17ft)(13.5ft) - (0.106\text{ klf})(17ft)(17ft/2) \le 17ft(T_2)$

$\underline{\underline{T_2 = -0.36^k}}$

$\boxed{\text{No HDU}}$

FOUNDATION:

TRY 2ft x 1ft CONT. FTG.

$0.67^k(14.5ft) \le (0.106\text{ klf} + 0.300\text{ klf}(0.6))(17ft)(8.5ft)$

$9.72^k \le 41.3^k$ √ OK

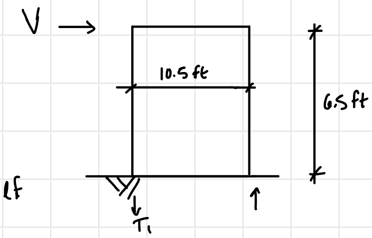
SLIDING: $[(0.106\text{ klf} + 0.180\text{ klf})(17ft)(0.3)] > 670\text{ lb}$

COEFFICIENT OF FRICTION

$\underline{\underline{1,458\text{ lb}}} > 670\text{ lb}$ √ OK

$\boxed{\text{LATERAL}}$

$\boxed{\text{S/W 3}}$



$V = 3.33^k$

$v = 3.33^k / (10.5 ft) = 0.318$ klf

$\boxed{\text{USE 10d @ 6" O.C.}}$

$D = (0.040$ klf $+ 0.117$ klf$)(0.6) = 0.09$ klf

OVERTURNING:

$0.318\ klf\,(10.5\ ft)(6.5\ ft) - (0.09\ klf)(10.5\ ft)(10.5\ ft/2) \le 10.5\ ft\,(T_2)$

$\underline{\underline{T_2 = 1.60^k}}$ $\boxed{\text{HDU 2}}$

FOUNDATION:

TRY 3 ft × 1 ft CONT. FTG.

$3.33^k\,(7.5\ ft) \le (0.09\ klf + 0.525\ klf\,(0.6) + 0.385\ klf\,(12\ ft)(0.6))(12\ ft)(6\ ft) + \underbrace{0.6(0.3\ klf)(4\ ft)(12\ ft)}_{\text{RETURN WALL}}$

SOIL ABOVE

$25.0^k \le 40.7^k$ ✓ ok

SLIDING:

$[(0.09\ klf + 0.315\ klf + 0.075\ klf\,(0.6))(12\ ft) + \underbrace{(0.6)(0.3\ klf)(4\ ft)(2)}_{\text{RETURN WALLS}}](0.3) > 3.33^k$

STEM WALL

$+ 0.385\ klf\,(12\ ft)(0.6)$

SOIL ABOVE

COEFFICIENT OF FRICTION

$+ 350\ pcf\,(1\ ft)(1/2)(10\ ft)$

PASSIVE SOIL RESISTANCE

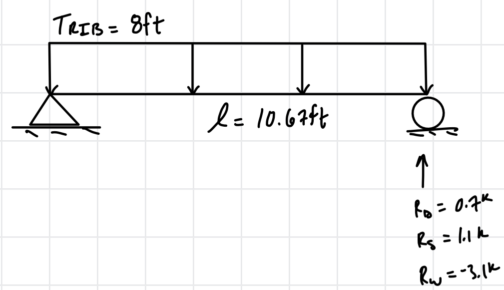
$\underline{\underline{4{,}633\ lb}} > 3{,}330\ lb$ ✓ ok

Project: Mercer Island Residence Job No: 21-201
Subject: Garage Sheet: Gravity Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland Date: 7-12-21

Gravity

See Enercalc for design calcs...

Beams:



W = -723 psf
D = 15 psf
S = 25 psf

USE 3 1/8" x 7 1/2" GLB

Columns:

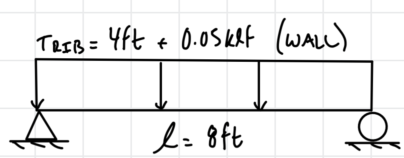
$P_D = R_D = 0.7^k$

$P_S = R_S = 1.1^k$

USE 3 1/8" x 7 1/2" GLB

Headers: By inspection, all headers ✓ok w/ typ. 6x10 header.

Garage Door Header –



D = 15 psf
S = 25 psf

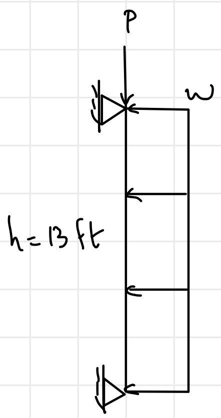
USE 6x10 DF #2

Seattle | 1011 Western Avenue, Suite 810 | Seattle, WA 98104 | 206.292.5076
Tacoma | 1250 Pacific Avenue, Suite 701 | Tacoma, WA 98402 | 253.383.2797
Portland | 101 SW Main Street, Suite 280 | Portland, OR 97204 | 503.232.3746
www.pcs-structural.com

GRAVITY

JAMB STUDS:

SEE SPREADSHEET FOR DESIGN CALCS...



$P_D = 0.5^k$

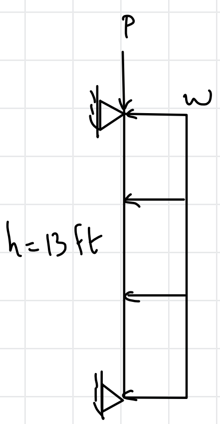
$P_S = 0.4^k$

$W = 29$ psf

$s = 56$ in

USE (1) 2x6 FULL-HT + (1) 2x6 BRG

TYPICAL STUDS



$P_D = 1.4^k$

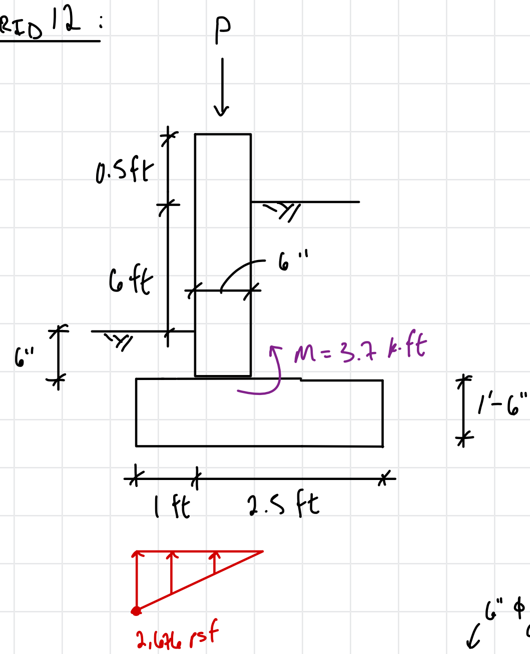
$P_S = 2.2^k$

$W = 29$ psf

$s = 16"$

USE 2x6 @ 16" O.C.

GRID 12:



BACKSLOPE = FLAT
E = 18H
H = 45 pcf (ACTIVE)

P_D = 60 plf + 55plf = 115plf
P_L = 100 plf

USE #5 @ 12" O.C. VERT
(3) #5 LONG (FTG.)
#5 @ 18" O.C. TRANS. (FTG.)

6" ϕ PIN PILE CAPACITY
SPACING
20,000 lb > 3,505 psf (x) ⟶ x < 5.71 ft
TOTAL BEARING LOAD FROM RETAINPRO

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

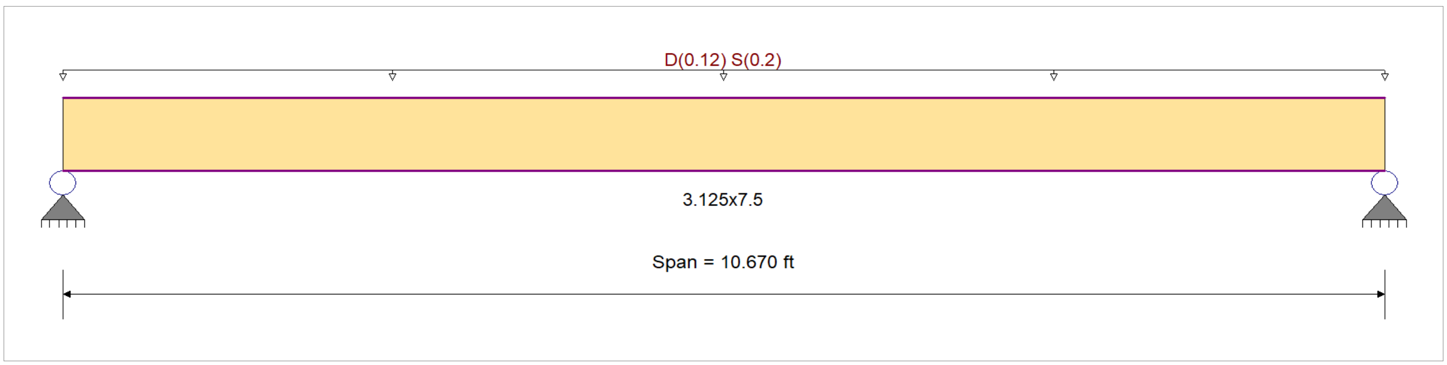
DESCRIPTION: Beams

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,200.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	1,850.0 psi	Ebend- xx	1,800.0 ksi
		Fc - Prll	1,650.0 psi	Eminbend - xx	950.0 ksi
Wood Species	DF/DF	Fc - Perp	650.0 psi	Ebend- yy	1,600.0 ksi
Wood Grade	24F-V/poc1	Fv	265.0 psi	Eminbend - yy	850.0 ksi
		Ft	1,100.0 psi	Density	31.210 pcf
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 loads
Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 8.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.749** : 1	Maximum Shear Stress Ratio	=	**0.364** : 1
Section used for this span		**3.125x7.5**	Section used for this span		**3.125x7.5**
fb: Actual	=	1,894.91 psi	fv: Actual	=	111.00 psi
Fb: Allowable	=	2,530.00 psi	Fv: Allowable	=	304.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	5.335 ft	Location of maximum on span	=	10.670 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.297 in	Ratio =	431 >=360	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.482 in	Ratio =	265 >=240	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 10.670 ft	**1**	0.368	0.179	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.78	729.10	1980.00	0.67	42.71	238.50
+D+S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 10.670 ft	**1**	0.749	0.364	1.15	1.000	1.00	1.00	1.00	1.00	1.00	4.63	1,894.91	2530.00	1.73	111.00	304.75
+D+0.750S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 10.670 ft	**1**	0.634	0.308	1.15	1.000	1.00	1.00	1.00	1.00	1.00	3.91	1,603.46	2530.00	1.47	93.92	304.75
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 10.670 ft	**1**	0.124	0.060	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.07	437.46	3520.00	0.40	25.62	424.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.4822	5.374		0.0000	0.000

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

DESCRIPTION: Beams

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.734	1.734
Overall MINimum	1.067	1.067
D Only	0.667	0.667
+D+S	1.734	1.734
+D+0.750S	1.468	1.468
+0.60D	0.400	0.400
S Only	1.067	1.067

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

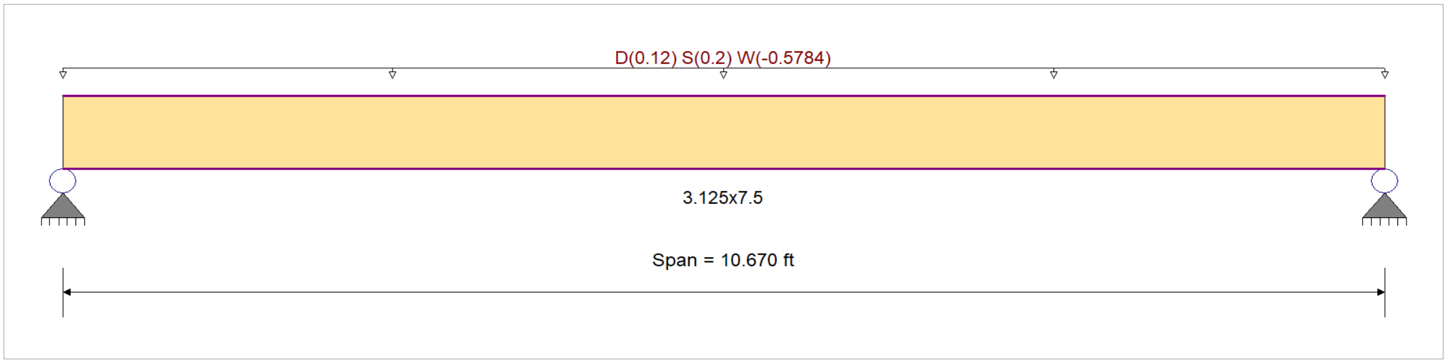
DESCRIPTION: Beams - uplift

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	2,200.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	1,850.0 psi	Ebend- xx	1,800.0 ksi
		Fc - Prll	1,650.0 psi	Eminbend - xx	950.0 ksi
Wood Species	DF/DF	Fc - Perp	650.0 psi	Ebend- yy	1,600.0 ksi
Wood Grade	24F-V/poc1	Fv	265.0 psi	Eminbend - yy	850.0 ksi
		Ft	1,100.0 psi	Density	31.210 pcf
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 loads
Uniform Load : D = 0.0150, S = 0.0250, W = -0.07230 ksf, Tributary Width = 8.0 ft

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio	=	**0.749** : 1	Maximum Shear Stress Ratio	=	**0.322** : 1
Section used for this span		**3.125x7.5**	Section used for this span		**3.125x7.5**
fb: Actual	=	1,894.91 psi	fv: Actual	=	98.03 psi
Fb: Allowable	=	2,530.00 psi	Fv: Allowable	=	304.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	5.335 ft	Location of maximum on span	=	10.047 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

OK

Maximum Deflection

Max Downward Transient Deflection	0.297 in	Ratio =	431 >=360	Span: 1 : S Only
Max Upward Transient Deflection	-0.360 in	Ratio =	355 <360	Span: 1 : +0.420W
Max Downward Total Deflection	0.482 in	Ratio =	265 >=240	Span: 1 : +D+S
Max Upward Total Deflection	-0.105 in	Ratio =	1220 >=240	Span: 1 : +0.60D+0.2520W

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 10.670 ft	**1**	0.368	0.158	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.78	729.10	1980.00	0.59	37.72	238.50
+D+S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 10.670 ft	**1**	0.749	0.322	1.15	1.000	1.00	1.00	1.00	1.00	1.00	4.63	1,894.91	2530.00	1.53	98.03	304.75
+D+0.750S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 10.670 ft	**1**	0.634	0.272	1.15	1.000	1.00	1.00	1.00	1.00	1.00	3.91	1,603.46	2530.00	1.30	82.95	304.75
+D+0.60W					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 10.670 ft	**1**	0.437	0.158	1.60	1.000	1.00	1.00	1.00	1.00	1.00	3.16	1,293.82	2960.00	1.05	66.94	424.00
+D+0.450W					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 10.670 ft	**1**	0.266	0.096	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.92	788.09	2960.00	0.64	40.77	424.00
+D+0.750S+0.450W					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 10.670 ft	**1**	0.025	0.011	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.21	86.27	3520.00	0.07	4.46	424.00
+0.60D+0.60W					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: Beams - uplift

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
Length = 10.670 ft	**1**	0.536	0.193	1.60	1.000	1.00	1.00	1.00	1.00	1.00	3.87	1,585.46	2960.00	1.28	82.02	424.00
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 10.670 ft	**1**	0.124	0.053	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.07	437.46	3520.00	0.35	22.63	424.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.4822	5.374		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	-3.086	-3.086
Overall MINimum	-1.184	-1.184
D Only	0.667	0.667
+D+S	1.734	1.734
+D+0.750S	1.468	1.468
+D+0.60W	-1.184	-1.184
+D+0.450W	-0.721	-0.721
+D+0.750S+0.450W	0.079	0.079
+0.60D+0.60W	-1.451	-1.451
+0.60D	0.400	0.400
S Only	1.067	1.067
W Only	-3.086	-3.086

Wood Column

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: Columns

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Analysis Method	Allowable Stress Design		
End Fixities	Top & Bottom Pinned		
Overall Column Height		10 ft	

(Used for non-slender calculations)

Wood Species	POC/POC		
Wood Grade	20F-V14		
Fb +	1400 psi	Fv	230 psi
Fb -	1450 psi	Ft	1050 psi
Fc - Prll	1900 psi	Density	28.72 pcf
Fc - Perp	470 psi		

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1500	1400	1500 ksi
Minimum	790	740	

Wood Section Name	3.125x7.5
Wood Grading/Manuf.	Western
Wood Member Type	GLB
Exact Width	3.125 in
Exact Depth	7.50 in
Area	23.438 in^2
Ix	109.863 in^4
Iy	19.073 in^4

Allow Stress Modification Factors

Cf or Cv for Bending	1.0
Cf or Cv for Compressio	1.0
Cf or Cv for Tension	1.0
Cm : Wet Use Factor	1.0
Ct : Temperature Fact	1.0
Cfu : Flat Use Factor	1.0
Kf : Built-up columns	1.0 NDS 15.3.2
Use Cr : Repetitive ?	No

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 1(
Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 1(

Applied Loads

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

Column self weight included : 46.746 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 10.0 ft, Xecc = 1.563 in, Yecc = 3.750 in, D = 0.70, S = 1.10 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS	Max. Axial+Bending Stress Ratio =	**0.3533 : 1**
	Load Combination	+D+S
	Governing NDS Forumla	Comp + Mxx + Myy, NDS Eq. 3.9-
	Location of max.above base	9.933 ft
	At maximum location values are .	
	Applied Axial	1.847 k
	Applied Mx	-0.5587 k-ft
	Applied My	-0.2328 k-ft
	Fc : Allowable	429.861 psi
PASS	Maximum Shear Stress Ratio =	**0.01361 : 1**
	Load Combination	+D+S
	Location of max.above base	10.0 ft
	Applied Design Shear	3.60 psi
	Allowable Shear	264.50 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.05625 k	Bottom along Y-Y	0.05625 k
Top along X-X	0.02344 k	Bottom along X-X	0.02344 k

Maximum SERVICE Load Lateral Deflections . . .

Along Y-Y -0.03817 in at 5.839 ft above base
for load combination : +D+S
Along X-X -0.09814 in at 5.839 ft above base
for load combination : +D+S

Other Factors used to calculate allowable stresses . . .

Bending	Compression	Tension

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
D Only	0.900	0.249	0.1521	PASS	9.933 ft	0.006763	PASS	10.0 ft
+D+S	1.150	0.197	0.3533	PASS	9.933 ft	0.01361	PASS	10.0 ft
+D+0.750S	1.150	0.197	0.2896	PASS	9.933 ft	0.01153	PASS	10.0 ft
+0.60D	1.600	0.142	0.05091	PASS	9.933 ft	0.002283	PASS	10.0 ft

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction k @ Base	@ Top	Y-Y Axis Reaction @ Base	@ Top	Axial Reaction @ Base	My - End Moments k-ft @ Base	@ Top	Mx - End Moments @ Base	@ Top
D Only	-0.009	0.009	-0.022	0.022	0.747				
+D+S	-0.023	0.023	-0.056	0.056	1.847				
+D+0.750S	-0.020	0.020	-0.048	0.048	1.572				

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

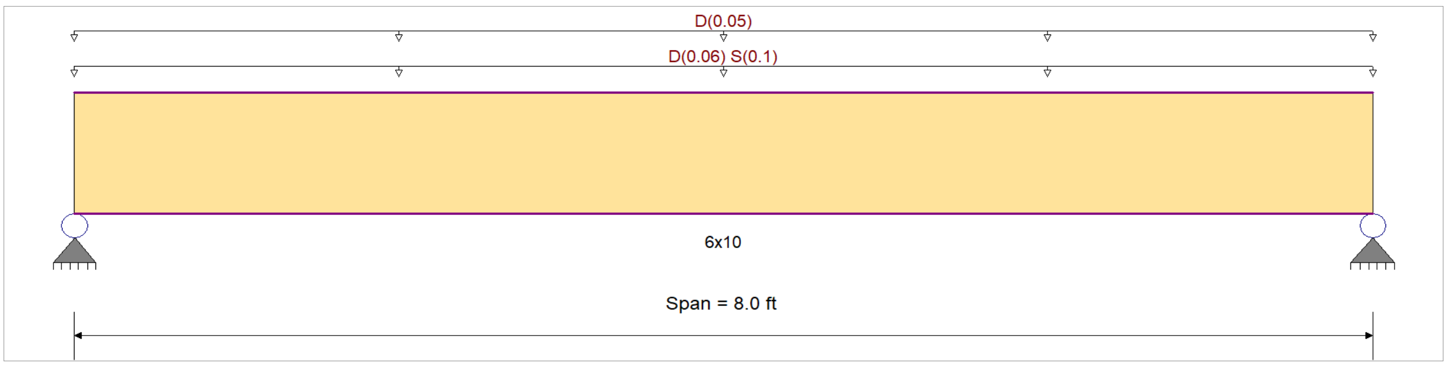
DESCRIPTION: Headers

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	875.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	875.0 psi	Ebend- xx	1,300.0 ksi
		Fc - Prll	600.0 psi	Eminbend - xx	470.0 ksi
Wood Species	Douglas Fir-Larch	Fc - Perp	625.0 psi		
Wood Grade	No.2	Fv	170.0 psi		
		Ft	425.0 psi	Density	31.210 pcf
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 loads
Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 4.0 ft
Uniform Load : D = 0.050 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.255** : 1	Maximum Shear Stress Ratio	=	**0.104** : 1
Section used for this span		**6x10**	Section used for this span		**6x10**
fb: Actual	=	256.83 psi	fv: Actual	=	20.41 psi
Fb: Allowable	=	1,006.25 psi	Fv: Allowable	=	195.50 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	4.000 ft	Location of maximum on span	=	7.212 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.018 in	Ratio =	5290 >=360	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.040 in	Ratio =	2390 >=240	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 8.0 ft	1	0.179	0.073	0.90	1.000	1.00	1.00	1.00	1.00	1.00	0.97	140.79	787.50	0.39	11.19	153.00
+D+S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 8.0 ft	1	0.255	0.104	1.15	1.000	1.00	1.00	1.00	1.00	1.00	1.77	256.83	1006.25	0.71	20.41	195.50
+D+0.750S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 8.0 ft	1	0.226	0.093	1.15	1.000	1.00	1.00	1.00	1.00	1.00	1.57	227.82	1006.25	0.63	18.10	195.50
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 8.0 ft	1	0.060	0.025	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.58	84.47	1400.00	0.23	6.71	272.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.0402	4.029		0.0000	0.000

Wood Beam

Project Filename: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.21.8.4 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: Headers

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.885	0.885
Overall MINimum	0.400	0.400
D Only	0.485	0.485
+D+S	0.885	0.885
+D+0.750S	0.785	0.785
+0.60D	0.291	0.291
S Only	0.400	0.400

Wood Column

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.22.4.16 | PCS STRUCTURAL SOLUTIONS |

DESCRIPTION: Columns

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Analysis Method: Allowable Stress Design
End Fixities: Top & Bottom Pinned
Overall Column Height: 11 ft
(Used for non-slender calculations)

Wood Species: POC/POC
Wood Grade: 20F-V14

Fb +	1,400.0 psi	Fv	230.0 psi
Fb -	1,450.0 psi	Ft	1,050.0 psi
Fc - Prll	1,900.0 psi	Density	28.720 pcf
Fc - Perp	470.0 psi		

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1,500.0	1,400.0	1,500.0 ksi
Minimum	790.0	740.0	

Wood Section Name: **3.125x7.5**
Wood Grading/Manuf.: Western
Wood Member Type: GLB

Exact Width	**3.125** in
Exact Depth	**7.50** in
Area	23.438 in^2
Ix	109.863 in^4
Iy	19.073 in^4

Allow Stress Modification Factors

Cf or Cv for Bending	1.0	
Cf or Cv for Compressio	1.0	
Cf or Cv for Tension	1.0	
Cm : Wet Use Factor	1.0	
Ct : Temperature Fact	1.0	
Cfu : Flat Use Factor	1.0	
Kf : Built-up columns	1.0	*NDS 15.3.2*
Use Cr : Repetitive ?	No	

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 1'
Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 1'

Applied Loads

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

Column self weight included : 51.420 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 11.0 ft, Xecc = 1.563 in, Yecc = 3.750 in, D = 0.70, S = 1.10 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio = **0.3793 : 1**

Load Combination	+D+S
Governing NDS Forumla	Comp + Mxx + Myy, NDS Eq. 3.9-
Location of max.above base	10.926 ft
At maximum location values are .	
Applied Axial	1.851 k
Applied Mx	-0.5587 k-ft
Applied My	-0.2328 k-ft
Fc : Allowable	356.986 psi

PASS Maximum Shear Stress Ratio = **0.01237 : 1**

Load Combination	+D+S
Location of max.above base	11.0 ft
Applied Design Shear	3.273 psi
Allowable Shear	264.50 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.05114 k	Bottom along Y-Y	0.05114 k
Top along X-X	0.02131 k	Bottom along X-X	0.02131 k

Maximum SERVICE Load Lateral Deflections . . .

Along Y-Y -0.04618 in at 6.423 ft above base
for load combination : +D+S
Along X-X -0.1188 in at 6.423 ft above base
for load combination : +D+S

Other Factors used to calculate allowable stresses . . .

Bending	Compression	Tension

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
D Only	0.900	0.207	0.1564	PASS	10.926 ft	0.006148	PASS	11.0 ft
+D+S	1.150	0.163	0.3793	PASS	10.926 ft	0.01237	PASS	11.0 ft
+D+0.750S	1.150	0.163	0.3080	PASS	10.926 ft	0.01048	PASS	11.0 ft
+0.60D	1.600	0.118	0.05356	PASS	0.0 ft	0.002075	PASS	11.0 ft

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction (k) @ Base	@ Top	Y-Y Axis Reaction @ Base	@ Top	Axial Reaction @ Base	My - End Moments (k-ft) @ Base	@ Top	Mx - End Moments @ Base	@ Top
D Only	-0.008	0.008	-0.020	0.020	0.751				
+D+S	-0.021	0.021	-0.051	0.051	1.851				
+D+0.750S	-0.018	0.018	-0.043	0.043	1.576				

Wood Column

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.22.4.16 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: Columns

Maximum Reactions

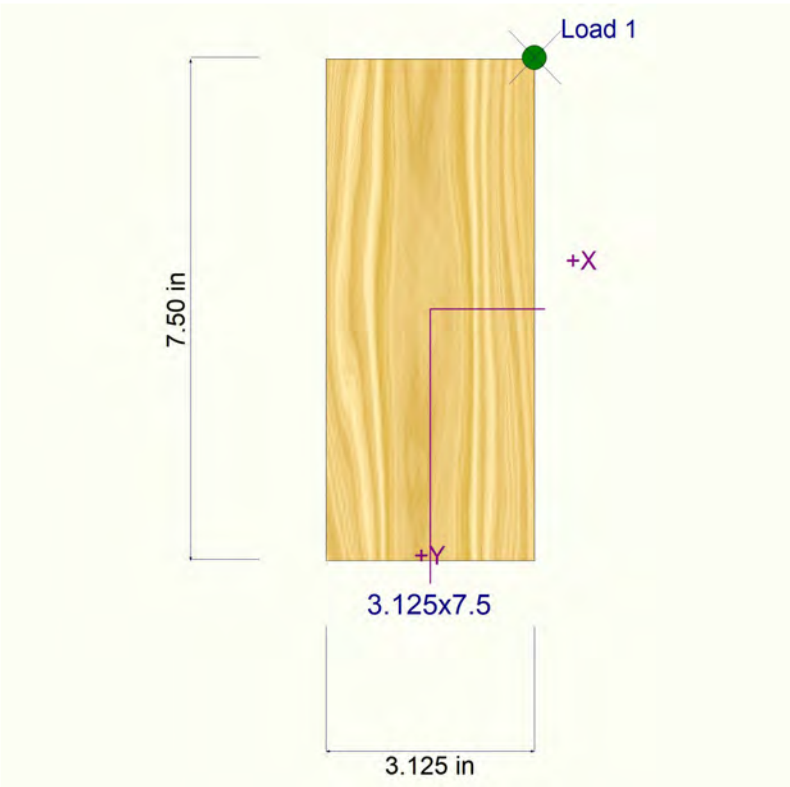
Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction k @ Base	X-X Axis Reaction k @ Top	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Axial Reaction @ Base	My - End Moments k-ft @ Base	My - End Moments k-ft @ Top	Mx - End Moments @ Base	Mx - End Moments @ Top
+0.60D	-0.005	0.005	-0.012	0.012	0.451				
S Only	-0.013	0.013	-0.031	0.031	1.100				

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	-0.0462 in	6.423 ft	-0.018 in	6.423 ft
+D+S	-0.1188 in	6.423 ft	-0.046 in	6.423 ft
+D+0.750S	-0.1006 in	6.423 ft	-0.039 in	6.423 ft
+0.60D	-0.0277 in	6.423 ft	-0.011 in	6.423 ft
S Only	-0.0726 in	6.423 ft	-0.028 in	6.423 ft

Sketches

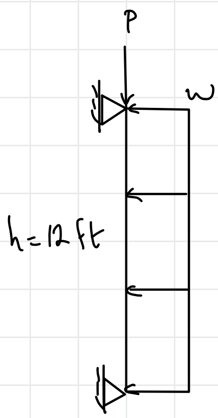


PCS Structural Solutions

Project: Mercer Island Residence | Job No: 21-201
Subject: Garage | Sheet: Gravity | Name: BRT
Originating Office: ☐ Seattle ☒ Tacoma ☐ Portland | Date: 7-12-21

$\boxed{\text{GRAVITY}}$

JAMB STUDS: SEE SPREADSHEET FOR DESIGN CALCS...



$P_D = 0.5^k$

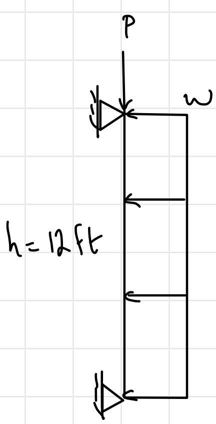
$P_S = 0.4^k$

$W = 29$ psf

$s = 56$ in

$\boxed{\text{USE (1) 2x6 FULL-HT + (1) 2x6 BRG}}$

TYPICAL STUDS



$P_D = 1.4^k$

$P_S = 2.2^k$

$W = 29$ psf

$s = 16"$

$\boxed{\text{USE 2x6 @ 16" O.C.}}$

Seattle | 1011 Western Avenue, Suite 810 | Seattle, WA 98104 | 206.292.5076
Tacoma | 1250 Pacific Avenue, Suite 701 | Tacoma, WA 98402 | 253.383.2797
Portland | 101 SW Main Street, Suite 280 | Portland, OR 97204 | 503.232.3746
www.pcs-structural.com

PCS Structural Solutions

STUD WALL DESIGN - Garage

2018 NDS/2018 IBC

WALL DATA

LUMBER TYPE: DF#2/HF#1

F_b = 900 PSI
F_c = 1350 PSI
$F_{c\perp}$ = 405 PSI
E = 1.50E+06 PSI

APPLIED LOADS:

W_{WIND} = 29.0 PSF
$W_{SEISMIC}$ = 0.0 PSF

P_{DEAD} = 1400 LBS
P_{LIVE} = 0 LBS
P_{SNOW} = 2200 LBS
P_{WIND} = 0 LBS
$P_{SEISMIC}$ = 0 LBS

STUD SIZE: (1) 2x6

A_X = 8.25 IN^2
S_X = 7.56 IN^3
I_X = 20.80 IN^4
$C_{F(BENDING)}$ = 1.3 (NDS 4.3.6)
F_{cE} = 559.4 PSI
C_b = 1.25 (NDS 3.10.4)

MISCELLANEOUS:

HEIGHT = 13 FT
SPACING = 16 IN
ECCENTRICITY = 0.1 IN
$C_{F(COMPRESSION)}$ = 1.10 (NDS 4.3.6)

		APPLY?	
$C_{SYS(BENDING)}$ =	1.35	YES	(SDPWS T3.1.1.1)
$C_{r(BENDING)}$ =	1.15	YES	(NDS 4.3.9)

LOAD CASES - IBC 1605.3.1

CASE 1	DEAD + LIVE + 5 PSF LAT.
CASE 2	DEAD + SNOW + 5 PSF LAT.
CASE 3	DEAD + 0.75LIVE + 0.75SNOW + 5 PSF LAT.
CASE 4	DEAD + 0.45WIND + 0.75LIVE + 0.75SNOW
CASE 5	DEAD + 0.60WIND
CASE 6	DEAD + 0.7SEISMIC
CASE 7	DEAD + 0.53SEISMIC + 0.75LIVE + 0.75SNOW

ALLOWABLE STRESSES - Cd PER NDS T2.3.2, Cp PER NDS 3.7.1, ASSUME Cm, Ct, Ci, CL = 1.0

CASE	C_D	F_c^*	F_{cE}/F_c^*	C_P	F_c'	F_b'	$F_{c\perp}$
1	1.00	1485	0.38	0.341	507	1346	506
2 & 3	1.15	1708	0.33	0.302	515	1547	506
4 & 5	1.60	2376	0.24	0.223	529	2527	506
6 & 7	1.60	2376	0.24	0.223	529	2153	506

APPLIED STRESSES - NDS CHAPTER 3 DESIGN EQUATIONS

CASE	$P_{APPLIED}$	f_c	$M_{LAT. LOAD}$	$M_{ECC.}$	M_{TOTAL}	f_b
1	1400	170	141	12	148	235
2	3600	436	141	30	160	253
3	3050	370	141	25	157	249
4	3050	370	368	25	383	608
5	1400	170	490	12	497	789
6	1400	170	0	12	7	12
7	3050	370	0	25	16	25

DESIGN CHECKS - COMBINED STRESS CHECK PER NDS EQN 3.9-3

CASE	f_c/F_c'	f_b/F_b'	$f_c/F_{c\perp}$	Combined	f_c/F_{cE}	Deflection	L/?
1	0.33	0.17	0.34	0.36	0.30	0.14	L/1080
2	0.85	0.16	0.86	1.46	0.78	0.16	L/1002
3	0.72	0.16	0.73	0.99	0.66	0.15	L/1021
4*	0.70	0.24	0.73	1.20	0.66	0.19	L/805
5*	0.32	0.31	0.34	0.55	0.30	0.25	L/620
6	0.32	0.01	0.34	0.11	0.30	0.01	L/21940
7	0.70	0.01	0.73	0.52	0.66	0.02	L/10071
MAX. --->	0.85	0.31	0.86	1.46	0.78	0.25	L/620
	O.K.	O.K.	O.K.	N.G.	O.K.		

* Deflections reduced by 0.42 per IBC Table 1604.3 footnote f. Increase deflection by 1.4 for jambs supporting glass.

PLATE BENDING - *ALIGN STUDS WITH JOISTS WHERE POSSIBLE*

MISCELLANEOUS:

C_{fu} = 1.15 (NDS 4.3.7)
F_V = 150 PSI

ALLOWABLE STRESSES:

F_V' = 173 PSI
F_b' = 1547 PSI

STUD REACTIONS (OUT - OF - PLANE)

251 LB

DBL TOP PLATE PROPERTIES:

A_X = 16.50 IN^2
S_X = 4.13 IN^3
I_X = 3.09 IN^4

APPLIED STRESSES:

f_v = 218 PSI <--- N.G.
f_b = 3491 PSI <--- N.G.
Δ_{MAX} = 0.066 IN

Project: MERCER ISLAND RESIDENCE Job Number: 21-201

Sheet: ____ of ____ Name: BRT

Originating Office: Tacoma Date: 04/19/22

PCS Structural Solutions

BEARING STUD DESIGN - Garage Brg

2018 NDS/2018 IBC

WALL DATA

LUMBER TYPE: DF#2/HF#1

F_b =	900	PSI	
F_c =	1350	PSI	
$F_{c\perp}$ =	405	PSI	
E =	1.50E+06	PSI	

APPLIED LOADS:

W_{WIND} =	0.0 PSF	P_{DEAD} =	500	LBS
$W_{SEISMIC}$ =	0.0 PSF	P_{LIVE} =	0	LBS
		P_{SNOW} =	400	LBS
		P_{WIND} =	0	LBS
		$P_{SEISMIC}$ =	0	LBS

STUD SIZE: (1) 2x6

A_X =	8.25	IN^2
S_X =	7.56	IN^3
I_X =	20.80	IN^4
$C_{F(BENDING)}$ =	1.3	(NDS 4.3.6)
F_{cE} =	559.4	PSI
C_b =	1.25	(NDS 3.10.4)

MISCELLANEOUS:

HEIGHT =	13	FT	
SPACING =	0	IN	
ECCENTRICITY =	0.1	IN	
$C_{F(COMPRESSION)}$ =	1.10	(NDS 4.3.6)	
		APPLY?	
$C_{SYS(BENDING)}$ =	1.00	NO	(SDPWS T3.1.1.1)
$C_{r(BENDING)}$ =	1.00	NO	(NDS 4.3.9)

LOAD CASES - IBC 1605.3.1

CASE 1	DEAD + LIVE + 5 PSF LAT.	CASE 4	DEAD + 0.45WIND + 0.75LIVE + 0.75SNOW
CASE 2	DEAD + SNOW + 5 PSF LAT.	CASE 5	DEAD + 0.60WIND
CASE 3	DEAD + 0.75LIVE + 0.75SNOW + 5 PSF LAT.	CASE 6	DEAD + 0.7SEISMIC
		CASE 7	DEAD + 0.53SEISMIC + 0.75LIVE + 0.75SNOW

ALLOWABLE STRESSES - Cd PER NDS T2.3.2, Cp PER NDS 3.7.1, ASSUME Cm, Ct, Ci, CL = 1.0

CASE	C_D	F_c*	F_{cE}/F_c*	C_P	F_c'	F_b'	$F_{c\perp}$
1	1.00	1485	0.38	0.341	507	1170	506
2 & 3	1.15	1708	0.33	0.302	515	1346	506
4 & 5	1.60	2376	0.24	0.223	529	1872	506
6 & 7	1.60	2376	0.24	0.223	529	1872	506

APPLIED STRESSES - NDS CHAPTER 3 DESIGN EQUATIONS

CASE	$P_{APPLIED}$	f_c	$M_{LAT.\ LOAD}$	$M_{ECC.}$	M_{TOTAL}	f_b
1	500	61	0	4	3	4
2	900	109	0	8	5	7
3	800	97	0	7	4	7
4	800	97	0	7	4	7
5	500	61	0	4	3	4
6	500	61	0	4	3	4
7	800	97	0	7	4	7

DESIGN CHECKS - COMBINED STRESS CHECK PER NDS EQN 3.9-3

CASE	f_c/F_c'	f_b/F_b'	$f_c/F_{c\perp}$	Combined	f_c/F_{cE}	Deflection	L/?
1	0.12	0.00	0.12	0.02	0.11	0.00	L/61431
2	0.21	0.01	0.22	0.05	0.20	0.00	L/34128
3	0.19	0.00	0.19	0.04	0.17	0.00	L/38394
4*	0.18	0.00	0.19	0.04	0.17	0.00	L/54849
5*	0.11	0.00	0.12	0.02	0.11	0.00	L/87758
6	0.11	0.00	0.12	0.02	0.11	0.00	L/61431
7	0.18	0.00	0.19	0.04	0.17	0.00	L/38394
MAX. --->	0.21	0.01	0.22	0.05	0.20	0.00	L/34128
	O.K.	O.K.	O.K.	O.K.	O.K.		

* Deflections reduced by 0.42 per IBC Table 1604.3 footnote f. Increase deflection by 1.4 for jambs supporting glass.

PCS Structural Solutions

Project: MERCER ISLAND RESIDENCE | Job Number: 21-201

Sheet: ____ of ____ | Name: BRT

Originating Office: Tacoma | Date: 04/19/22

FULL HT STUD DESIGN - Garage Full Ht

2018 NDS/2018 IBC

WALL DATA

LUMBER TYPE: DF#2/HF#1

F_b = 900 PSI

F_c = 1350 PSI

$F_{c\perp}$ = 405 PSI

E = 1.50E+06 PSI

APPLIED LOADS:

W_{WIND} = 29.0 PSF

$W_{SEISMIC}$ = 5.0 PSF

P_{DEAD} = 0 LBS

P_{LIVE} = 0 LBS

P_{SNOW} = 0 LBS

P_{WIND} = 0 LBS

$P_{SEISMIC}$ = 0 LBS

STUD SIZE: (3) 2x6

A_X = 24.75 IN^2

S_X = 22.69 IN^3

I_X = 62.39 IN^4

$C_{F(BENDING)}$ = 1.3 (NDS 4.3.6)

F_{cE} = 559.4 PSI

C_b = 1.08 (NDS 3.10.4)

MISCELLANEOUS:

HEIGHT = 13 FT

SPACING = 56 IN

ECCENTRICITY = 0.1 IN

$C_{F(COMPRESSION)}$ = 1.10 (NDS 4.3.6)

		APPLY?	
$C_{SYS(BENDING)}$ =	1.00	NO	(SDPWS T3.1.1.1)
$C_{r(BENDING)}$ =	1.00	NO	(NDS 4.3.9)

LOAD CASES - IBC 1605.3.1

CASE 1	DEAD + LIVE + 5 PSF LAT.	CASE 4	DEAD + 0.45WIND + 0.75LIVE + 0.75SNOW
CASE 2	DEAD + SNOW + 5 PSF LAT.	CASE 5	DEAD + 0.60WIND
CASE 3	DEAD + 0.75LIVE + 0.75SNOW + 5 PSF LAT.	CASE 6	DEAD + 0.7SEISMIC
		CASE 7	DEAD + 0.53SEISMIC + 0.75LIVE + 0.75SNOW

ALLOWABLE STRESSES - Cd PER NDS T2.3.2, Cp PER NDS 3.7.1, ASSUME Cm, Ct, Ci, CL = 1.0

CASE	C_D	F_c*	F_{cE}/F_c*	C_P	F_c'	F_b'	$F_{c\perp}$
1	1.00	1485	0.38	0.341	507	1170	439
2 & 3	1.15	1708	0.33	0.302	515	1346	439
4 & 5	1.60	2376	0.24	0.223	529	1872	439
6 & 7	1.60	2376	0.24	0.223	529	1872	439

APPLIED STRESSES - NDS CHAPTER 3 DESIGN EQUATIONS

CASE	$P_{APPLIED}$	f_c	$M_{LAT.\ LOAD}$	$M_{ECC.}$	M_{TOTAL}	f_b
1	0	0	493	0	493	261
2	0	0	493	0	493	261
3	0	0	493	0	493	261
4	0	0	1287	0	1287	680
5	0	0	1715	0	1715	907
6	0	0	345	0	345	183
7	0	0	261	0	261	138

DESIGN CHECKS - COMBINED STRESS CHECK PER NDS EQN 3.9-3

CASE	f_c/F_c'	f_b/F_b'	$f_c/F_{c\perp}$	Combined	f_c/F_{cE}	Deflection	L/?
1	0.00	0.22	0.00	0.22	0.00	0.16	L/974
2	0.00	0.19	0.00	0.19	0.00	0.16	L/974
3	0.00	0.19	0.00	0.19	0.00	0.16	L/974
4*	0.00	0.36	0.00	0.36	0.00	0.29	L/533
5*	0.00	0.48	0.00	0.48	0.00	0.39	L/400
6	0.00	0.10	0.00	0.10	0.00	0.11	L/1391
7	0.00	0.07	0.00	0.07	0.00	0.08	L/1837
MAX. --->	0.00	0.48	0.00	0.48	0.00	0.39	L/400
	O.K.	O.K.	O.K.	O.K.	O.K.		

* Deflections reduced by 0.42 per IBC Table 1604.3 footnote f. Increase deflection by 1.4 for jambs supporting glass.

PLATE BENDING - *ALIGN STUDS WITH JOISTS WHERE POSSIBLE*

MISCELLANEOUS:

C_{fu} = 1.15 (NDS 4.3.7)

F_v = 150 PSI

ALLOWABLE STRESSES:

F_v' = 150 PSI

F_b' = 1346 PSI

STUD REACTIONS (OUT - OF - PLANE)
880 LB

DBL TOP PLATE PROPERTIES:

A_X = 16.50 IN^2

S_X = 4.13 IN^3

I_X = 3.09 IN^4

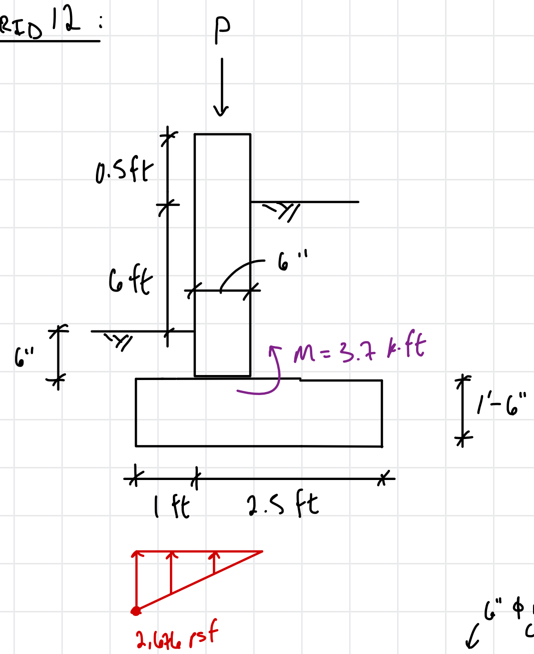
APPLIED STRESSES:

f_v = 0 PSI <--- O.K.

f_b = 0 PSI <--- O.K.

Δ_{MAX} = 0.000 IN

Grid 12:



Backslope = Flat

E = 18H

H = 45 pcf (Active)

P_D = 60 plf + 55 plf = 115 plf

P_L = 100 plf

USE #5 @ 12" O.C. VERT

(3) #5 LONG (FTG.)

#5 @ 18" O.C. TRANS. (FTG.)

6" ϕ PIN PILE CAPACITY

SPACING

20,000 lb > 3,505 psf (x) ⟶ x < 5.71 ft

TOTAL BEARING LOAD FROM RETAINPRO

This Wall in File: \\pcs-fileserver\data\2021 jobs\21201 mercer island residence\calcs\retainpro\212

RetainPro (c) 1987-2018, Build 11.18.12.04
License : KW-06057733
License To : PCS STRUCTURAL SOLUTIONS

Cantilevered Retaining Wall

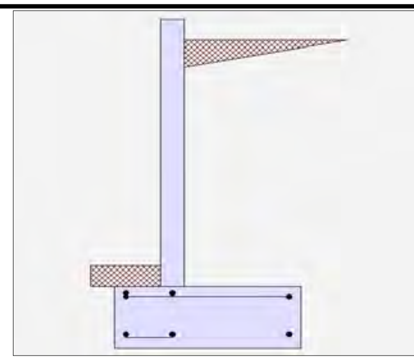
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	63.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	115.0 lbs
Axial Live Load	=	100.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.66 OK
Sliding	=	1.16 Ratio < 1.5!
Total Bearing Load	=	3,505 lbs
...resultant ecc.	=	13.52 in
Soil Pressure @ Toe	=	2,676 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	3,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	3,640 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	0.4 psi OK
Footing Shear @ Heel	=	9.3 psi OK
Allowable	=	82.2 psi

Sliding Calcs

Lateral Sliding Force	=	1,771.9 lbs
less 100% Passive Force	= -	525.0 lbs
less 100% Friction Force	= -	1,532.3 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	600.6 lbs NG

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

		2nd	Bottom
		Stem OK	Stem OK
Design Height Above Ftg	ft =	6.50	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Design Method	=	LRFD	LRFD
Thickness	=	6.00	6.00
Rebar Size	=	# 5	# 5
Rebar Spacing	=	12.00	12.00
Rebar Placed at	=	Center	Center
Design Data			
fb/FB + fa/Fa	=	**-0.001**	**0.938**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =		1,814.4
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =		3,628.8
Moment.....Allowable	ft-# =	3,866.1	3,866.1
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =		50.4
Shear.....Allowable	psi =	94.9	94.9
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	3.00	3.00
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	90.0	90.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	4,000.0	4,000.0
Fy	psi =	60,000.0	60,000.0

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0 in2/ft		
(4/3) * As :	0 in2/ft	Min Stem T&S Reinf Area 0.000 in2	
200bd/fy : 200(12)(3)/60000 :	0.12 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.000 in2/ft	
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.1296 in2/ft	#4@ 0.00 in	#4@ 0.00 in
Provided Area :	0.31 in2/ft	#5@ 0.00 in	#5@ 0.00 in
Maximum Area :	0.6503 in2/ft	#6@ 0.00 in	#6@ 0.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.3008 in2/ft		
(4/3) * As :	0.401 in2/ft	Min Stem T&S Reinf Area 0.936 in2	
200bd/fy : 200(12)(3)/60000 :	0.12 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft	
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.3008 in2/ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.31 in2/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.6503 in2/ft	#6@ 36.67 in	#6@ 73.33 in

Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	3.00
Total Footing Width	=	4.00
Footing Thickness	=	18.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	2.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 3.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	3,640	0 psf
Mu' : Upward	=	1,588	325 ft-#
Mu' : Downward	=	168	3,319 ft-#
Mu: Design	=	1,420	2,994 ft-#
Actual 1-Way Shear	=	0.39	9.29 psi
Allow 1-Way Shear	=	43.82	43.82 psi

Toe Reinforcing = # 5 @ 17.99 in
Heel Reinforcing = # 5 @ 17.99 in
Key Reinforcing = None Spec'd

Other Acceptable Sizes & Spacings

Toe: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area 1.56 in2
Min footing T&S reinf Area per foot 0.39 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

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Cantilevered Retaining Wall Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

.....OVERTURNING.....

Item		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,771.9	2.50	4,429.7
Surcharge over Heel	=			
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=			
Load @ Stem Above Soil	=			
	=			
Total		1,771.9	**O.T.M.**	4,429.7
	=		=	

Resisting/Overturning Ratio = **1.66**
Vertical Loads used for Soil Pressure = 3,505.0 lbs

.....RESISTING.....

Item		Force lbs	Distance ft	Moment ft-#
Soil Over Heel	=	1,650.0	2.75	4,537.5
Sloped Soil Over Heel	=			
Surcharge Over Heel	=			
Adjacent Footing Load	=			
Axial Dead Load on Stem	=	215.0	1.25	268.8
* Axial Live Load on Stem	=	100.0	1.25	125.0
Soil Over Toe	=	55.0	0.50	27.5
Surcharge Over Toe	=			
Stem Weight(s)	=	585.0	1.25	731.3
Earth @ Stem Transitions	=			
Footing Weight	=	900.0	2.00	1,800.0
Key Weight	=		2.00	
Vert. Component	=			
Total =		3,405.0 lbs	**R.M.=**	7,365.0

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.121	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

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RetainPro (c) 1987-2018, Build 11.18.12.04
License : KW-06057733
License To : PCS STRUCTURAL SOLUTIONS

Cantilevered Retaining Wall

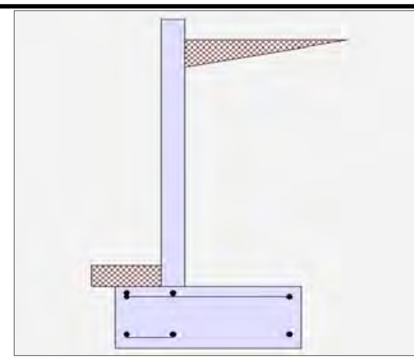
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	63.0 psf/ft
	=	
Passive Pressure	=	350.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.450
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	115.0 lbs
Axial Live Load	=	100.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Seismic (E) (Service Level)
Wind on Exposed Stem (Strength Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	1.66 OK
Sliding	=	1.16 Ratio < 1.5!
Total Bearing Load	=	3,505 lbs
...resultant ecc.	=	13.52 in
Soil Pressure @ Toe	=	2,676 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	3,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	3,640 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	0.4 psi OK
Footing Shear @ Heel	=	9.3 psi OK
Allowable	=	82.2 psi

Sliding Calcs

Lateral Sliding Force	=	1,771.9 lbs
less 100% Passive Force	= -	525.0 lbs
less 100% Friction Force	= -	1,532.3 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	600.6 lbs NG

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

		2nd	Bottom
		Stem OK	Stem OK
Design Height Above Ftg	ft =	6.50	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Design Method	=	LRFD	LRFD
Thickness	=	6.00	6.00
Rebar Size	=	# 5	# 5
Rebar Spacing	=	12.00	12.00
Rebar Placed at	=	Center	Center
Design Data			
fb/FB + fa/Fa	=	**-0.001**	**0.938**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =		1,814.4
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =		3,628.8
Moment.....Allowable	ft-# =	3,866.1	3,866.1
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =		50.4
Shear.....Allowable	psi =	94.9	94.9
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	3.00	3.00
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	90.0	90.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	4,000.0	4,000.0
Fy	psi =	60,000.0	60,000.0

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0 in2/ft		
(4/3) * As :	0 in2/ft	Min Stem T&S Reinf Area 0.000 in2	
200bd/fy : 200(12)(3)/60000 :	0.12 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.000 in2/ft	
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.1296 in2/ft	#4@ 0.00 in	#4@ 0.00 in
Provided Area :	0.31 in2/ft	#5@ 0.00 in	#5@ 0.00 in
Maximum Area :	0.6503 in2/ft	#6@ 0.00 in	#6@ 0.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.3008 in2/ft		
(4/3) * As :	0.401 in2/ft	Min Stem T&S Reinf Area 0.936 in2	
200bd/fy : 200(12)(3)/60000 :	0.12 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft	
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :	
	============	One layer of :	Two layers of :
Required Area :	0.3008 in2/ft	#4@ 16.67 in	#4@ 33.33 in
Provided Area :	0.31 in2/ft	#5@ 25.83 in	#5@ 51.67 in
Maximum Area :	0.6503 in2/ft	#6@ 36.67 in	#6@ 73.33 in

Footing Dimensions & Strengths

Toe Width	=	1.00 ft
Heel Width	=	3.00
Total Footing Width	=	4.00
Footing Thickness	=	18.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	2.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 3.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	3,640	0 psf
Mu' : Upward	=	1,588	325 ft-#
Mu' : Downward	=	168	3,319 ft-#
Mu: Design	=	1,420	2,994 ft-#
Actual 1-Way Shear	=	0.39	9.29 psi
Allow 1-Way Shear	=	43.82	43.82 psi
Toe Reinforcing	=	# 5 @ 17.99 in	
Heel Reinforcing	=	# 5 @ 17.99 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined

Min footing T&S reinf Area 1.56 in2
Min footing T&S reinf Area per foot 0.39 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 6.17 in	#4@ 12.35 in
#5@ 9.57 in	#5@ 19.14 in
#6@ 13.58 in	#6@ 27.16 in

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

.....OVERTURNING.....

Item		Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,771.9	2.50	4,429.7
Surcharge over Heel	=			
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=			
Load @ Stem Above Soil	=			
	=			
Total		1,771.9	**O.T.M.**	4,429.7
	=		=	

Resisting/Overturning Ratio = **1.66**
Vertical Loads used for Soil Pressure = 3,505.0 lbs

.....RESISTING.....

		Force lbs	Distance ft	Moment ft-#
Soil Over Heel	=	1,650.0	2.75	4,537.5
Sloped Soil Over Heel	=			
Surcharge Over Heel	=			
Adjacent Footing Load	=			
Axial Dead Load on Stem	=	215.0	1.25	268.8
* Axial Live Load on Stem	=	100.0	1.25	125.0
Soil Over Toe	=	55.0	0.50	27.5
Surcharge Over Toe	=			
Stem Weight(s)	=	585.0	1.25	731.3
Earth @ Stem Transitions	=			
Footing Weight	=	900.0	2.00	1,800.0
Key Weight	=		2.00	
Vert. Component	=			
Total =		3,405.0 lbs	**R.M.=**	7,365.0

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus 250.0 pci

Horizontal Defl @ Top of Wall (approximate only) 0.121 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

SHED

Project:	MERCER ISLAND RESIDENCE (SHED)	Job Number:	21-201
Sheet:	of	Name:	BRT
Originating Office:	Tacoma	Date:	5/25/2021

PCS Structural Solutions

DESIGN CRITERIA CHECKLIST

CODE: IBC 2018, ASCE 7-16

LOCATION: MERCER ISLAND, WA

VERTICAL DESIGN CRITERIA

	DEAD	LIVE	PARTITION	CONCENTRATED
ROOF:	10 PSF	25 PSF		

WIND DESIGN CRITERIA

BASIC WIND SPEED (V) =	97 MPH	(Per ASCE 7-16 Sec. 26.5.1, Fig. 26.5-1A; 1B; 1C & 1D, or as required by Bld'g Dept.)
RISK CATEGORY:	II	(Per ASCE 7-16 Table 1.5-1 & IBC Table 1604.5)
EXPOSURE CATEGORY:	D	(Per ACSE 7-16 Section 26.7.3)
DIRECTIONALITY FACTOR (K_d):	0.85	(Per ASCE 7-16 Table 26.6-1)
GUST EFFECT FACTOR (G):	0.85	(Per ASCE 7-16 Section 26.11)
TOPOGRAPHIC FACTOR (K_{zt}):	1.00	(Per ASCE 7-16 Section 26.8.2)
MEAN ROOF HEIGHT:	0-15 FT	(See ASCE 7-16 Section 26.2 - Definitions)
ELEVATION:	0 FT	(See ASCE 7-16 Section 26.9)
ENCLOSURE CLASSIFICATION:	Partially Enclosed	(See ASCE 7-16 Secion 26.2 & Table 26.13-1)
ROOF TYPE:	Monoslope	(See ASCE 7-16 Figure 27.3-1)
ROOF SLOPE (__:12):	3.00:12	(Enter vertical rise in 12 horizontal units)
θ (degrees):	14.04	

SEISMIC DESIGN CRITERIA

RISK CATEGORY:	I & II	(Per ASCE 7-16 Table 1.5-1 & IBC Table 1604.5)
SITE CLASS:	D	(Per IBC Section 1613.2.2, Assumed as "D" or per Geotech.)
IMPORTANCE FACTOR (I_E):	1	(Per ASCE 7-16 Table 1.5-2)
STRUCTURAL SYSTEM (R):	1.5	(Per ASCE 7-16 Table 12.2-1)
OVERSTRENGTH FACTOR (Ω_o):	1.5	(Per ASCE 7-16 Table 12.2-1)

INFORMATION BELOW FROM "EARTHQUAKE SPECTRAL RESPONSE ACCELERATION MAPS" PER USGS

LATITUDE:	47.541	S_S =	1.449	F_a =	1.000
LONGITUDE:	-122.209	S_1 =	0.501	F_v =	1.800

DEFLECTION CRITERIA

FLOOR (LIVE):	L/ 480	ROOF (LIVE):	L/ 360
FLOOR (TOTAL):	L/ 360	ROOF (TOTAL):	L/ 240
WALLS:	L/ 360	SPECIAL:	L/

SOIL DESIGN CRITERIA

REPORT: YES

SEE SOILS REPORT FOR ACTIVE, PASSIVE PRESSURES AND FRICTION COEFFICIENT

BEARING:	1500 PSF
ACTIVE:	VARIES
PASSIVE:	350 PCF
COEFFICIENT OF FRICTION:	0.30

MINIMUM FOOTING DIMENSIONS:

CONTINUOUS:	1'-4"
SPREAD:	1'-6"
FROST DEPTH:	1'-6"

PILE TYPE:	NONE		
VERTICAL CAPACITY :	N/A	LATERAL CAPACITY:	N/A
UPLIFT CAPACITY:	N/A	SIZE:	N/A

MATERIALS

CONCRETE

Footings/Piles:	3000 PSI	Columns:	4000 PSI
Slabs/Walls:	4000 PSI	Beams:	4000 PSI
-	-	-	-

REINFORCING

Steel Grade =	60	f_y =	60 KSI

STRUCTURAL STEEL

W-Flange Beams	ASTM A992	f_y =	50 KSI
Shapes & Plates	ASTM A36	f_y =	36 KSI
Pipes	ASTM A53, Grade B	f_y =	35 KSI
HSS Rect.	ASTM A500, Grade C	f_y =	50 KSI
HSS Round	ASTM A500, Grade C	f_y =	46 KSI

MASONRY

ASTM C90	f'_m =	1900 PSI	SOLID GROUTED

GLULAM BEAMS

Simple Spans		Cantilevers
24F-V4	Grade =	24F-V8
1.80E+06 PSI	E =	1.80E+06 PSI
2400 PSI	$F_{b\ (BOTTOM)}$ =	2400 PSI
1850 PSI	$F_{b\ (TOP)}$ =	2400 PSI
240 PSI	F_v =	240 PSI

SCL PRODUCTS

	2x SCL	1¾" SCL	3½, 5¼ SCL
E =	1.30E+06 PSI	1.80E+06 PSI	2.00E+06 PSI
F_b =	1700 PSI	2600 PSI	2900 PSI
F_v =	285 PSI	285 PSI	285 PSI
F_c =	1400 PSI	2400 PSI	2600 PSI

FRAMING LUMBER

Joists & Studs	2x DF #2	2x HF #1	-
E =	1.60E+06 PSI	1.50E+06 PSI	-
F_b =	900 PSI	975 PSI	-
F_v =	180 PSI	150 PSI	-
F_c =	1350 PSI	1350 PSI	-
Beams & Headers	4x DF #2	4x HF #1	6x DF #1
E =	1.60E+06 PSI	1.50E+06 PSI	1.60E+06 PSI
F_b =	900 PSI	975 PSI	1350 PSI
F_v =	180 PSI	150 PSI	170 PSI
Posts & Timbers	6x DF #1	-	-
E =	1.60E+06 PSI	-	-
F_c =	1000 PSI	-	-

PCS Structural Solutions

Project: MERCER ISLAND RESIDENCE (SHED) Job Number: 21-201

Sheet: ____ of ____ Name: BRT

Originating Office: Tacoma Date: 05/25/21

DESIGN CRITERIA - WIND

BASIC WIND SPEED (V):	97 MPH	MEAN ROOF HEIGHT:	15 FT
RISK CATEGORY:	II	GROUND ELEVATION FACTOR (Ke):	1.00
EXPOSURE CATEGORY:	D	ENCLOSURE CLASSIFICATION:	Partially Enclosed
DIRECTIONALITY FACTOR (K_d):	0.85	ROOF TYPE:	Monoslope
GUST EFFECT FACTOR (G):	0.85	ROOF SLOPE (__:12):	3.0:12
TOPOGRAPHIC FACTOR (K_{zt}):	1.00	θ (degrees):	14.04

ASCE 7-16 CHAPTER 27: WIND LOADS ON BUILDINGS: MWFRS (DIRECTIONAL PROCEDURE)
PART 1: ENCLOSED AND PARTIALLY ENCLOSED BUILDINGS OF ALL HEIGHTS

NOTE: q_z and q_i have conservatively been taken equal to q_h.

HORIZONTAL WALL PRESSURES (Figure 27.3-1)

	External Pressures ($q*(GC_p)$):			Internal Pressures ($\pm q_i*(GC_{pi})$)
L/B:	Windward wall	Leeward wall	Sidewall	All walls
0-1	14.3	-9.0	-12.5	11.6
2		-5.4		
≥4		-3.6		

ROOF PRESSURES (Figure 27.3-1)

		External Pressures ($q*(GC_p)$):			Internal Pressures ($\pm q_i*(GC_{pi})$)
Wind Direction:	h/L:	Windward (Positive)	Windward (Negative)	Leeward	All Roofs
Normal to Ridge for θ ≥ 10°	≤0.25	-0.6	-9.7	-8.3	11.6
	0.50	-3.2	-13.2	-9.0	
	≥1.0	-3.2	-19.0	-11.1	

			External Pressures ($q*(GC_p)$):		Internal Pressures ($\pm q_i*(GC_{pi})$)
	h/L:	Horizontal Distance from Windward Edge	Positive Pressure	Negative Pressure	All Roofs
Normal to Ridge for θ < 10° and Parallel to Ridge for All θ	≤0.5	0 to h	-3.2	-16.1	11.6
		h to 2h		-9.0	
		>2h		-5.4	
	≥1.0	0 to h/2	-3.2	-23.3	
		>h/2		-12.5	

ASCE 7-16 27.1.5: Minimum Design Wind Loads: The wind load used for design of the MWFRS shall not be less than 16 PSF multiplied by the wall area of the building, and 8 PSF multiplied by the roof area of the building projected on a vertical plane normal to the assumed wind direction. Wall and roof loads shall be applied simultaneously.

ASCE 7-16 CHAPTER 30: WIND LOADS: COMPONENTS AND CLADDING
PART 1: LOW-RISE BUILDINGS (h≤60 ft)

ROOF SURFACES

Effective Wind Area	POSITIVE PRESSURES	NEGATIVE PRESSURES					
		ZONE					
	ALL ZONES	1	2	3	N/A	N/A	N/A
10 SF	20.0	-39.0	-45.3	-72.8	N/A	N/A	N/A
20 SF	19.6	-37.3	-43.2	-66.4	N/A	N/A	N/A
50 SF	16.0	-36.5	-38.6	-59.3	N/A	N/A	N/A
100 SF	17.9	-34.8	-36.9	-53.8	N/A	N/A	N/A

WALL SURFACES & ROOF OVERHANGS

Effective Wind Area	WALL ZONES				ROOF OVERHANG ZONES					
	POSITIVE PRESSURES		NEGATIVE PRESSURES		NEGATIVE PRESSURES					
	4	5	4	5	1	2	3	N/A	N/A	N/A
10 SF	32.7	32.7	-34.8	-41.1	-60.1	-66.4	-93.8	N/A	N/A	N/A
20 SF	31.6	31.6	-33.7	-38.9	-57.3	-63.2	-86.4	N/A	N/A	N/A
50 SF	30.1	30.1	-32.2	-35.9	-55.0	-57.1	-77.7	N/A	N/A	N/A
100 SF	29.0	29.0	-31.1	-33.7	-52.2	-54.3	-71.1	N/A	N/A	N/A
500 SF	26.4	26.4	-28.5	-28.5	-49.6	-51.7	-68.5	N/A	N/A	N/A

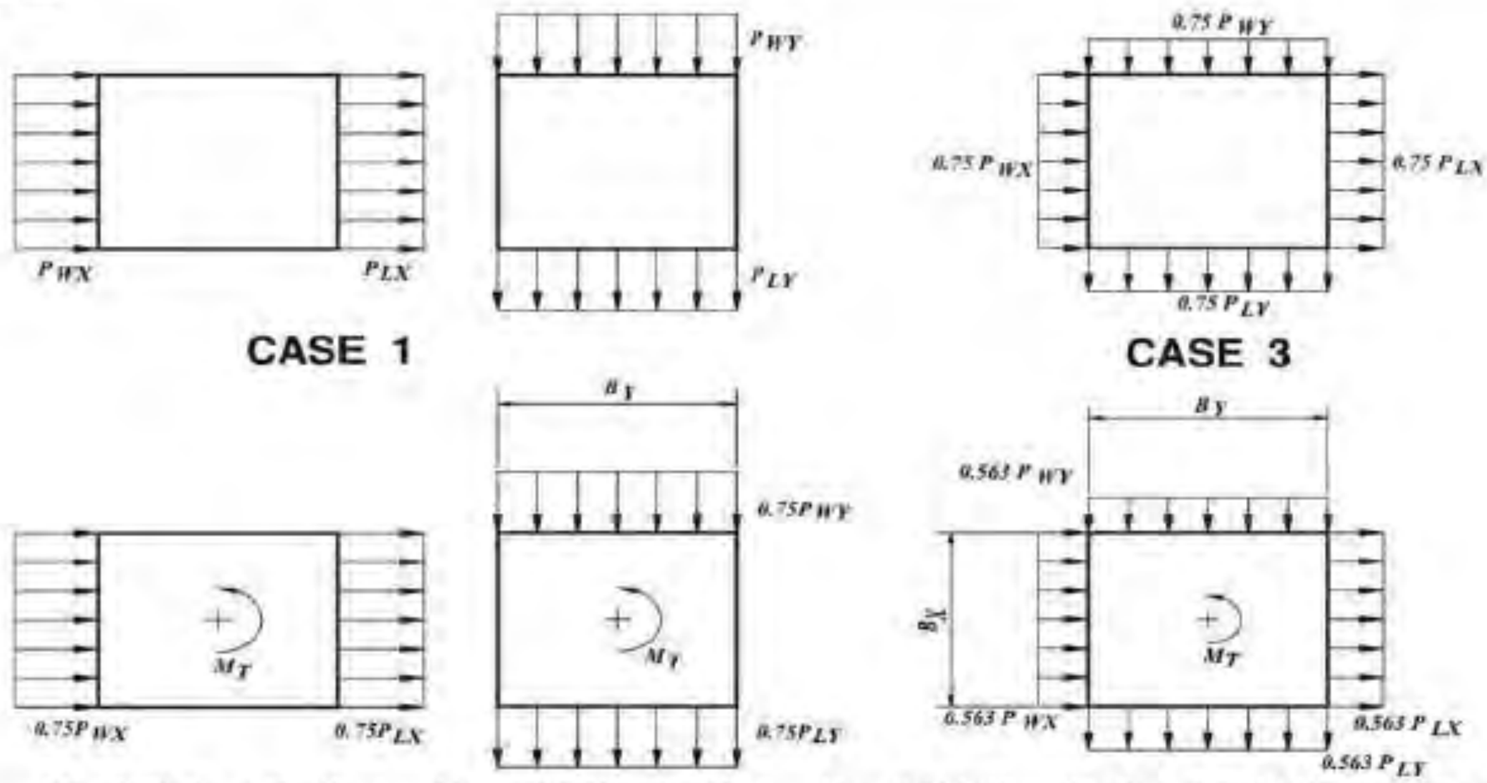
ASCE 7-16 30.2.2: Minimum Design Wind Loads: The design wind pressure for C&C of buildings shall not be less than a net pressure of 16 PSF acting in either direction normal to the surface.

PCS Structural Solutions

DESIGN CRITERIA - WIND

FIGURE 27.3-8: Main Wind Force Resisting System, Part 1 (All Heights): Design Wind Load Cases per ASCE 7-16

Diagrams



$M_T = 0.75\ (P_{WX}+P_{LX})B_X e_X$ $\quad e_X = \pm\ 0.15\ B_X$

$M_T = 0.75\ (P_{WY}+P_{LY})B_Y e_Y$ $\quad e_Y = \pm\ 0.15\ B_Y$

CASE 2

$M_T = 0.563\ (P_{WX}+P_{LX})B_X e_X + 0.563\ (P_{WY}+P_{LY})B_Y e_Y$ $\quad e_X = \pm\ 0.15\ B_X \quad e_Y = \pm\ 0.15\ B_Y$

CASE 4

Notation

P_{WX}, P_{WY} = Windward face design pressure acting in the x, y principal axis, respectively.
P_{LX}, P_{LY} = Leeward face design pressure acting in the x, y principal axis, respectively.
$e(e_X, e_Y)$ = Eccentricity for the x, y principal axis of the structure, respectively.
M_T = Torsional moment per unit height acting about a vertical axis of the building.

Case 1. Full design wind pressure acting on the projected area perpendicular to each principal axis of the structure, considered separately along each principal axis.
Case 2. Three-quarters of the design wind pressure acting on the projected area perpendicular to each principal axis of the structure in conjunction with a torsional moment as shown, considered separately for each principal axis.
Case 3. Wind loading as defined in Case 1, but considered to act simultaneously at 75% of the specified value.
Case 4. Wind loading as defined in Case 2, but considered to act simultaneously at 75% of the specified value.

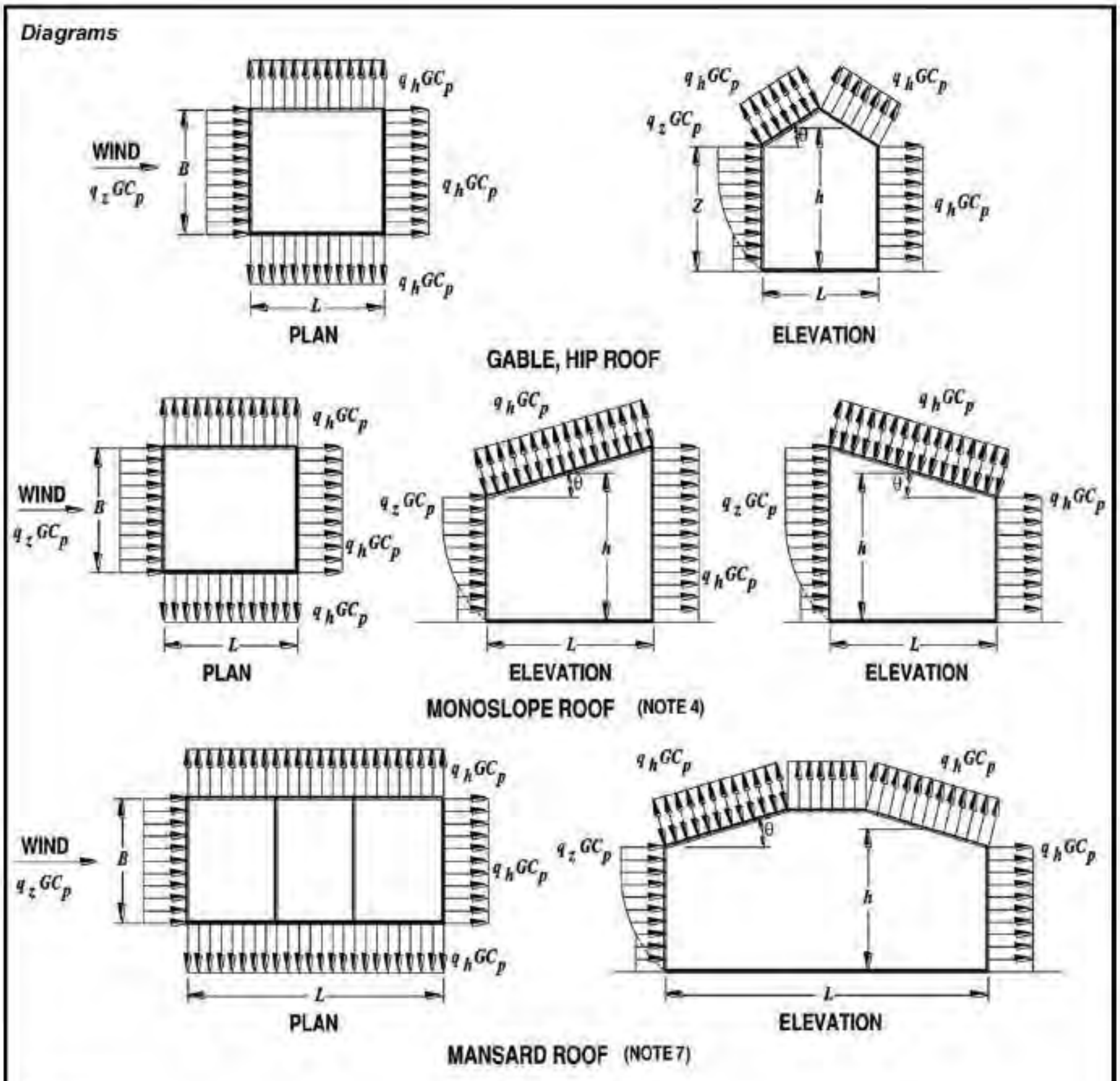
Notes

1. Design wind pressures for windward and leeward faces shall be determined in accordance with the provisions of Sections 27.3.1 and 27.3.2 as applicable for buildings of all heights.
2. Diagrams show plan views of buildings.

FIGURE 27.3-8 Main Wind Force Resisting System, Part 1 (All Heights): Design Wind Load Cases

DESIGN CRITERIA - WIND

FIGURE 27.3-1 Main Wind Force Resisting System, Part 1 (All Heights): External Pressure Coefficients, Cp, for Enclosed and Partially Enclosed Buildings - Walls and Roofs per ASCE 7-16



Notation

B = Horizontal dimension of building, in ft (m), measured normal to wind direction.
L = Horizontal dimension of building, in ft (m), measured parallel to wind direction.
h = Mean roof height, in ft (m), except that eave height shall be used for $\theta \leq 10$ degrees.
z = Height above ground, in ft (m).
G = Gust-effect factor.
q_z, q_h = Velocity pressure, in lb/ft^2 (N/m^2), evaluated at respective height.
θ = Angle of plane of roof from horizontal, in degrees.

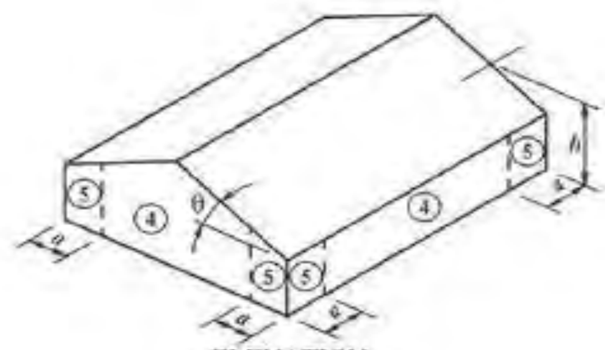
FIGURE 27.3-1 Main Wind Force Resisting System, Part 1 (All Heights): External Pressure Coefficients, C_p, for Enclosed and Partially Enclosed Buildings—Walls and Roofs

PCS Structural Solutions

DESIGN CRITERIA - WIND

FIGURE 30.3-1: Components and Cladding [h ≤ 60 ft]: External Pressure Coefficients, (GCp), for Enclosed and Partially Enclosed Buildings - Walls

Diagram



ELEVATION

Notation

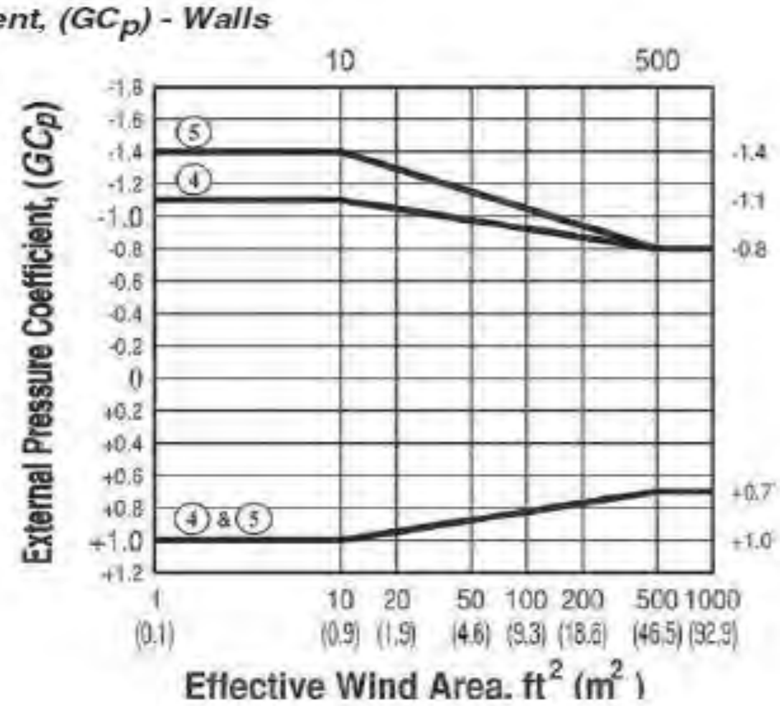
a = 10% of least horizontal dimension or 0.4h, whichever is smaller, but not less than either 4% of least horizontal dimension or 3 ft (0.9 m).

Exception: For buildings with θ = 0° to 7° and a least horizontal dimension greater than 300 ft (90 m), dimension a shall be limited to a maximum of 0.8h.

h = Mean roof height, in ft (m), except that eave height shall be used for θ ≤ 10°.

θ = Angle of plane of roof from horizontal, in degrees.

External Pressure Coefficient, (GC_p) - Walls



Notes

1. Vertical scale denotes (GCp) to be used with qh.
2. Horizontal scale denotes effective wind area, in ft^2 (m^2).
3. Plus and minus signs signify pressures acting toward and away from the surfaces, respectively.
4. Each component shall be designed for maximum positive and negative pressures.
5. Values of (GCp) for walls shall be reduced by 10% when θ ≤ 10°.

FIGURE 30.3-1 Components and Cladding [h ≤ 60 ft (h ≤ 18.3 m)]: External Pressure Coefficients, (GC_p), for Enclosed and Partially Enclosed Buildings—Walls

DESIGN CRITERIA - SEISMIC

ASCE 7-16 SECTION 12.8 - EQUIVALENT LATERAL FORCE PROCEDURE

OCCUPANCY CATEGORY:	I & II	LATITUDE:	47.541
SITE CLASS:	D	LONGITUDE:	-122.209
IMPORTANCE FACTOR (I_E):	1	S_S =	1.449
STRUCTURAL SYSTEM (R):	1.5	S_1 =	0.501
OVERSTRENGTH FACTOR (Ω_o):	1.5	F_a =	1.000
		F_v =	1.800

ASCE 7-16 SECTION 11.4 SEISMIC GROUND MOTION VALUES

Section 11.4.4 - Coefficients and Risk-Targeted Maximum Considered Earthquake (MCER) Spectral Response Acceleration Parameters

$S_{MS} = F_a*S_S =$ 1.449 $S_{M1} = F_v*S_1 =$ 0.902

Section 11.4.5 - Design Spectral Response Acceleration Parameters

$S_{DS} = 2/3*S_{MS} =$ 0.966 $S_{D1} = 2/3*S_{M1} =$ 0.601

ASCE 7-16 SECTION 11.6 - SEISMIC DESIGN CATEGORY - SECTION 12.8.2 - PERIOD DETERMINATION

ASCE 7-16 TABLE 11.6-1

SEISMIC DESIGN CATEGORY BASED ON S_{DS}

	RISK CATEGORY:		
	I & II	III	IV
< 0.167g	A	A	A
< 0.33g	B	B	C
< 0.50g	C	C	D
>= 0.50g	D	D	D
	D		

ASCE 7-16 TABLE 11.6-2

SEISMIC DESIGN CATEGORY BASED ON S_{D1}

	RISK CATEGORY:		
	I & II	III	IV
< 0.067g	A	A	A
< 0.133g	B	B	C
< 0.20g	C	C	D
>= 0.20g	D	D	D
	D		

Each building and structure shall be assigned to the most severe Seismic Design Category in accordance with Table 11.6-1 or Table 11.6-2, irrespective of the fundamental period of vibration of the structure.

PERIOD DETERMINATION:

C_t =	0.02
h_n =	14 FT
x =	0.75
$T_a = C_t*h_n^x$ =	0.141

ASCE 7-16 SECTION 12.8.1.1 - SEISMIC RESPONSE COEFFICIENT

GENERAL EQUATION:	$C_S = S_{DS}/(R/I)$ =	0.644	<--CONTROLS	EQ. 12.8-2
MAXIMUM:	CS = 1.5*SD1/(T*(R/I)) =	4.268		EQ. 12.8-3
MINIMUM:	$C_S = 0.044*S_{DS}*I > 0.01$ =	0.043		EQ. 12.8-5
For structures located where S1 > 0.6g	$C_S = 0.5*S_1/(R/I)$ =	0.000		EQ. 12.8-6

ASCE 7-10 SECTION 12.8.1 - SEISMIC BASE SHEAR

$V = C_S*W =$ **0.644*W**

W = the total dead load and applicable portion of other loads as indicated in Section 12.7.2

GRAVITY

METAL DECK

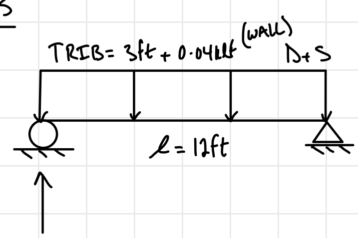
SPAN = 5ft , SINGLE-SPAN

D+S = 10 PSF + 25 PSF = 35 PSF

UNIFORM LOAD = 35 PSF

20 GA. TYPE "B" METAL DECK ⟶ 115 PSF ALLOWABLE > 35 PSF ✓OK

ROOF BEAMS



$R_D = 0.45^k$

$R_S = 0.45^k$

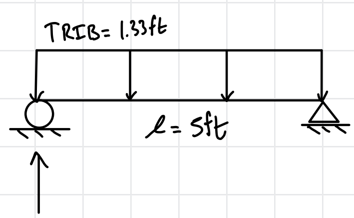
D = 10 PSF

S = 25 PSF

$\boxed{\text{4x8 DF-L \#2}}$

SEE ENERCALC...

FLOOR JOISTS



$R_D = 0.06^k$

$R_L = 0.14^k$

D = 15 PSF

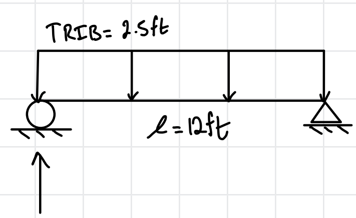
L = 40 PSF

NO.2 TREATED

$\boxed{\text{2x6 @ 16" O.C.}}$

SEE ENERCALC...

FLOOR BEAMS



$R_D = 0.27^k$

$R_L = 0.60^k$

D = 15 PSF

L = 40 PSF

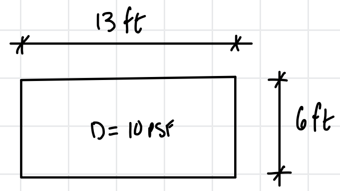
NO.2 TREATED

$\boxed{\text{USE 4x10}}$

SEE ENERCALC...

LATERAL

SEISMIC



$W = 10_{PSF}\,(13ft \times 6ft) = 780\#$

$C_s = 0.644$

$V = 780\,lb\,(0.644) = 503\,lb\,(0.7) = 353\,lb$

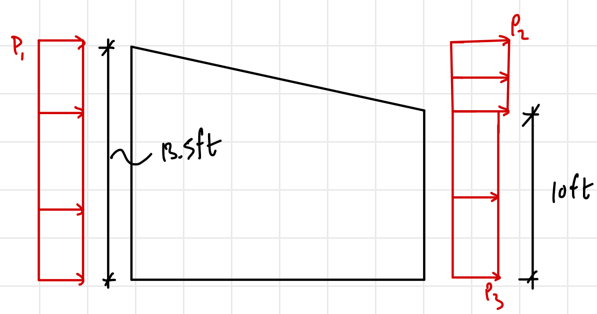
$M = 353\,lb \times 13.5ft = 4.77\ k{\cdot}ft$

WIND:

$L/B = 13ft/6ft = 2.17 \longrightarrow$ USE 2.0

$h/L = 13.5ft/13ft = 1.04 \geq 1.0$

E/W



$P_1 = 14.3_{PSF}$

$P_2 = 19.0\ PSF$

$P_3 = 5.4\ PSF$

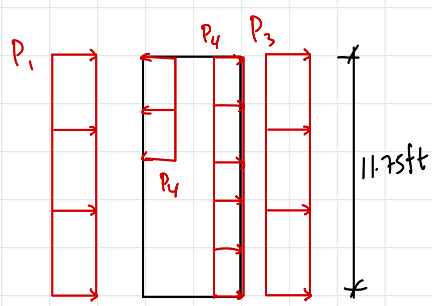
$P_4 = q_i\ GC_{pi} = 11.6\ PSF$

$V_{E\text{-}W} = \left[(14.3_{PSF} \times 13.5ft) + (19_{PSF} \times 3.5ft) + (5.4_{PSF} \times 10ft)\right](6ft)(0.6) = 1129\,lb$

$M = 1129\,lb\,(13.5ft/2) = 7.62\,k{\cdot}ft > 4.77\,k{\cdot}ft$

∴ WIND CONTROLS

N/S

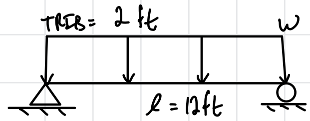


$V_{N\text{-}S} = \left[(14.3_{PSF} \times 11.75ft) + (5.4_{PSF} \times 11.75ft) + (11.6_{PSF} \times 11.75ft) - (11.6_{PSF} \times 2\,ft)\right](13ft)(0.6) = 2{,}688\,lb > 1129\,lb$

∴ WIND CONTROLS

$\boxed{\text{LATERAL}}$

Wind Beams:

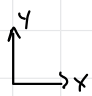


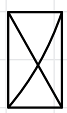
W = 17 psf

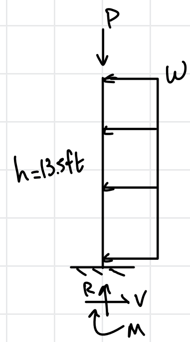
$\boxed{\text{2x6 DF-L \#2 @ 2ft O.C.}}$

See Enercalc...

Columns:







$P_D = 0.22^k$
$P_S = 0.45^k$
$W_x = 35\,plf$
$W_y = 83\,plf$

See Enercalc..

$\boxed{\text{8x8 DF-L \#1}}$

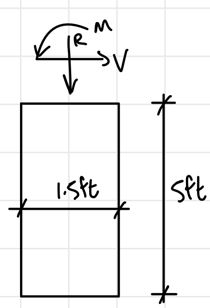
$$2\ell/180 = \left((2)\,13.5ft \times 12in/ft\right)/180 = 1.8in < \underset{\text{X-DIR}}{0.593in},\ \underset{\text{Y-DIR}}{0.844in}$$

$$0.02h_{sx} = 0.02\,(13.5ft \times 12in/ft) = 3.24in < 0.593in,\ 0.844in$$

Simpson MPBZ: $V_{MAX} = 0.68^k < 4.8^k$ ✓ ok

$M_{MAX} = 4.54\,k\cdot ft < 4.56\,kft$ ✓ ok

Footing:



$R_D = 0.3^k$
$R_S = 0.5^k$
$W = 83\,plf$

h = 13.5ft

Wood Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.22.1.12 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: Roof Beams

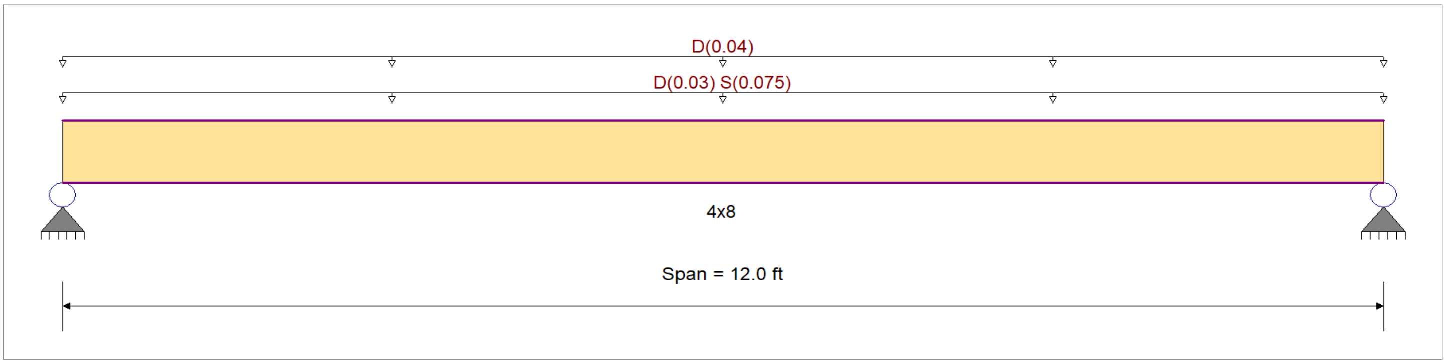
CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	875.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	875.0 psi	Ebend- xx	1,300.0 ksi
		Fc - Prll	600.0 psi	Eminbend - xx	470.0 ksi
Wood Species :	Douglas Fir-Larch	Fc - Perp	625.0 psi		
Wood Grade :	No.2	Fv	170.0 psi		
		Ft	425.0 psi	Density	31.210 pcf

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 loads
Uniform Load : D = 0.010, S = 0.0250 ksf, Tributary Width = 3.0 ft
Uniform Load : D = 0.040 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.810**: 1	Maximum Shear Stress Ratio	=	**0.247** : 1
Section used for this span		**4x8**	Section used for this span		**4x8**
fb: Actual	=	1,060.22 psi	fv: Actual	=	48.31 psi
Fb: Allowable	=	1,308.13 psi	Fv: Allowable	=	195.50 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	6.000 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.244 in	Ratio =	591 >=360	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.489 in	Ratio =	294 >=240	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 12.0 ft	1	0.520	0.158	0.90	1.300	1.00	1.00	1.00	1.00	1.00	1.36	531.87	1023.75	0.41	24.24	153.00
+D+S					1.300	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 12.0 ft	1	0.810	0.247	1.15	1.300	1.00	1.00	1.00	1.00	1.00	2.71	1,060.22	1308.13	0.82	48.31	195.50
+D+0.750S					1.300	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 12.0 ft	1	0.710	0.216	1.15	1.300	1.00	1.00	1.00	1.00	1.00	2.37	928.13	1308.13	0.72	42.29	195.50
+0.60D					1.300	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 12.0 ft	1	0.175	0.053	1.60	1.300	1.00	1.00	1.00	1.00	1.00	0.82	319.12	1820.00	0.25	14.54	272.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.4888	6.044		0.0000	0.000

Wood Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.22.1.12 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: Roof Beams

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.903	0.903
Overall MINimum	0.450	0.450
D Only	0.453	0.453
+D+S	0.903	0.903
+D+0.750S	0.790	0.790
+0.60D	0.272	0.272
S Only	0.450	0.450

Wood Beam

Project File: 21201enercalc_brt.ec6

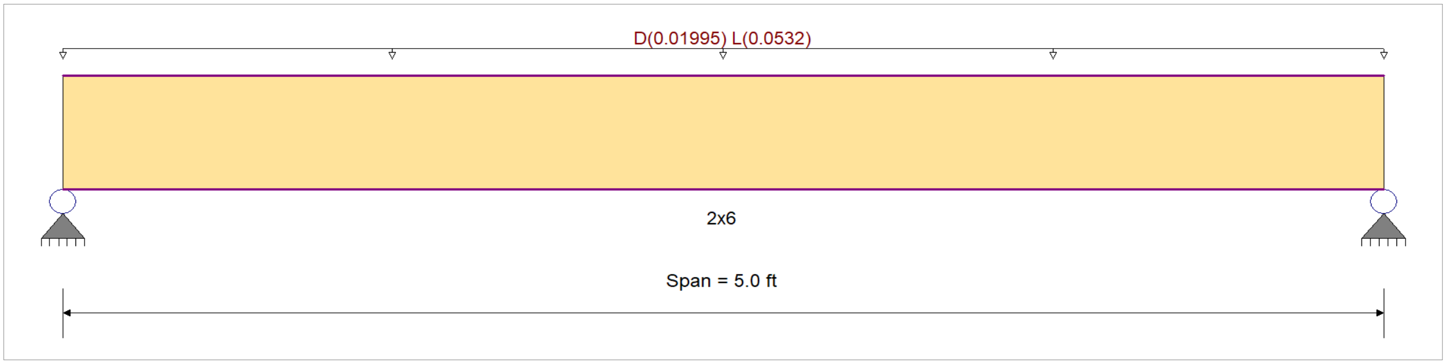
DESCRIPTION: Floor Joists

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	875.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	875.0 psi	Ebend- xx	1,300.0 ksi
		Fc - Prll	600.0 psi	Eminbend - xx	470.0 ksi
Wood Species :	Douglas Fir-Larch	Fc - Perp	625.0 psi		
Wood Grade :	No.2	Fv	170.0 psi		
		Ft	425.0 psi	Density	31.210 pcf
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling			Repetitive Member Stress Increase	



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 = 1.330 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.355**: 1	Maximum Shear Stress Ratio	=	**0.205** : 1
Section used for this span		**2x6**	Section used for this span		**2x6**
fb: Actual	=	371.59 psi	fv: Actual	=	27.85 psi
Fb: Allowable	=	1,046.50 psi	Fv: Allowable	=	136.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	2.500 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.029 in	Ratio =	2047 >=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <480	n/a
Max Downward Total Deflection	0.041 in	Ratio =	1453 >=360	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0 <360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 5.0 ft	1	0.114	0.066	0.90	1.300	0.80	1.15	1.00	1.00	1.00	0.07	107.79	941.85	0.04	8.08	122.40
+D+L					1.300	0.80	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 5.0 ft	1	0.355	0.205	1.00	1.300	0.80	1.15	1.00	1.00	1.00	0.23	371.59	1046.50	0.15	27.85	136.00
+D+0.750L					1.300	0.80	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 5.0 ft	1	0.234	0.135	1.25	1.300	0.80	1.15	1.00	1.00	1.00	0.19	305.64	1308.13	0.13	22.90	170.00
+0.60D					1.300	0.80	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 5.0 ft	1	0.039	0.022	1.60	1.300	0.80	1.15	1.00	1.00	1.00	0.04	64.68	1674.40	0.03	4.85	217.60

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0413	2.518		0.0000	0.000

Wood Beam

Project File: 21201enercalc_brt.ec6

DESCRIPTION: Floor Joists

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.187	0.187
Overall MINimum	0.133	0.133
D Only	0.054	0.054
+D+L	0.187	0.187
+D+0.750L	0.154	0.154
+0.60D	0.033	0.033
L Only	0.133	0.133

Wood Beam

Project File: 21201enercalc_brt.ec6

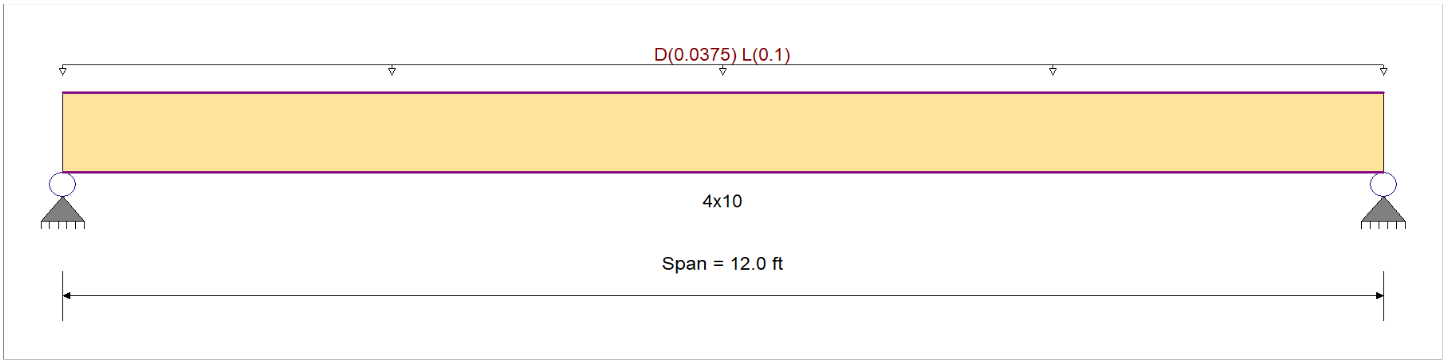
DESCRIPTION: Floor Beams

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	875.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	875.0 psi	Ebend- xx	1,300.0ksi
		Fc - Prll	600.0 psi	Eminbend - xx	470.0ksi
Wood Species :	Douglas Fir-Larch	Fc - Perp	625.0 psi		
Wood Grade :	No.2	Fv	170.0 psi		
		Ft	425.0 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 = 2.50 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.745 : 1	Maximum Shear Stress Ratio	=	0.259 : 1
Section used for this span		**4x10**	Section used for this span		**4x10**
fb: Actual	=	625.42 psi	fv: Actual	=	35.19 psi
Fb: Allowable	=	840.00 psi	Fv: Allowable	=	136.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	6.000ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.165 in	Ratio =	874	>=480	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0	<480	n/a
Max Downward Total Deflection	0.238 in	Ratio =	605	>=360	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0	<360	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 12.0 ft	1	0.255	0.089	0.90	1.200	0.80	1.00	1.00	1.00	1.00	0.80	192.65	756.00	0.23	10.84	122.40
+D+L					1.200	0.80	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 12.0 ft	1	0.745	0.259	1.00	1.200	0.80	1.00	1.00	1.00	1.00	2.60	625.42	840.00	0.76	35.19	136.00
+D+0.750L					1.200	0.80	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 12.0 ft	1	0.493	0.171	1.25	1.200	0.80	1.00	1.00	1.00	1.00	2.15	517.23	1050.00	0.63	29.10	170.00
+0.60D					1.200	0.80	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 12.0 ft	1	0.086	0.030	1.60	1.200	0.80	1.00	1.00	1.00	1.00	0.48	115.59	1344.00	0.14	6.50	217.60

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.2379	6.044		0.0000	0.000

Wood Beam

DESCRIPTION: Floor Beams

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.867	0.867
Overall MINimum	0.600	0.600
D Only	0.267	0.267
+D+L	0.867	0.867
+D+0.750L	0.717	0.717
+0.60D	0.160	0.160
L Only	0.600	0.600

Wood Beam

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.22.1.12 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

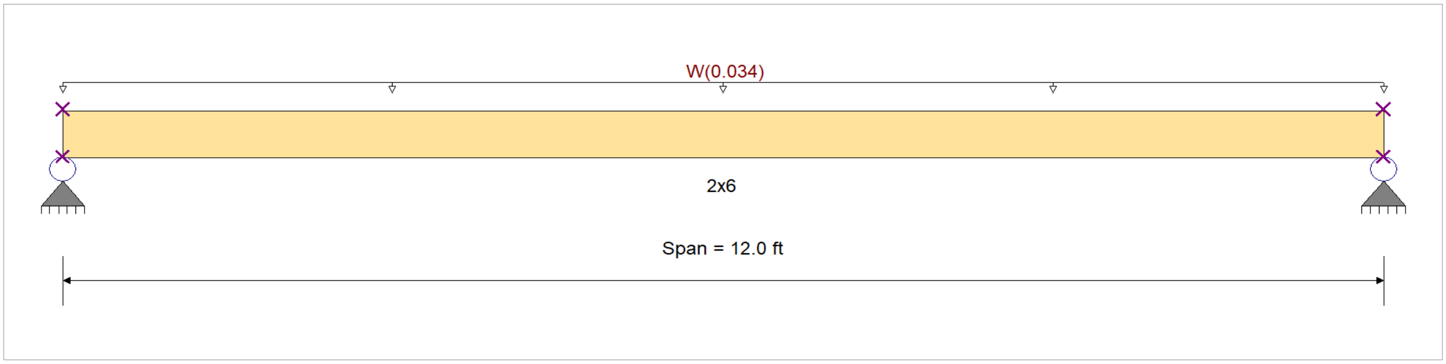
DESCRIPTION: Wind Beams

CODE REFERENCES

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

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	875.0 psi	*E : Modulus of Elasticity*	
Load Combination	IBC 2018	Fb -	875.0 psi	Ebend- xx	1,300.0 ksi
		Fc - Prll	600.0 psi	Eminbend - xx	470.0 ksi
Wood Species :	Douglas Fir-Larch	Fc - Perp	625.0 psi		
Wood Grade :	No.2	Fv	170.0 psi		
		Ft	425.0 psi	Density	31.210 pcf
Beam Bracing :	Completely Unbraced			Repetitive Member Stress Increase	



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : W = 0.0170 ksf, Tributary Width = 2.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.752** 1	Maximum Shear Stress Ratio	=	**0.082** : 1
Section used for this span		**2x6**	Section used for this span		**2x6**
fb: Actual	=	633.74 psi	fv: Actual	=	22.44 psi
Fb: Allowable	=	842.43 psi	Fv: Allowable	=	272.00 psi
Load Combination		+D+0.60W	Load Combination		+D+0.60W
Location of maximum on span	=	6.000 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.590 in	Ratio =	244 >=240	Span: 1 : W Only
Max Upward Transient Deflection	0 in	Ratio =	0 <240	n/a
Max Downward Total Deflection	0.385 in	Ratio =	373 >=180	Span: 1 : +D+0.60W
Max Upward Total Deflection	0 in	Ratio =	0 <180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 12.0 ft	1	0.065	0.012	0.90	1.300	1.00	1.15	1.00	1.00	0.67	0.03	51.07	790.16	0.01	1.81	153.00
+D+0.60W					1.300	1.00	1.15	1.00	1.00	0.67			0.00	0.00	0.00	0.00
Length = 12.0 ft	1	0.752	0.082	1.60	1.300	1.00	1.15	1.00	1.00	0.40	0.40	633.74	842.43	0.12	22.44	272.00
+D+0.450W					1.300	1.00	1.15	1.00	1.00	0.40			0.00	0.00	0.00	0.00
Length = 12.0 ft	1	0.579	0.064	1.60	1.300	1.00	1.15	1.00	1.00	0.40	0.31	488.07	842.43	0.10	17.28	272.00
+0.60D+0.60W					1.300	1.00	1.15	1.00	1.00	0.40			0.00	0.00	0.00	0.00
Length = 12.0 ft	1	0.728	0.080	1.60	1.300	1.00	1.15	1.00	1.00	0.40	0.39	613.31	842.43	0.12	21.72	272.00
+0.60D					1.300	1.00	1.15	1.00	1.00	0.40			0.00	0.00	0.00	0.00
Length = 12.0 ft	1	0.036	0.004	1.60	1.300	1.00	1.15	1.00	1.00	0.40	0.02	30.64	842.43	0.01	1.08	272.00

Wood Beam

Project File: 21201 enercalc - brt.ec6

DESCRIPTION: Wind Beams

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
W Only	1	0.5902	6.044		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.204	0.204
Overall MINimum	0.204	0.204
D Only	0.011	0.011
+D+0.60W	0.133	0.133
+D+0.450W	0.103	0.103
+0.60D+0.60W	0.129	0.129
+0.60D	0.006	0.006
W Only	0.204	0.204

Wood Column

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.22.1.12 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: Columns: Y-direction

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Analysis Method	Allowable Stress Design		
End Fixities	Top Free, Bottom Fixed		
Overall Column Height	13.5 ft		
(Used for non-slender calculations)			
Wood Species	Douglas Fir-Larch		
Wood Grade	No.1		
Fb +	1,350.0 psi	Fv	170.0 psi
Fb -	1,350.0 psi	Ft	675.0 psi
Fc - Prll	925.0 psi	Density	31.210 pcf
Fc - Perp	625.0 psi		

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1,600.0	1,600.0	1,600.0 ksi
Minimum	580.0	580.0	

Wood Section Name	**8x8**
Wood Grading/Manuf.	Graded Lumber
Wood Member Type	Sawn
Exact Width	**7.50** in
Exact Depth	**7.50** in
Area	56.250 in^2
Ix	263.672 in^4
Iy	263.672 in^4

Allow Stress Modification Factors	
Cf or Cv for Bending	1.0
Cf or Cv for Compressio	1.0
Cf or Cv for Tension	1.0
Cm : Wet Use Factor	1.0
Ct : Temperature Fact	1.0
Cfu : Flat Use Factor	1.0
Kf : Built-up columns	1.0 *NDS 15.3.2*
Use Cr : Repetitive ?	No

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 13
Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 13

Applied Loads

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

Column self weight included : 164.584 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 13.50 ft, D = 0.220, S = 0.450 k
BENDING LOADS . . .
Lat. Uniform Load creating Mx-x, W = 0.0830 k/ft

DESIGN SUMMARY

Bending & Shear Check Results

PASS	Max. Axial+Bending Stress Ratio =	**0.3610 : 1**
	Load Combination	+D+0.60W
	Governing NDS Forumla	Comp + Mxx, NDS Eq. 3.9-3
	Location of max.above base	0.0 ft
	At maximum location values are .	
	Applied Axial	0.3846 k
	Applied Mx	-4.538 k-ft
	Applied My	0.0 k-ft
	Fc : Allowable	818.95 psi
PASS	Maximum Shear Stress Ratio =	**0.06591 : 1**
	Load Combination	+D+0.60W
	Location of max.above base	0.0 ft
	Applied Design Shear	17.928 psi
	Allowable Shear	272.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.0 k	Bottom along Y-Y	1.121 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .

Along Y-Y 0.8431 in at 13.50 ft above base
for load combination : +D+0.60W
Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

Other Factors used to calculate allowable stresses . . .

Bending	Compression	Tension

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
D Only	0.900	0.757	0.01085	PASS	0.0 ft	0.0	PASS	13.50 ft
+D+S	1.150	0.677	0.02060	PASS	0.0 ft	0.0	PASS	13.50 ft
+D+0.750S	1.150	0.677	0.01783	PASS	0.0 ft	0.0	PASS	13.50 ft
+D+0.60W	1.600	0.553	0.3610	PASS	0.0 ft	0.06591	PASS	0.0 ft
+D+0.450W	1.600	0.553	0.2708	PASS	0.0 ft	0.04943	PASS	0.0 ft
+D+0.750S+0.450W	1.600	0.553	0.2726	PASS	0.0 ft	0.04943	PASS	0.0 ft
+0.60D+0.60W	1.600	0.553	0.360	PASS	0.0 ft	0.06591	PASS	0.0 ft
+0.60D	1.600	0.553	0.005009	PASS	0.0 ft	0.0	PASS	13.50 ft

Wood Column

DESCRIPTION: Columns: Y-direction

Maximum Reactions

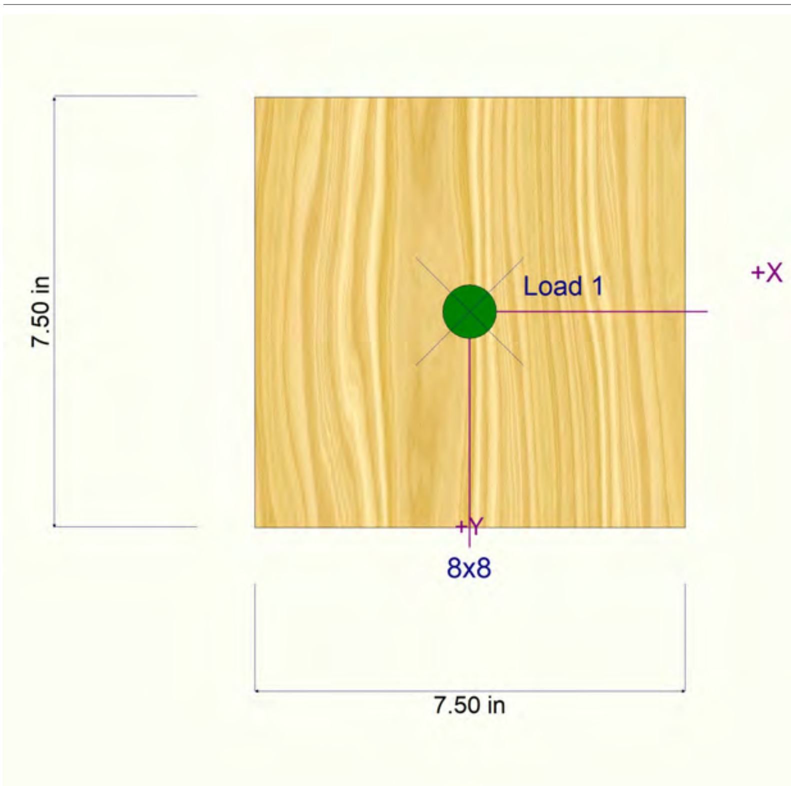
Note: Only non-zero reactions are listed.

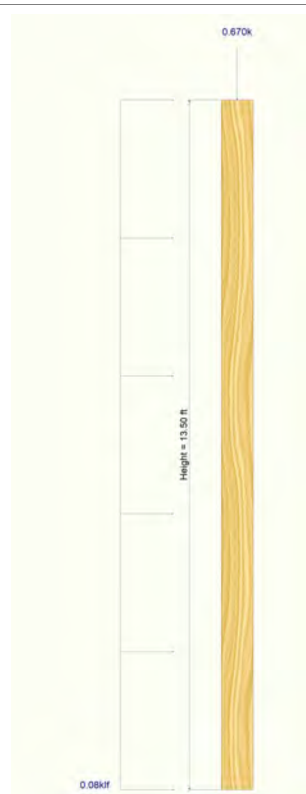
Load Combination	X-X Axis Reaction @ Base	X-X Axis Reaction @ Top (k)	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Axial Reaction @ Base	My - End Moments @ Base	My - End Moments @ Top (k-ft)	Mx - End Moments @ Base	Mx - End Moments @ Top
D Only					0.385				
+D+S					0.835				
+D+0.750S					0.722				
+D+0.60W			0.672		0.385			4.538	
+D+0.450W			0.504		0.385			3.404	
+D+0.750S+0.450W			0.504		0.722			3.404	
+0.60D+0.60W			0.672		0.231			4.538	
+0.60D					0.231				
S Only					0.450				
W Only			1.121					7.563	

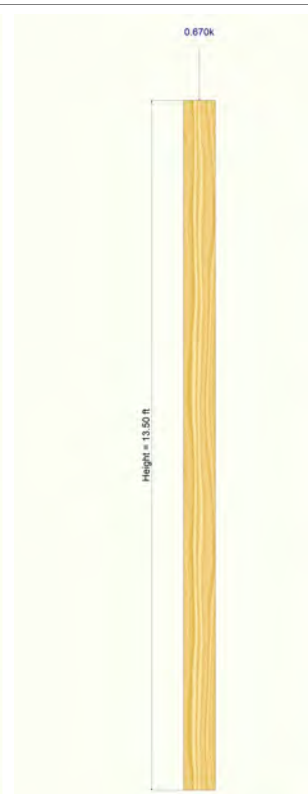
Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+S	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.750S	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.60W	0.0000 in	0.000 ft	0.843 in	13.500 ft
+D+0.450W	0.0000 in	0.000 ft	0.632 in	13.500 ft
+D+0.750S+0.450W	0.0000 in	0.000 ft	0.632 in	13.500 ft
+0.60D+0.60W	0.0000 in	0.000 ft	0.843 in	13.500 ft
+0.60D	0.0000 in	0.000 ft	0.000 in	0.000 ft
S Only	0.0000 in	0.000 ft	0.000 in	0.000 ft

Sketches







Wood Column

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.22.1.12 PCS STRUCTURAL SOLUTIONS (c) ENERCALC INC 1983-2021

DESCRIPTION: Columns: X-direction

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Analysis Method	Allowable Stress Design		Wood Section Name	8x8	
End Fixities	Top Free, Bottom Fixed		Wood Grading/Manuf.	Graded Lumber	
Overall Column Height	13.5 ft		Wood Member Type	Sawn	
(Used for non-slender calculations)					

Wood Species	Douglas Fir-Larch		
Wood Grade	No.1		
Fb +	1,350.0 psi	Fv	170.0 psi
Fb -	1,350.0 psi	Ft	675.0 psi
Fc - Prll	925.0 psi	Density	31.210 pcf
Fc - Perp	625.0 psi		

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1,600.0	1,600.0	1,600.0 ksi
Minimum	580.0	580.0	

Exact Width	**7.50** in
Exact Depth	**7.50** in
Area	56.250 in^2
Ix	263.672 in^4
Iy	263.672 in^4

Allow Stress Modification Factors	
Cf or Cv for Bending	1.0
Cf or Cv for Compressio	1.0
Cf or Cv for Tension	1.0
Cm : Wet Use Factor	1.0
Ct : Temperature Fact	1.0
Cfu : Flat Use Factor	1.0
Kf : Built-up columns	1.0 *NDS 15.3.2*
Use Cr : Repetitive ?	No

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 13
Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 13

Applied Loads

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

Column self weight included : 164.584 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 13.50 ft, D = 0.220, S = 0.450 k
BENDING LOADS . . .
Lat. Uniform Load creating My-y, W = 0.0350 k/ft

DESIGN SUMMARY

Bending & Shear Check Results

PASS	Max. Axial+Bending Stress Ratio =	**0.1523 : 1**
	Load Combination	+D+0.60W
	Governing NDS Forumla Comp + Myy, NDS Eq. 3.9-3	
	Location of max.above base	0.0 ft
	At maximum location values are .	
	Applied Axial	0.3846 k
	Applied Mx	0.0 k-ft
	Applied My	-1.914 k-ft
	Fc : Allowable	818.95 psi
PASS	Maximum Shear Stress Ratio =	**0.02779 : 1**
	Load Combination	+D+0.60W
	Location of max.above base	0.0 ft
	Applied Design Shear	7.560 psi
	Allowable Shear	272.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.0 k	Bottom along Y-Y	0.0 k
Top along X-X	0.0 k	Bottom along X-X	0.4725 k

Maximum SERVICE Load Lateral Deflections . . .

Along Y-Y 0.0 in at 0.0 ft above base
for load combination : n/a
Along X-X 0.5926 in at 13.50 ft above base
for load combination : W Only

Other Factors used to calculate allowable stresses . . .

Bending	Compression	Tension

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
D Only	0.900	0.757	0.01085	PASS	0.0 ft	0.0	PASS	13.50 ft
+D+S	1.150	0.677	0.02060	PASS	0.0 ft	0.0	PASS	13.50 ft
+D+0.750S	1.150	0.677	0.01783	PASS	0.0 ft	0.0	PASS	13.50 ft
+D+0.60W	1.600	0.553	0.1523	PASS	0.0 ft	0.02779	PASS	0.0 ft
+D+0.450W	1.600	0.553	0.1142	PASS	0.0 ft	0.02085	PASS	0.0 ft
+D+0.750S+0.450W	1.600	0.553	0.1151	PASS	0.0 ft	0.02085	PASS	0.0 ft
+0.60D+0.60W	1.600	0.553	0.1518	PASS	0.0 ft	0.02779	PASS	0.0 ft
+0.60D	1.600	0.553	0.005009	PASS	0.0 ft	0.0	PASS	13.50 ft

Wood Column

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.22.1.12 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: Columns: X-direction

Maximum Reactions

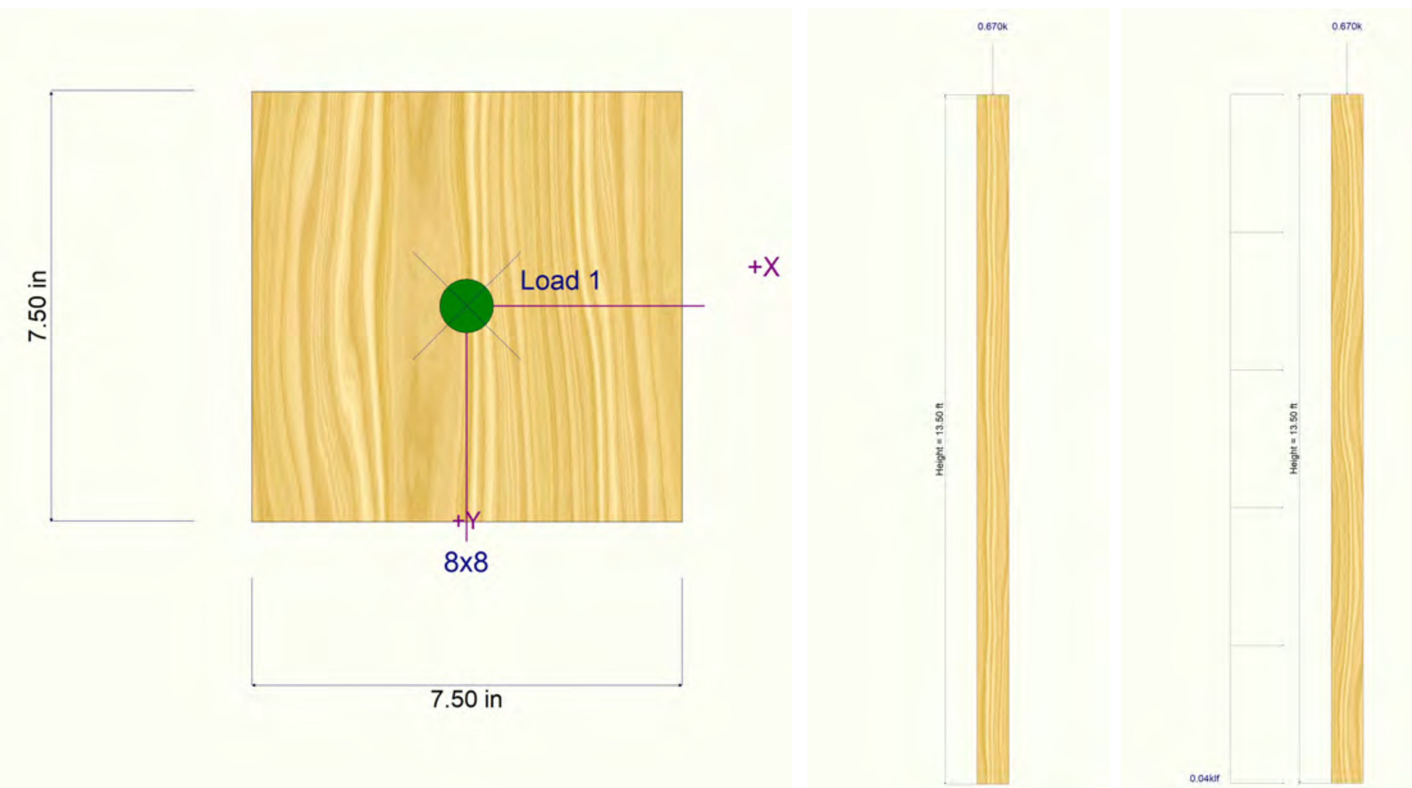
Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction @ Base	X-X Axis Reaction @ Top	k Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Axial Reaction @ Base	My - End Moments @ Base	My - End Moments k-ft @ Top	Mx - End Moments @ Base	Mx - End Moments @ Top
D Only					0.385				
+D+S					0.835				
+D+0.750S					0.722				
+D+0.60W	0.284				0.385	1.914			
+D+0.450W	0.213				0.385	1.435			
+D+0.750S+0.450W	0.213				0.722	1.435			
+0.60D+0.60W	0.284				0.231	1.914			
+0.60D					0.231				
S Only					0.450				
W Only	0.473					3.189			

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+S	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.750S	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.60W	0.3555 in	13.500 ft	0.000 in	0.000 ft
+D+0.450W	0.2666 in	13.500 ft	0.000 in	0.000 ft
+D+0.750S+0.450W	0.2666 in	13.500 ft	0.000 in	0.000 ft
+0.60D+0.60W	0.3555 in	13.500 ft	0.000 in	0.000 ft
+0.60D	0.0000 in	0.000 ft	0.000 in	0.000 ft
S Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
W Only	0.5872 in	13.409 ft	0.000 in	0.000 ft

Sketches



Pole Footing Embedded in Soil

Project File: 21201 enercalc - brt.ec6

LIC# : KW-06014122, Build:20.22.1.12 PCS STRUCTURAL SOLUTIONS

DESCRIPTION: Footing

Code References

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16
Load Combinations Used : ASCE 7-16

General Information

Pole Footing Shape Circular
Pole Footing Diameter . . . . 18.0 in
Calculate Min. Depth for Allowable Pressures
No Lateral Restraint at Ground Surface
Allow Passive . . . . 350.0 pcf
Max Passive . . . . 1,500.0 psf

Controlling Values

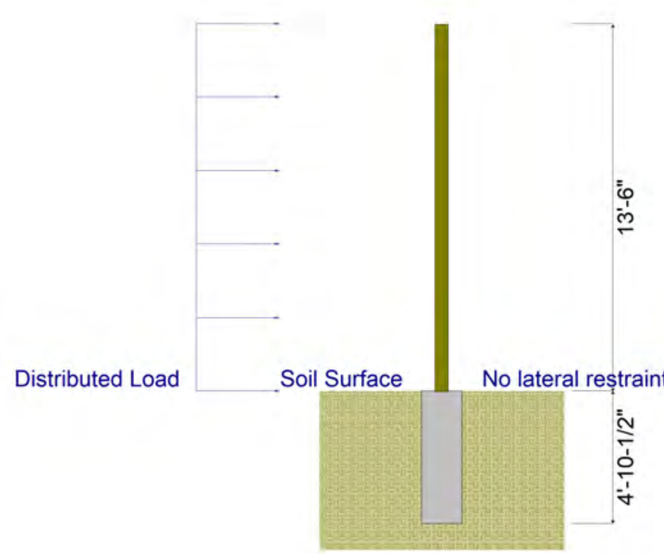
Governing Load Combination +D+0.60W
Lateral Load 0.6723 k
Moment 4.538 k-ft

NO Ground Surface Restraint

Pressures at 1/3 Depth
Actual **556.11** psf
Allowable **558.31** psf

Minimum Required Depth 4.875 ft

Footing Base Area 1.767 ft^2
Maximum Soil Pressure 0.4527 ksf



Applied Loads

	Lateral Concentrated Load (k)	Lateral Distributed Loads (k	Vertical Load (k)
D : Dead Load	k	k/ft	0.30 k
Lr : Roof Live	k	k/ft	k
L : Live	k	k/ft	k
S : Snow	k	k/ft	0.50 k
W : Wind	k	0.0830 k/ft	k
E : Earthquake	k	k/ft	k
H : Lateral Earth	k	k/ft	k
Load distance above ground surface	13.50 ft	TOP of Load above ground surface 13.50 ft	
		BOTTOM of Load above ground surface ft	

Load Combination Results

Load Combination	Forces @ Ground Surface Loads - (k)	Forces @ Ground Surface Moments - (ft-k)	Required Depth - (ft)	Pressure at 1/3 Depth Actual - (psf)	Pressure at 1/3 Depth Allow - (psf)	Soil Increase Factor
D Only	0.000	0.000	0.13	0.0	0.0	1.000
+D+S	0.000	0.000	0.13	0.0	0.0	1.000
+D+0.750S	0.000	0.000	0.13	0.0	0.0	1.000
+D+0.60W	0.672	4.538	4.88	556.1	558.3	1.000
+D+0.450W	0.504	3.404	4.38	499.2	499.7	1.000
+D+0.750S+0.450W	0.504	3.404	4.38	499.2	499.7	1.000
+0.60D+0.60W	0.672	4.538	4.88	556.1	558.3	1.000
+0.60D	0.000	0.000	0.13	0.0	0.0	1.000