3804 House

Project Number: 22-112

3804 E Mercer Way

Mercer Island, WA 98040

Structural Calculations

Lateral Calculations……S1 – S104

Gravity Calculations……S105 – S248

2/11/25

Reviewed by:

Nabil Kausal-Hayes, PE

206-601-9728

www.nkhengineering.com

Prepared By:

Allen Rishel, EIT

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LATERAL LOAD CALCULATIONS FOR RESIDENTIAL PROPERTY LOCATED AT 3804 Mercer Way

Basis of Design

This document is showing the detail of design and calculations of framing, foundation and shear walls, for gravity and lateral loads according to IRC 2018, NDS 2018, IBC 2018, ASCE7-16, AISC 2015 and ACI 318-14.

The load distribution is as follow:
Floor Dead Load ---------- 15 psf
Roof Dead Load----------15 psf
Floor Live Load----------40 psf
Roof Live Load----------20 psf
Roof Snow Load----------25 psf
Deck Live Load----------60 psf
Deck Dead Load----------15 psf

The maximum wind speed is assumed 110 MPH per ASCE-7-16 with exposure category B for risk category II per King County.

Ground peak accelerations is 0.607g and seismic design category D2.

The maximum bearing pressure on soil was considered at least 1500 psf . Concrete strength is assumed to be at least 2500 psi

Material Properties for Design

$f'_c := 2500psi$ Concrete compressive strength

$f_y := 60 \cdot ksi$ Yield strength of rebar

$f_{soil.bearing} := 1500psf$ Minimum soil bearing capacity

$\gamma_{concrete} := 150pcf$ Concrete unit weight

$\gamma_{steel} := 490pcf$ Steel unit weight

$E_s := 29000ksi$ Young modulus of steel

$E_c := 57000 \cdot \sqrt{\frac{f'_c}{psi}} \cdot psi = 2.85 \times 10^3 \cdot ksi$ Young modulus of concrete (ACI-318-14)

Load Assumptions

$LL_{floor} := 40psf$ Floor live load

$DL_{floor} := 15psf$ Floor dead load

$DL_{roof} := 15psf$ Roof dead load

$LL_{roof} := 20psf$ Roof live load

$SL_{roof} := 25psf$ Roof snow load

LATERAL LOAD CALCULATION Parameters
(SEISMIC & WIND)

Seismic Force Calculation on Building-ASCE7-16 for Wood Frame Structure

Site Class D was considered for this project according to IBC 1613.3.2

According to USGS Data for the site the seismic parameters are according to the followings

$PGA := 0.607$ Peak Ground Acceleration from USGS site

$S_{DS} := 1.134$ Design short period acceleration

$S_S := 1.418$ Short period spectral

$S_1 := 0.493$ Long Period Spectral

$F_a := 1.2$ Table 11.4.1

$F_v := 1.8$ Table 11.4.2

$S_{MS} := F_a \cdot S_S = 1.702$ 11-4-1

$S_{M1} := F_v \cdot S_1 = 0.887$ 11-4-2

$S_{D1} := \frac{2}{3} \cdot S_{M1} = 0.592$

$T_s := \frac{S_{D1}}{S_{DS}} \cdot s = 0.522\,s$

$h_{building} := 30ft$ Height of building

$W_{ext} := 12psf$ Weight of external walls

$T_a := 0.02 \cdot \left(\frac{h_{building}}{ft}\right)^{0.75} \cdot s = 0.256\,s$ Fundamental period of structure ASCE 7-16-12.8.7

$T_L := 6s$ Long period Transition ACE 7-16- Fig 22-14

$R := 6.5$ Seismic Modification factor for light frame ASCE 7-16- Table 12.2.1

$I := 1.0$ Importance factor for residential building

$\frac{T_a}{1.5 \cdot T_s} = 0.328$ Ta is less than 1.5Ts. Equation ASCE 716- 12.8.2 should be used

$C_S := \frac{S_{DS}}{\left(\frac{R}{I}\right)} = 0.174$ Seismic Response Factor ASCE 7-16-12.8.1.1

$C_{S.min} := .044 S_{DS} \cdot I = 0.05$ Cs is more than minimum-OK

$C_{S.Design} := \max\left(C_S, C_{S.min}\right) = 0.174$

Force Distribution Along the Height

$N_{story} := 3$ Number of story including roof

$i := 1 .. N_{story}$

$j := 1 .. N_{story}$

$W_1 := 2780\left(ft^2\right) \cdot DL_{floor} + W_{ext} \cdot 248ft10ft = 71.46 \cdot kip$ Total dead weight of second floor

$W_2 := 2250ft^2 \cdot DL_{floor} + W_{ext} \cdot (230ft)\ 12ft = 66.87 \cdot kip$ Total dead weight of second floor

$W_3 := 2250ft^2 \cdot DL_{roof} + W_{ext} \cdot 208ft \cdot \frac{12ft}{2} = 48.726 \cdot kip$ Total dead weight of third floor

$h_{floor_1} := 7ft$ Height of first floor from ground

$h_{floor_2} := h_{floor_1} + 11ft = 18 \cdot ft$ Height of second floor from ground

$h_{floor_3} := h_{floor_2} + 12ft = 30 \cdot ft$ Height of second floor from ground

$$V_{base_EQ.wall} := C_{S.Design} \cdot \sum_{i=1}^{N_{story}} W_i = 32.634 \cdot kip$$

Total base shear due to seismic for all building

$$C_{v_i} := \frac{W_i \cdot h_{floor_i}}{\sum_{i=1}^{N_{story}} \left(W_i \cdot h_{floor_i}\right)}$$

Story force distribution factor- ASCE7-16-12.8-12

$C_{v_i} =$

$F_i := C_{v_i} \cdot V_{base_EQ.wall}$ Seismic force at each floor

$F_i =$

$\cdot kip$

$$V_{story_j} := \sum_{i=j}^{N_{story}} F_i$$

Shear at each floor

$V_{story_j} =$

$\cdot kip$

Wind Force Calculation on Building-ASCE7-16

$I := 1$	Risk category II for residential structure	ASCE7-16-Table 1.5.1
$V_{wind} := 110 \frac{mi}{hr}$	Wind speed	ASCE7-16-Fig 26.5.1B
$K_d := 0.85$	Wind directionality factor for buildings	ASCE7-16-Table 26.6-1

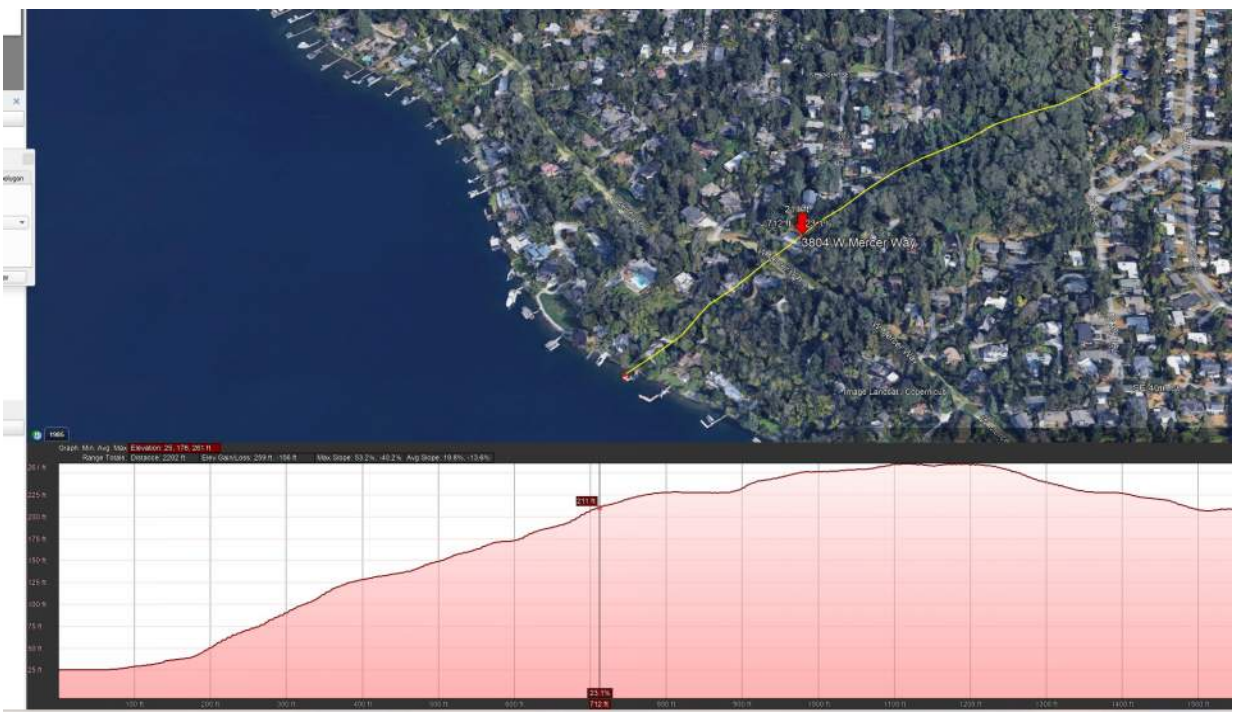
Exposure Category B was considered for this design according to king County

$L_{house} := 58ft$

House foot print dimension

$W_{house} := 50.5ft$

Topographic Factor



$H_{zt} := 260ft - 25ft = 235 \cdot ft$ Height of hill from lowest side

$L_h := 1125ft - 438ft = 687 \cdot ft$ Distance from hill to location with half of hill height

$K_1 := 0.75 \cdot \frac{H_{zt}}{L_h} = 0.257$ From table 26.8-1 for Exposure B

$x := (1125ft - 708ft) = 417 \cdot ft$ Distance from crest to building

$\mu_{upwind} := 1.5$ From table 26.8-1

$\mu_{downwind} := 4$ From table 26.8-1-2D Escapement

$\gamma := 2.5$ 2D Escapement

$K_{2_upwind} := 1 - \frac{x}{L_h \cdot \mu_{upwind}} = 0.595$

$K_{2_downwind} := 1 - \frac{x}{L_h \cdot \mu_{downwind}} = 0.848$

$K_3 := e^{-\gamma \cdot \frac{h_{building}}{L_h}} = 0.897$

$K_{zt.upwind} := \left(1 + K_1 \cdot K_{2_upwind} \cdot K_3\right)^2 = 1.293$ ASCE7-16- 26.8.2

$K_{zt.downwind} := \left(1 + K_1 \cdot K_{2_downwind} \cdot K_3\right)^2 = 1.428$

$K_{zt} := \max\left(K_{zt.downwind}, K_{zt.upwind}\right) = 1.428$

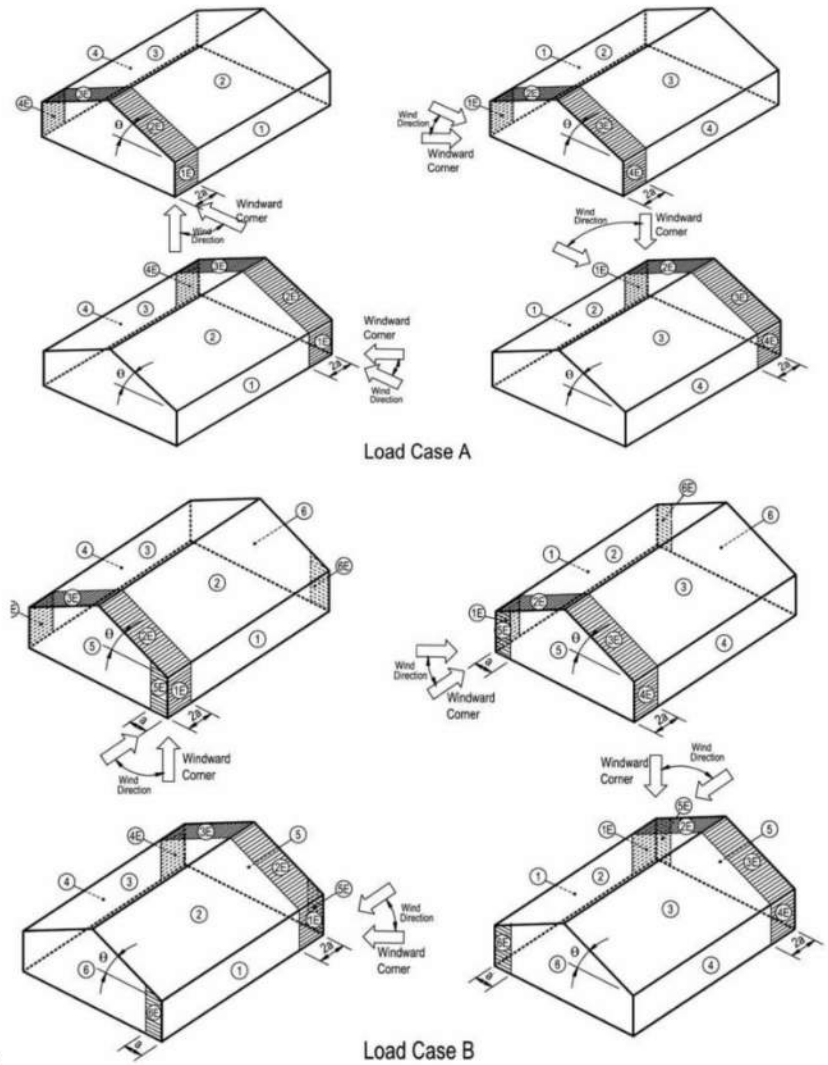
$K_e := 1.0$	Ground elevation factor	ASCE7-16-26.9
$GC_{pi} := -0.18$	Internal Pressure Coefficient for enclosed building	ASCE7-16-Table 26.13-1
$K_z := 0.7$	Velocity pressure exposure coefficient-Assume 25 ft total height for exposure B	ASCE7-16-Table 26.10-1

$$q_z := 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot K_e \cdot \left(\frac{V_{wind}}{\frac{mi}{hr}} \right)^2 \cdot \frac{lbf}{ft^2} = 26.325 \cdot psf$$

$\theta_{roof} := atan\left(\frac{0}{12}\right) = 0 \cdot deg$ Approximate roof angle

Wind Load On building Using Envelope Procedure-Chapter 28 ASCE7-16

Diagrams



Notation

a 10% of least horizontal dimension or 0.4 *h*, 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 0.8 *h*.

h Mean roof height, in feet (meters), except that eave height shall be used for $\theta \le 10°$.

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

$$a := \frac{\max\left(\min\left(0.1\cdot\min\left(L_{house}, W_{house}\right), 0.4\cdot h_{building}\right), 0.04\cdot\min\left(L_{house}, W_{house}\right), 3\,ft\right)}{\min\left(L_{house}, W_{house}\right)} = 0.1$$

Load Case A

Roof Angle θ (degrees)	Building Surface 1	2	3	4	1E	2E	3E	4E
0–5	0.40	−0.69	−0.37	−0.29	0.61	−1.07	−0.53	−0.43
20	0.53	−0.69	−0.48	−0.43	0.80	−1.07	−0.69	−0.64
30–45	0.56	0.21	−0.43	−0.37	0.69	0.27	−0.53	−0.48
90	0.56	0.56	−0.37	−0.37	0.69	0.69	−0.48	−0.48

Load Case B

Roof Angle θ (degrees)	Building Surface 1	2	3	4	5	6	1E	2E	3E	4E	5E	6E
0–90	−0.45	−0.69	−0.37	−0.45	0.40	−0.29	−0.48	−1.07	−0.53	−0.48	0.61	−0.43

The structure is regular shape and less than 60 ft high, so chapter 28 is applicable to use

Load Case A

External pressure on wall for 10 deg roof (Conservatively assumed 20 deg) ASCE7-16-Table 28.3-1

$$angle := \begin{pmatrix} 0 \\ 5 \\ 20 \\ 30 \\ 45 \\ 90 \end{pmatrix} deg \quad wall_{p.factor.1} := \begin{pmatrix} 0.4 \\ 0.4 \\ 0.53 \\ 0.56 \\ 0.56 \\ 0.56 \end{pmatrix} \quad wall_{p.factor.2} := \begin{pmatrix} -0.69 \\ -0.69 \\ -0.69 \\ 0.21 \\ 0.21 \\ 0.56 \end{pmatrix} \quad wall_{p.factor.3} := \begin{pmatrix} -0.37 \\ -0.37 \\ -0.48 \\ -0.43 \\ -0.43 \\ -0.37 \end{pmatrix}$$

$$wall_{p.factor.4} := \begin{pmatrix} -0.29 \\ -0.29 \\ -0.43 \\ -0.37 \\ -0.37 \\ -0.37 \end{pmatrix} \quad wall_{p.factor.1E} := \begin{pmatrix} 0.61 \\ 0.61 \\ 0.8 \\ 0.69 \\ 0.69 \\ 0.69 \end{pmatrix} \quad wall_{p.factor.2E} := \begin{pmatrix} -1.07 \\ -1.07 \\ -1.07 \\ 0.27 \\ 0.27 \\ 0.69 \end{pmatrix}$$

$$wall_{p.factor.3E} := \begin{pmatrix} -0.53 \\ -0.53 \\ -0.69 \\ -0.53 \\ -0.53 \\ -0.48 \end{pmatrix} \qquad wall_{p.factor.4E} := \begin{pmatrix} -0.43 \\ -0.43 \\ -0.64 \\ -0.48 \\ -0.48 \\ -0.48 \end{pmatrix}$$

$$wall_{factor.A.1}(\theta) := linterp(angle, wall_{p.factor.1}, \theta)$$

$$wall_{factor.A.2}(\theta) := linterp(angle, wall_{p.factor.2}, \theta)$$

$$wall_{factor.A.3}(\theta) := linterp(angle, wall_{p.factor.3}, \theta)$$

$$wall_{factor.A.4}(\theta) := linterp(angle, wall_{p.factor.4}, \theta)$$

$$wall_{factor.A.1E}(\theta) := linterp(angle, wall_{p.factor.1E}, \theta)$$

$$wall_{factor.A.2E}(\theta) := linterp(angle, wall_{p.factor.2E}, \theta)$$

$$wall_{factor.A.3E}(\theta) := linterp(angle, wall_{p.factor.3E}, \theta)$$

$$wall_{factor.A.4E}(\theta) := linterp(angle, wall_{p.factor.4E}, \theta)$$

Weighted averaging along length

Wal pressure ASCE7-16-Table 28.3-1

$$GC_{p_wall_windward.A} := a \cdot wall_{factor.A.1E}(\theta_{roof}) + (1 - a) \cdot wall_{factor.A.1}(\theta_{roof}) = 0.421$$

$$GC_{p_wall_leeward.A} := a \cdot wall_{factor.A.4E}(\theta_{roof}) + (1 - a) \cdot wall_{factor.A.3}(\theta_{roof}) = -0.376$$

External pressure for roof ASCE7-16-Table 28.3-1

$GC_{p_roof_windward.A} := a \cdot wall_{factor.A.2E}(\theta_{roof}) + (1 - a) \cdot wall_{factor.A.2}(\theta_{roof}) = -0.728$

$GC_{p_roof_leeward.A} := a \cdot wall_{factor.A.3E}(\theta_{roof}) + (1 - a) \cdot wall_{factor.A.3}(\theta_{roof}) = -0.386$

Wind pressure for Case A ASCE7-16-28-3-1

$p_{wind_wall_windward.A} := q_z \cdot (GC_{p_wall_windward.A} + if(GC_{p_wall_windward.A} > 0, -GC_{pi}, GC_{pi})) = 15.821 \cdot psf$

$p_{wind_wall_leeward.A} := q_z \cdot (GC_{p_wall_leeward.A} + if(GC_{p_wall_leeward.A} > 0, -GC_{pi}, GC_{pi})) = -14.636 \cdot psf$

$p_{wind_roof_windward.A} := q_z \cdot (GC_{p_roof_windward.A} + if(GC_{p_roof_windward.A} > 0, -GC_{pi}, GC_{pi})) = -23.903 \cdot psf$

$p_{wind_roof_leeward.A} := q_z \cdot (GC_{p_roof_leeward.A} + if(GC_{p_roof_leeward.A} > 0, -GC_{pi}, GC_{pi})) = -14.9 \cdot psf$

Load Case B

$GC_{p_wall_windward.B} := a \cdot 0.61 + (1 - a) \cdot 0.4 = 0.421$

ASCE7-16-Table 28.3-1

$GC_{p_wall_leeward.B} := -a \cdot 0.43 + -(1 - a) \cdot 0.29 = -0.304$

$GC_{p_wall_windward.B_orthogonal} := a \cdot -0.48 + (1 - a) \cdot -0.45 = -0.453$

ASCE7-16-Table 28.3-1

$GC_{p_wall_leeward.B_orthogonal} := a \cdot -0.48 + (1 - a) \cdot -0.45 = -0.453$

External pressure for roof ASCE7-16-Table 28.3-1

$GC_{p_roof_windward.B} := a \cdot -1.07 + (1 - a) \cdot -0.69 = -0.728$ Windward pressure for roof

$GC_{p_roof_leeward.B} := -a \cdot 0.53 - (1 - a) \cdot .37 = -0.386$ Leeward pressure for roof

Wind pressure ASCE7-16-28-3-1

$p_{wind_wall_windward.B} := q_z \cdot if\left(GC_{p_wall_windward.B} > 0, -GC_{pi}, GC_{pi}\right) = 4.738 \cdot psf$

$p_{wind_wall_leeward.B} := q_z \cdot if\left(GC_{p_wall_leeward.B} > 0, -GC_{pi}, GC_{pi}\right) = -4.738 \cdot psf$

$p_{wind_wall_windward.B_orthogonal} := q_z \cdot \left(GC_{p_wall_windward.B_orthogonal} \cdots + if\left(GC_{p_wall_windward.B_orthogonal} > 0, -GC_{pi}, GC_{pi}\right)\right) = -16.663 \cdot p$

$p_{wind_wall_leeward.B_orthogonal} := q_z \cdot \left(GC_{p_wall_leeward.B_orthogonal} \cdots + if\left(GC_{p_wall_leeward.B_orthogonal} > 0, -GC_{pi}, GC_{pi}\right)\right) = -16.663 \cdot psf$

$p_{wind_roof_windward.B} := q_z \cdot \left(GC_{p_roof_windward.B} \cdots + if\left(GC_{p_roof_windward.B} > 0, -GC_{pi}, GC_{pi}\right)\right) = -23.903 \cdot psf$

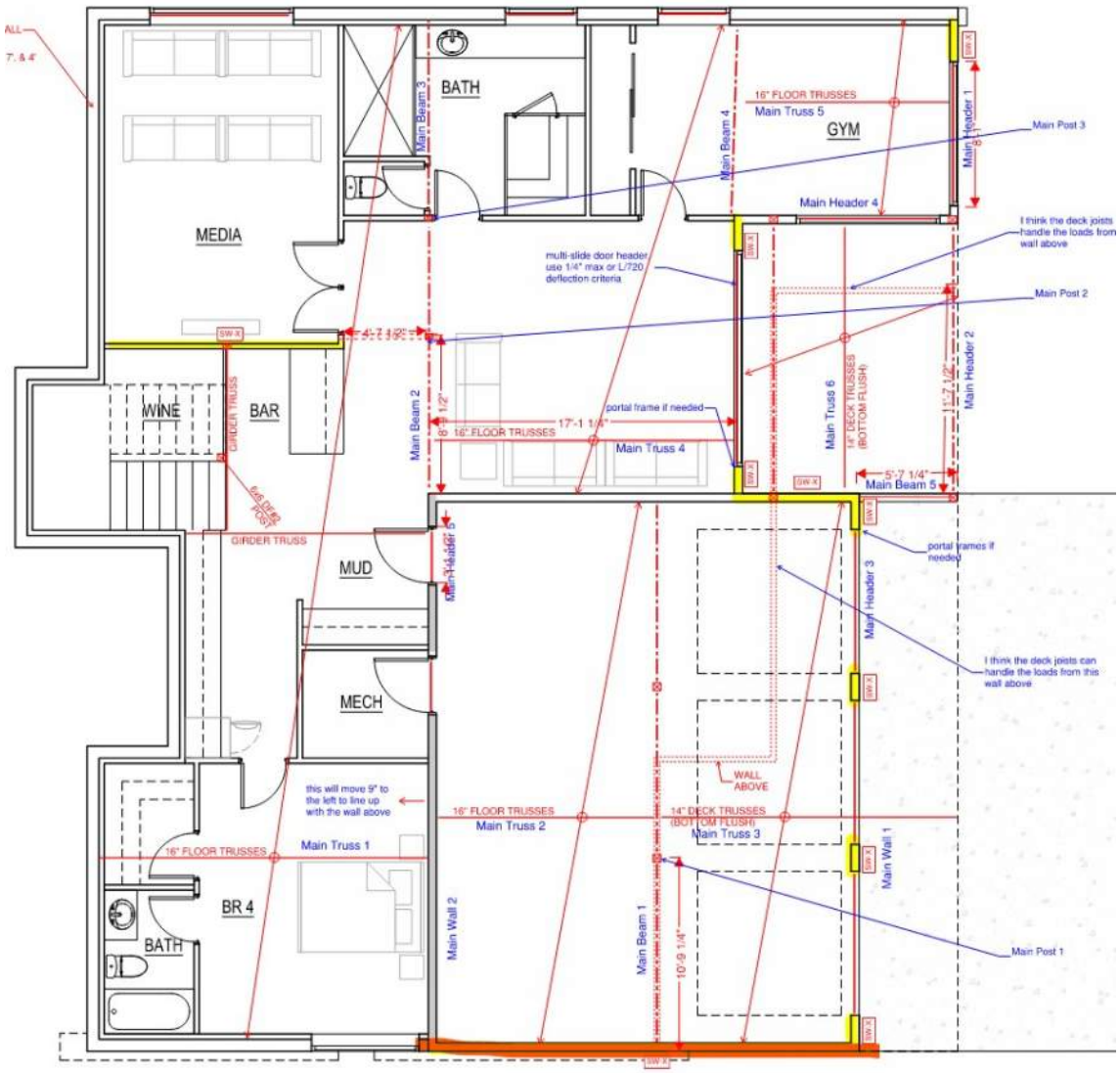
$p_{wind_roof_leeward.B} := q_z \cdot \left(GC_{p_roof_leeward.B} + if\left(GC_{p_roof_leeward.B} > 0, -GC_{pi}, GC_{pi}\right)\right) = -14.9 \cdot psf$

ASD load combination used for frame design :
- D+S
- D+ 0.6W
- D+0.7E
- D+0.75x0.6W+0.75L+0.75S
- D+0.75 x 0.7 E+0.75L+0.75S
- 0.6 D+0.6W
- 0.6D+0.7E

LRFD load combination for concrete design:
- 1.4D
-1.2D+1.6S
- 1.2D+1.6S+0.5W
- 1.2D+1.0W+0.5S
- 1.2D+1.0E+0.2S
- 0.9D+1.0W
- 0.9D+1.0E

Shear Wall Design for Lateral Load in East-West Direction per NDS-SDPWS2015

First Floor- Shear wall



$$V_{EQ} := V_{story_1} \cdot \frac{750ft^2}{2780ft^2} = 8.804 \cdot kip$$

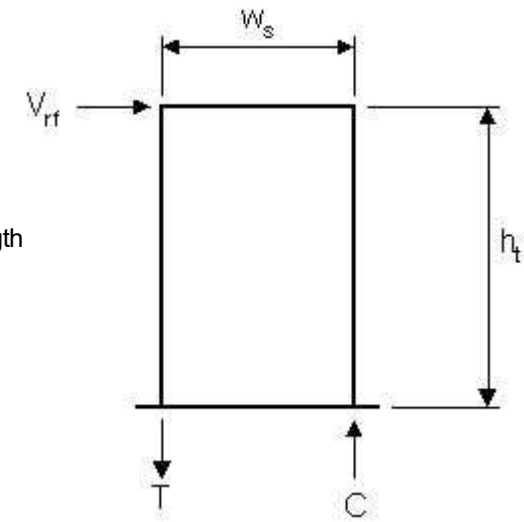
Tributary shear on the wall per plan dimensions

$$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 17.5ft \cdot h_{floor_3} = 15.99 \cdot kip$$

Wind load

$L_s := 24ft$ Wall height

Total shear wall length



First Segment:

$h_t := 9 \cdot ft$

$w_s := 24ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 0.375$ $\quad check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $\quad check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $\quad (WSP) = 1.0$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $\quad V_{rf.w} = 9.59 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $\quad V_{rf.E} = 6.16 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.w} = 86.3 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.E} = 55.5 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := 0 = 0 \cdot lbf$

Total gravity load on wall

$P_{rf} = 0 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wal self weight load $P_w = 2.592 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2} \right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 18.662 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 1$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 400 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 257 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.4} \cdot n}{\Omega_s} = 490 \cdot plf$ $check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.w}}{w_{all.w}} = 0.816$ $check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.4} \cdot n}{\Omega_s} = 350 \cdot plf$ $check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK" \right)$

$check_{wE} = "OK"$

Single Sided 7/16" sheathing w/ 8d @ 4**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Sill Plate Anchorage

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness

$dia_a := 0.625in$ Anchor Diameter

$sp_a := 32in$ Anchor spacing

$Z_{ll} := v_{A.625_2x} \cdot C_D = 1.488 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := \max(w_{v.w}, w_{v.E}) \cdot sp_a = 1.066 \cdot kip$ Shear load to each anchor

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.716$ $Check_a = "OK"$

Use 5/8" Dia. Anchor at 32"o.c. (7" min. embed)

Holdown

$$T := \frac{\max(M_{ot.w}, M_{ot.E}) - M_{res}}{w_s} = 2.82 \cdot kip$$

$check_T := if(T > 150lbf, "HD\ REQ'D", "NOT\ REQ'D")$ $check_T = "HD\ REQ'D"$

$T_{all} := HDU4 = 4.565 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 0.618$ $check_{HD} = "OK"$

Anchor

$$d_b := \begin{cases} \frac{5}{8}in & \text{if } T_{all} = HDU4 \vee T_{all} = HDU5 \\ \frac{7}{8}in & \text{if } T_{all} = HDU8 \\ 1in & \text{otherwise} \end{cases}$$

Bolt diameter

$d_b = 0.625 \cdot in$

$A_b := \frac{\pi}{4} \cdot (d_b)^2 = 0.307 \cdot in^2$ Area of bolt including thread

$F_y := 36ksi$ Nominal strength of bolt-F1554

$\Omega := 1.67$ ASD factor

$$T_{a.capacity} := \frac{A_b \cdot F_y}{\Omega} = 6.614 \cdot kip$$

$Check_{anchor} := \left(if\left(\frac{T}{T_{a.capacity}} \le 1, "OK", "NG"\right)\right)$ $\frac{T}{T_{a.capacity}} = 0.426$ $Check_{anchor} = "OK"$

Footing Uplift

$L_{ftg} := 24ft$	Length of footing	$t_{slab} := 0in$	Slab thickness
$W_{ftg} := 16in$	Width of footing	$trib_{slab} := 0ft$	Slab tributary
$t_{ftg} := 6in$	Thickness of footing	$t_{stem} := 6in$	Stem wall thick
$trib_{flr} := 0$	Floor/deck tributary	$ht_{stem} := 18in$	Stem wall height

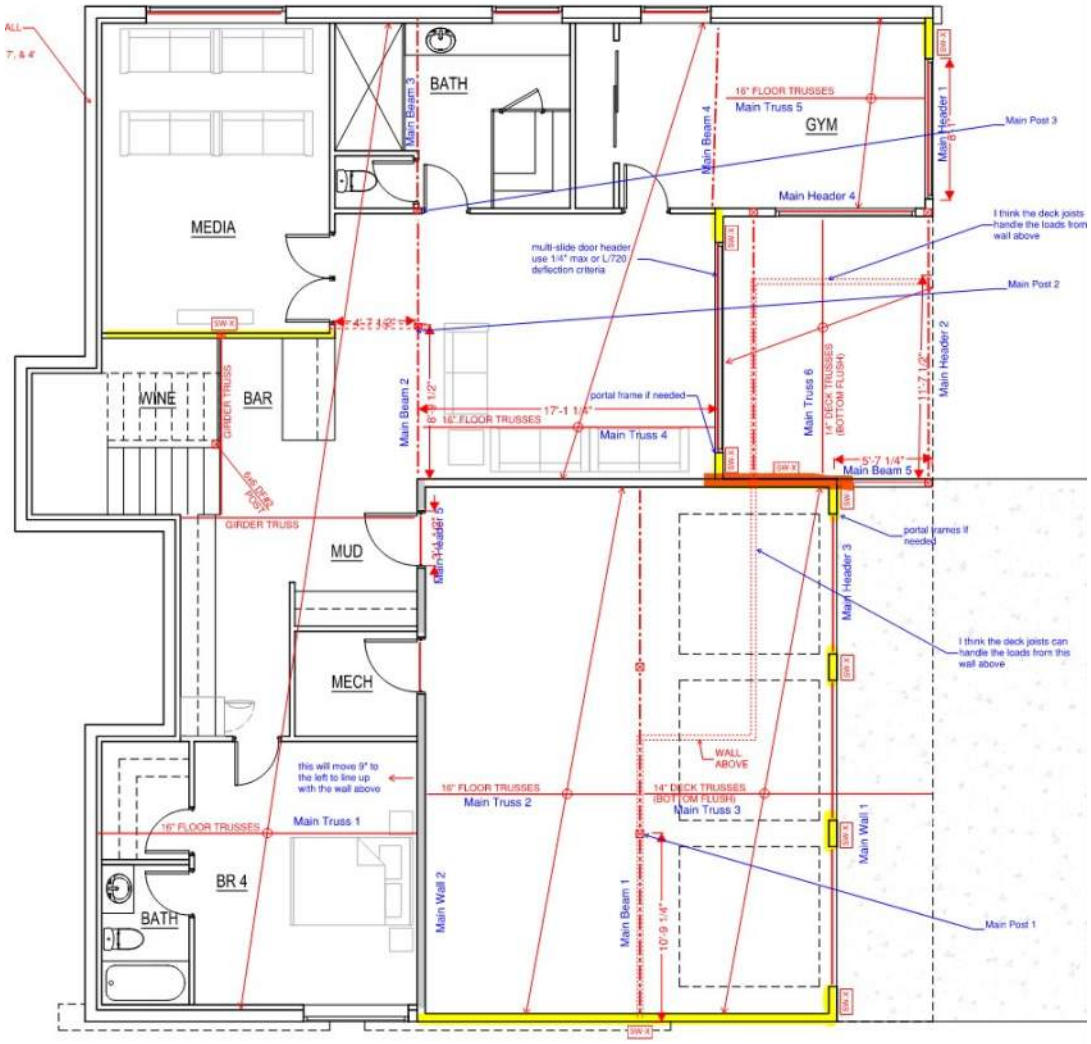
$$wt_{resist} := \left[\left(W_{ftg}\cdot t_{ftg} + t_{slab}\cdot trib_{slab} + t_{stem}\cdot ht_{stem}\right)\cdot L_{ftg}\cdot 150pcf + \left(P_{rf} + P_{w}\right) \ldots + \left(\frac{W_{ftg} - t_{stem}}{2}\right)\cdot ht_{stem}\cdot L_{ftg}\cdot 120pcf\right] = 9.492\cdot kip$$

$$e_{ftg} := \frac{M_{ot.w}}{wt_{resist}} = 9.097\cdot ft$$

$$check_{ftg} := if\left(e_{ftg} \le \frac{L_{ftg}}{2}, \text{"OK"}, \text{"NG-Axial Load is Outside of Footing"}\right)$$

$check_{ftg} = \text{"OK"}$

Use 1'-4"W x 8"D footing w/ (3) #4 Long., #4 @ 10" o.c. Trans

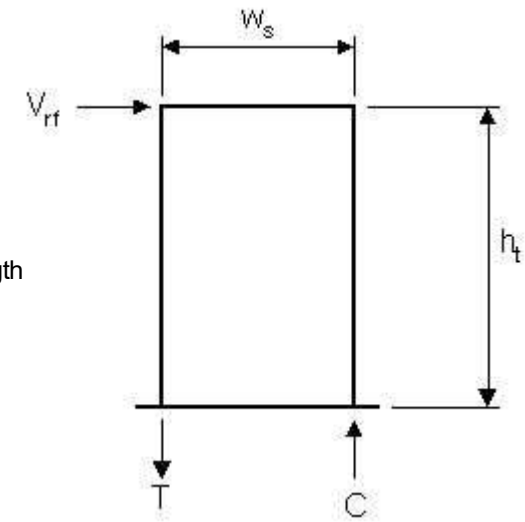


$$V_{EQ} := V_{story_1} \cdot \frac{900ft^2}{2780ft^2} = 10.565 \cdot kip$$

Tributary shear on the wall per plan dimensions

$$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 19ft \cdot h_{floor_3} = 17.361 \cdot kip$$

Wind load



Wal height

$L_s := 24ft$

Total shear wall length

First Segment:

$h_t := 9 \cdot ft$

$w_s := 24ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 0.375$ $\quad check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $\quad check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $\quad (WSP) = 1.0$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $\quad V_{rf.w} = 10.42 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $\quad V_{rf.E} = 7.4 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.w} = 93.7 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.E} = 66.6 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := (DL_{floor}) \cdot \left(\frac{15ft}{2}\right) \cdot w_s + 5626lbf = 8.326 \times 10^3 \cdot lbf$

Total gravity load on wall

$P_{rf} = 8.326 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wal self weight load $P_w = 2.592 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2}\right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 78.61 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 2$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 434 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 308 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.4} \cdot n}{\Omega_s} = 980 \cdot plf$ $check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK"\right)$

$\frac{w_{v.w}}{w_{all.w}} = 0.443$ $check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.4} \cdot n}{\Omega_s} = 700 \cdot plf$ $check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK"\right)$

$\frac{w_{v.E}}{w_{all.E}} = 0.44$ $check_{wE} = "OK"$

Single Sided 7/16" sheathing w/ 8d @ 4**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Sill Plate Anchorage

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness

$dia_a := 0.5in$ Anchor Diameter

$sp_a := 32in$ Anchor spacing

$Z_{ll} := v_{A.625_2x} \cdot C_D = 1.488 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := \max(w_{v.w}, w_{v.E}) \cdot sp_a = 1.157 \cdot kip$ Shear load to each anchor

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.778$ $Check_a = "OK"$

Use 5/8" Dia. Anchor at 32"o.c. (7" min. embed)

Holdown

$$T := \frac{\max(M_{ot.w}, M_{ot.E} \cdot \Omega_o) - M_{res}}{w_s} = 3.658 \cdot kip$$

$check_T := if(T > 150lbf, "HD REQ'D", "NOT REQ'D")$ $check_T = "HD REQ'D"$

$T_{all} := HDU4 = 4.565 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 0.801$ $check_{HD} = "OK"$

Anchor

$$d_b := \begin{cases} \frac{5}{8}in & \text{if } T_{all} = HDU4 \vee T_{all} = HDU5 \\ \frac{7}{8}in & \text{if } T_{all} = HDU8 \\ 1in & \text{otherwise} \end{cases}$$ Bolt diameter

$d_b = 0.625 \cdot in$

$A_b := \frac{\pi}{4} \cdot (d_b)^2 = 0.307 \cdot in^2$ Area of bolt including thread

$F_y := 36ksi$ Nominal strength of bolt-F1554

$\Omega := 1.67$ ASD factor

$$T_{a.capacity} := \frac{A_b \cdot F_y}{\Omega} = 6.614 \cdot kip$$

$$Check_{anchor} := \left(if\left(\frac{\frac{T}{2}}{T_{a.capacity}} \le 1, "OK", "NG" \right) \right) \qquad \frac{\frac{T}{2}}{T_{a.capacity}} = 0.277$$

$Check_{anchor} = "OK"$

Footing Uplift

$L_{ftg} := 12ft$	Length of footing	$t_{slab} := 4in$	Slab thickness
$W_{ftg} := 18in$	Width of footing	$trib_{slab} := 18ft$	Slab tributary
$t_{ftg} := 6in$	Thickness of footing	$t_{stem} := 6in$	Stem wall thick
$trib_{flr} := 0$	Floor/deck tributary	$ht_{stem} := 18in$	Stem wall height

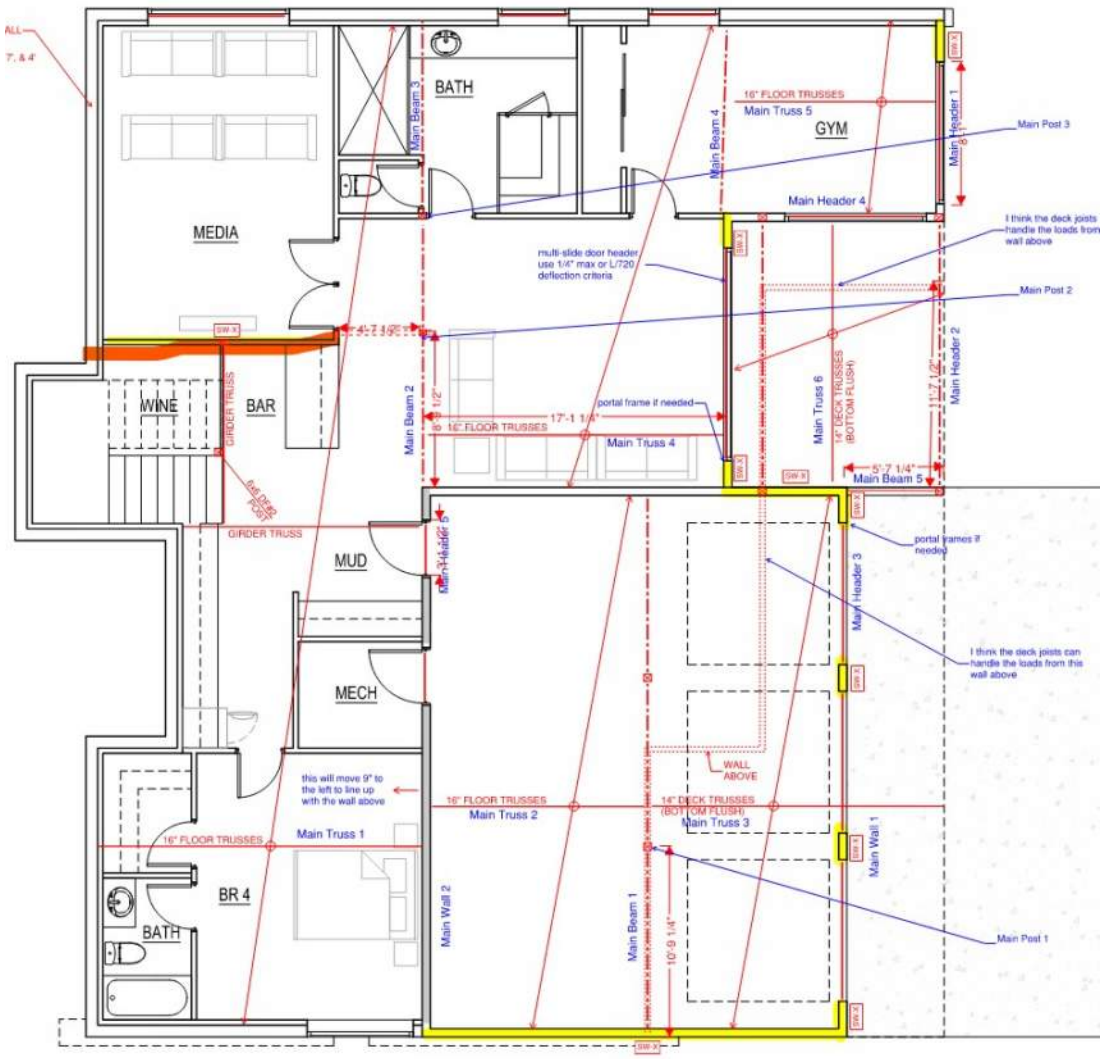
$$wt_{resist} := \left[\left(W_{ftg} \cdot t_{ftg} + t_{slab} \cdot trib_{slab} + t_{stem} \cdot ht_{stem}\right) \cdot L_{ftg} \cdot 150pcf + \left(P_{rf} + P_w\right) \ldots + \left(\frac{W_{ftg} - t_{stem}}{2}\right) \cdot ht_{stem} \cdot L_{ftg} \cdot 120pcf \right] = 25.498 \cdot kip$$

$$e_{ftg} := \frac{M_{ot.w}}{wt_{resist}} = 3.677 \cdot ft$$

$$check_{ftg} := if\left(e_{ftg} \le \frac{L_{ftg}}{2}, "OK", "NG\text{-}Axial\ Load\ is\ Outside\ of\ Footing" \right)$$

$check_{ftg} = "OK"$

Use 1'-4"W x 8"D footing w/ (3) #4 Long., #4 @ 10" o.c. Trans

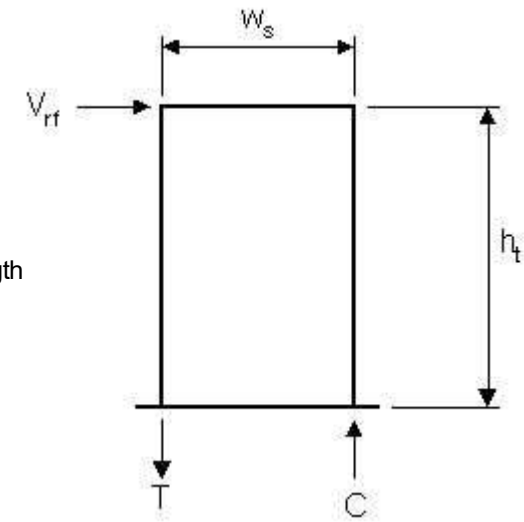


$$V_{EQ} := V_{story_1} \cdot \frac{1000ft^2}{2780ft^2} = 11.739 \cdot kip$$

Tributary shear on the wall per plan dimensions

$$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 22ft \cdot h_{floor_3} = 20.102 \cdot kip$$

Wind load



Wal height

$L_s := 13.5ft + 12ft$

Total shear wall length

First Segment:

$h_t := 9 \cdot ft$

$w_s := 12ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 0.75$ $\quad check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $\quad check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $\quad (WSP) = 1.0$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $\quad V_{rf.w} = 5.68 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $\quad V_{rf.E} = 3.87 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.w} = 51.1 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.E} = 34.8 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := 0 = 0 \cdot lbf$

Total gravity load on wall

$P_{rf} = 0 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wal self weight load $P_w = 1.296 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2} \right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 4.666 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 1$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 473 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 322 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.3} \cdot n}{\Omega_s} = 630 \cdot plf$ $check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.w}}{w_{all.w}} = 0.751$ $check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.3} \cdot n}{\Omega_s} = 450 \cdot plf$ $check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.E}}{w_{all.E}} = 0.716$ $check_{wE} = "OK"$

Double Sided 7/16" sheathing w/ 8d @ 3**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Sill Plate Anchorage

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness

$dia_a := 0.625in$ Anchor Diameter

$sp_a := 16in$ Anchor spacing

$Z_{ll} := v_{A.625_2x} \cdot C_D = 1.488 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := \max(w_{v.w}, w_{v.E} \cdot \Omega_o) \cdot sp_a = 1.074 \cdot kip$ Shear load to each anchor

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $\quad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.722$ $\quad Check_a = "OK"$

Use 5/8" Dia. Anchor at 16"o.c. (7" min. embed)

Holdown

$$T := \frac{\max(M_{ot.w}, M_{ot.E}) - M_{res}}{w_s} = 3.868 \cdot kip$$

$check_T := if(T > 150lbf, "HD REQ'D", "NOT REQ'D")$ $\quad check_T = "HD REQ'D"$

$T_{all} := HDU4 = 4.565 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $\quad ratio := \frac{T}{T_{all}} = 0.847$ $\quad check_{HD} = "OK"$

Anchor

$$d_b := \begin{cases} \frac{5}{8}in & \text{if } T_{all} = HDU4 \vee T_{all} = HDU5 \\ \frac{7}{8}in & \text{if } T_{all} = HDU8 \\ 1in & \text{otherwise} \end{cases}$$ Bolt diameter

$d_b = 0.625 \cdot in$

$A_b := \frac{\pi}{4} \cdot (d_b)^2 = 0.307 \cdot in^2$ Area of bolt including thread

$F_y := 36ksi$ Nominal strength of bolt-F1554

$\Omega := 1.67$ ASD factor

$$T_{a.capacity} := \frac{A_b \cdot F_y}{\Omega} = 6.614 \cdot kip$$

$$Check_{anchor} := \left(if\left(\frac{\frac{T}{2}}{T_{a.capacity}} \le 1, "OK", "NG"\right)\right) \quad \frac{\frac{T}{2}}{T_{a.capacity}} = 0.292$$

$Check_{anchor} = "OK"$

Footing Uplift

$L_{ftg} := 13.5ft$	Length of footing	$t_{slab} := 4in$	Slab thickness
$W_{ftg} := 18in$	Width of footing	$trib_{slab} := 18ft$	Slab tributary
$t_{ftg} := 6in$	Thickness of footing	$t_{stem} := 6in$	Stem wall thick
$trib_{flr} := 0$	Floor/deck tributary	$ht_{stem} := 18in$	Stem wall height

$$wt_{resist} := \left[\left(W_{ftg}\cdot t_{ftg} + t_{slab}\cdot trib_{slab} + t_{stem}\cdot ht_{stem}\right)\cdot L_{ftg}\cdot 150pcf + \left(P_{rf} + P_{w}\right) \ldots + \left(\frac{W_{ftg} - t_{stem}}{2}\right)\cdot ht_{stem}\cdot L_{ftg}\cdot 120pcf\right] = 17.698\cdot kip$$

$$e_{ftg} := \frac{M_{ot.w}}{wt_{resist}} = 2.886\cdot ft$$

$$check_{ftg} := if\left(e_{ftg} \le \frac{L_{ftg}}{2}, \text{"OK"}, \text{"NG-Axial Load is Outside of Footing"}\right)$$

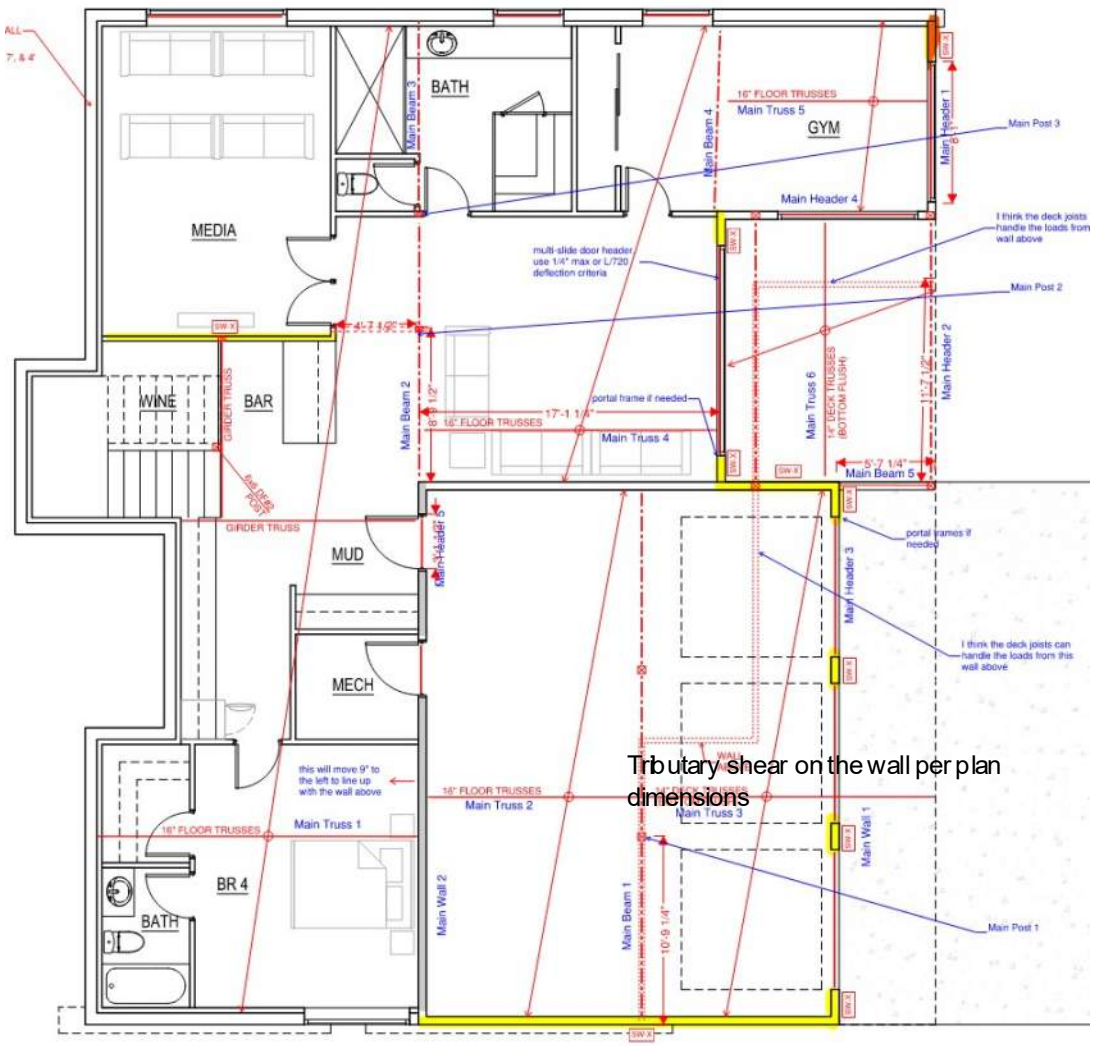
$check_{ftg} = \text{"OK"}$

Use 1'-4"W x 8"D footing w/ (3) #4 Long., #4 @ 10" o.c. Trans

Shear Wall Design for Lateral Load in North-South Direction per NDS-SDPWS2015

Firs Floor- Shear wall

As the retaining wall at west side is high up, it is assumed that the base shear for half of building (west side) will be taken by concrete walls for shear in norht-south direction and below would be wood frame wall designed for other half in east side.



$V_{EQ} := V_{story_1} \cdot \frac{177ft^2}{2780ft^2} = 2.078 \cdot kip$ Tributary shear on the wall per plan dimensions

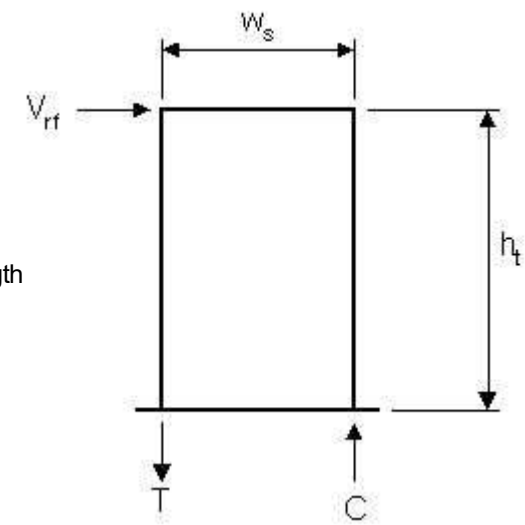
$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 4ft \cdot \left(h_{floor_3}\right) = 3.655 \cdot kip$

Wind load

$h_t := 9 \cdot ft$ Wal height

$L_s := 2ft + 4in$

Total shear wall length



First Segment:

$w_s := (3ft + 8in)$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 2.455$ $check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $(WSP) = 0.9$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $V_{rf.w} = 3.45 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $V_{rf.E} = 2.29 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $M_{ot.w} = 31 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $M_{ot.E} = 20.6 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := (DL_{floor}) \cdot \left(\frac{12ft}{2}\right) \cdot w_s$ Total gravity load on wall

$P_{rf} = 0.33 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wal self weight load $P_w = 0.396 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2}\right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 0.799 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 2$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 940 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 623 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.4} \cdot n}{\Omega_s} = 924.3 \cdot plf$ $check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK"\right)$

$\frac{w_{v.w}}{w_{all.w}} = 1.017$ $check_{wv} = "NG"$

It is less than 5% above-EOR is OK

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.4} \cdot n}{\Omega_s} = 660.2 \cdot plf$ $check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK"\right)$

$\frac{w_{v.E}}{w_{all.E}} = 0.944$ $check_{wE} = "OK"$

Double Sided 7/16" sheathing w/ 8d @ 4**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Sill Plate Anchorage

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness

$dia_a := 0.5in$ Anchor Diameter

$sp_a := 12in$ Anchor spacing

$Z_{ll} := v_{A.625_2x} \cdot C_D = 1.488 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := \max(w_{v.w}, w_{v.E} \cdot \Omega_o) \cdot sp_a = 1.558 \cdot kip$ Shear load to each anchor

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 1.047$ $Check_a = "NG"$

Use 5/8" Dia. Anchor at 30"o.c. (7" min. embed)

It is less than 5% above-EOR is OK

Holdown

$$T := \frac{\max(M_{ot.w}, M_{ot.E} \cdot \Omega_o) - M_{res}}{w_s} = 13.807 \cdot kip$$

$check_T := if(T > 150lbf, "HD\ REQ'D", "NOT\ REQ'D")$ $check_T = "HD\ REQ'D"$

$T_{all} := 2HDU8 = 13.53 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 1.02$ $check_{HD} = "NG"$

It is less than 5% above-EOR is OK

Anchor

$$d_b := \begin{cases} \frac{5}{8}in & \text{if } T_{all} = HDU4 \vee T_{all} = HDU5 \\ \frac{7}{8}in & \text{if } T_{all} = HDU8 \\ 1in & \text{otherwise} \end{cases}$$

Bolt diameter

$d_b = 1 \cdot in$

$A_b := \frac{\pi}{4} \cdot (d_b)^2 = 0.785 \cdot in^2$ Area of bolt including thread

$F_y := 36ksi$ Nominal strength of bolt-F1554

$\Omega := 1.67$ ASD factor

$$T_{a.capacity} := \frac{A_b \cdot F_y}{\Omega} = 16.931 \cdot kip$$

$$Check_{anchor} := \left(if\left(\frac{T}{T_{a.capacity}} \le 1, "OK", "NG"\right)\right) \qquad \frac{T}{T_{a.capacity}} = 0.816$$

$Check_{anchor} = "OK"$

Footing Uplift

$L_{ftg} := 12ft$	Length of footing	$t_{slab} := 4in$	Slab thickness
$W_{ftg} := 16in$	Width of footing	$trib_{slab} := 27ft$	Slab tributary
$t_{ftg} := 6in$	Thickness of footing	$t_{stem} := 6in$	Stem wall thick
$trib_{flr} := 0$	Floor/deck tributary	$ht_{stem} := 18in$	Stem wall height

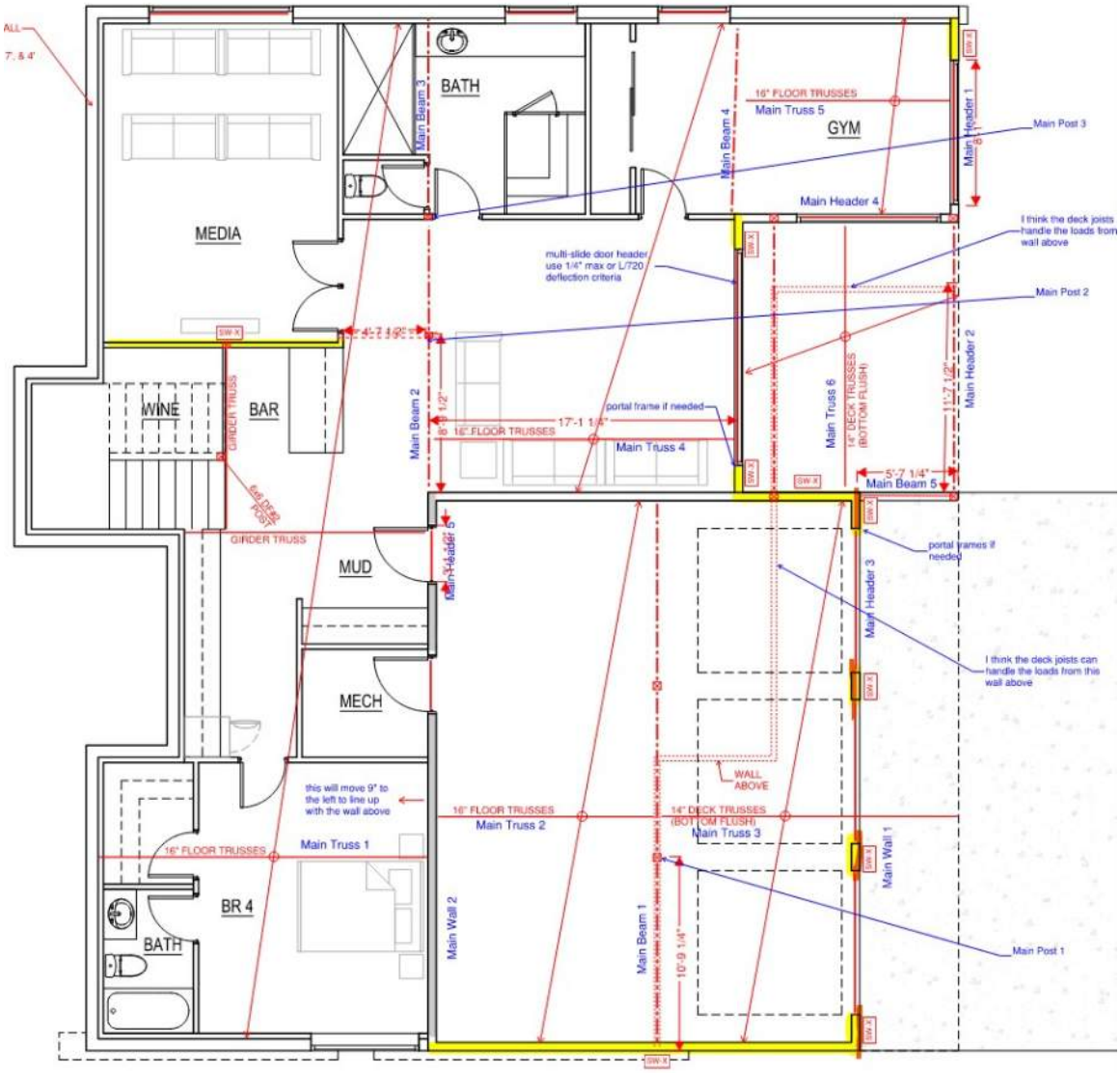
$$wt_{resist} := \left[\left(W_{ftg} \cdot t_{ftg} + t_{slab} \cdot trib_{slab} + t_{stem} \cdot ht_{stem}\right) \cdot L_{ftg} \cdot 150pcf + \left(P_{rf} + P_{w}\right) \ldots + \left(\frac{W_{ftg} - t_{stem}}{2}\right) \cdot ht_{stem} \cdot L_{ftg} \cdot 120pcf\right] = 20.376 \cdot kip$$

$$e_{ftg} := \frac{M_{ot.w}}{wt_{resist}} = 1.522 \cdot ft$$

$$check_{ftg} := if\left(e_{ftg} \le \frac{L_{ftg}}{2}, "OK", "NG\text{-}Axial\ Load\ is\ Outside\ of\ Footing"\right)$$

$check_{ftg} = "OK"$

Use 1'-4"W x 8"D footing w/ (3) #4 Long., #4 @ 10" o.c. Trans



$$V_{EQ} := V_{story_1} \cdot \frac{250ft^2}{2780ft^2} + V_{EQ} = 5.013 \cdot kip$$

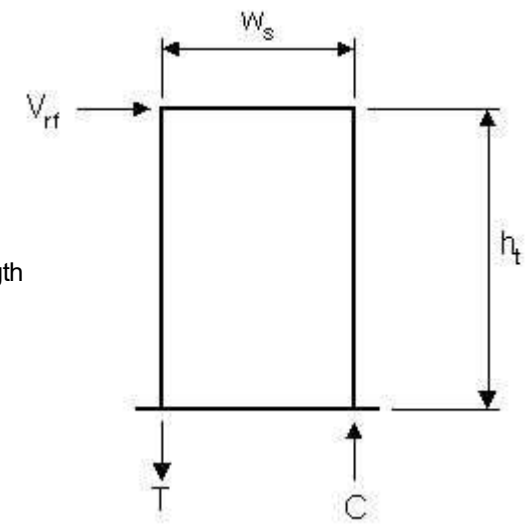
Tributary shear on the wall per plan dimensions

$$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 6ft \cdot \left(h_{floor_3}\right) + V_{wind} = 9.137 \cdot kip$$

Wind load

$h_t := 9ft$ Wal height

$L_s := 2ft + 3ft$ Total shear wall length



First Segment:

$w_s := 2ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 4.5$ $\quad check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $\quad check_{ratio} = "NG"$

these segments will be designed as portal frame

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $\quad (WSP) = 0.7$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $\quad V_{rf.w} = 2.19 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $\quad V_{rf.E} = 1.4 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.w} = 19.7 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.E} = 12.6 \cdot kip \cdot ft$

Resisting Forces

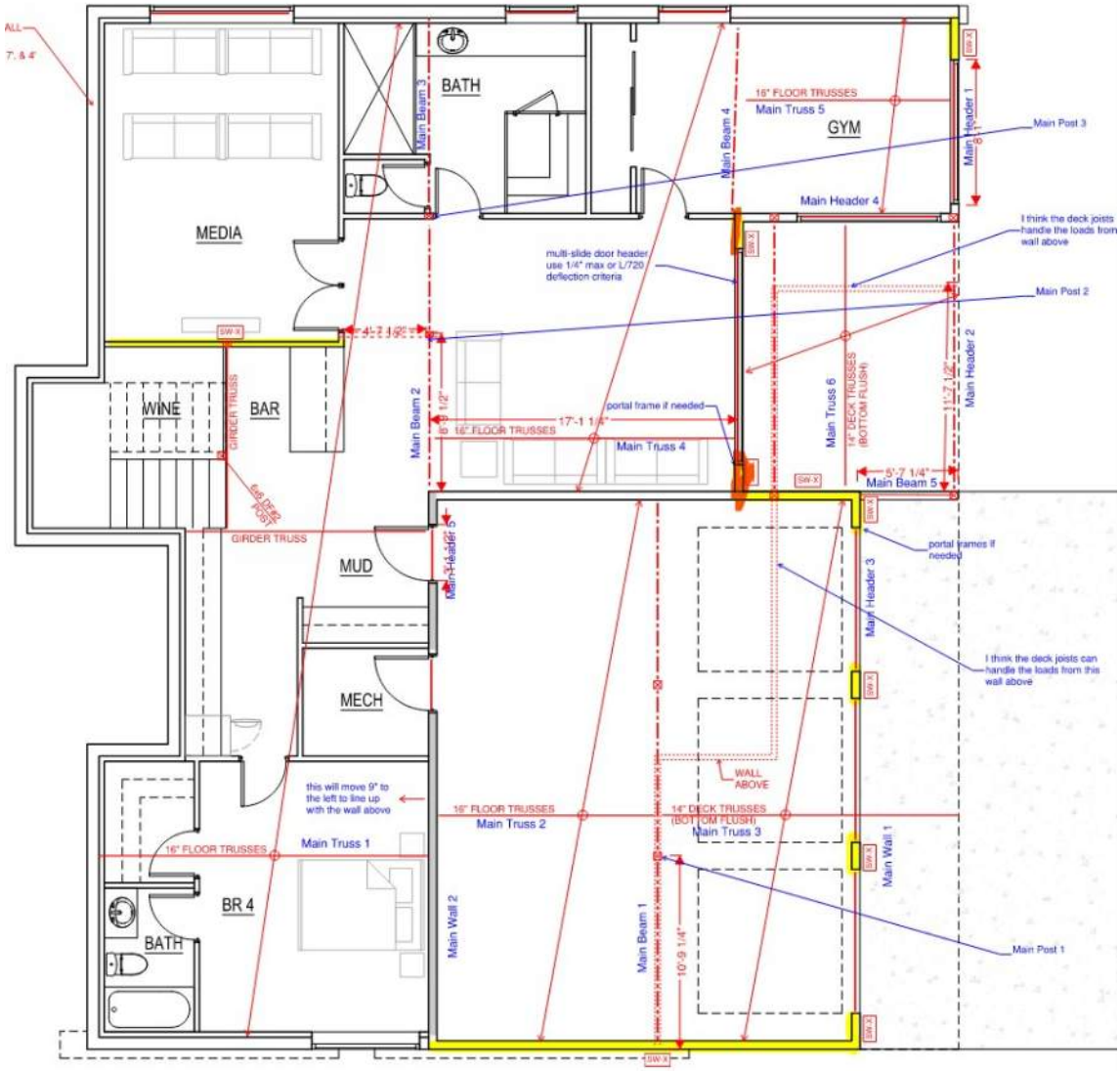
$P_{rf} := (DL_{floor}) \cdot \left(\frac{12ft}{2}\right) \cdot w_s$

Total gravity load on wall

$P_{rf} = 0.18 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wall self weight load $P_w = 0.216 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2}\right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 0.238 \cdot kip \cdot ft$



$$V_{EQ} := V_{story_1} \cdot \frac{850ft^2}{2780ft^2} + V_{EQ} = 14.991 \cdot kip$$

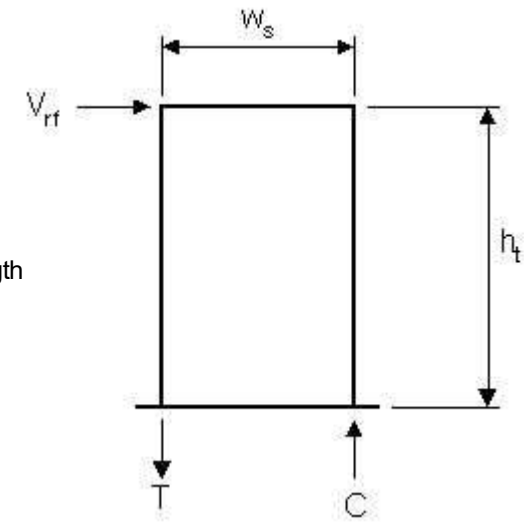
Tributary shear on the wall per plan dimensions

$$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 14ft \cdot \left(h_{floor_3}\right) + V_{wind} = 21.929 \cdot kip$$

Wind load

$h_t := 9ft$ Wall height

$L_s := 2 \cdot 3ft$ Total shear wall length



First Segment:

$w_s := 2ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 4.5$

$check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$

$check_{ratio} = "NG"$

smaller segments will be simpson strong wall

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor

$(WSP) = 0.7$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD)

$V_{rf.w} = 4.39 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD)

$V_{rf.E} = 3.5 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD)

$M_{ot.w} = 39.5 \cdot kip \cdot ft$

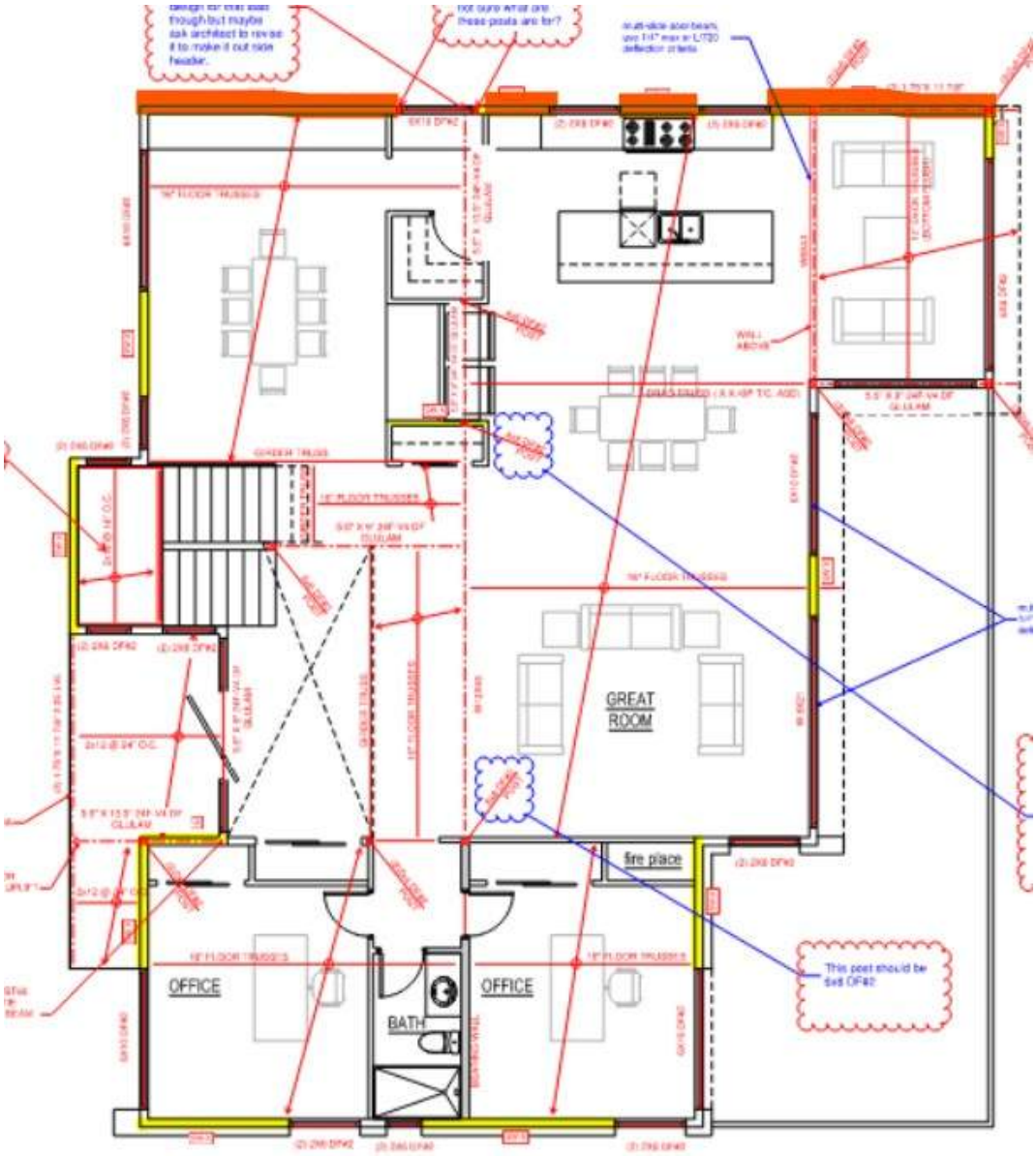
$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD)

$M_{ot.E} = 31.5 \cdot kip \cdot ft$

Use simpson-tie strong wall WSH 24x9

Shear Wall Design for Lateral Load in East-West Direction per NDS-SDPWS2015

Second Floor- Shear wall



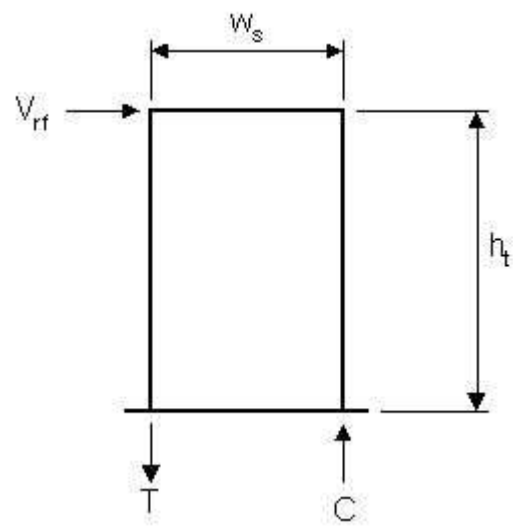
$V_{EQ} := V_{story_2} \cdot \frac{488ft^2}{2250ft^2} = 5.96 \cdot kip$ Tributary shear on the wall per plan dimensions

$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 12ft \cdot \left(h_{floor_3} - h_{floor_1}\right) = 8.406 \cdot kip$

Wind load

$h_t := 10 \cdot ft$ Wall height

$L_s := 9.58ft + 13ft + 15.67ft$ Total shear wall length



First Segment:

$w_s := 9.58ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 1.044$ $check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $(WSP) = 1.0$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $V_{rf.w} = 1.26 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $V_{rf.E} = 1.04 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $M_{ot.w} = 12.6 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $M_{ot.E} = 10.4 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := 0 = 0 \cdot lbf$

Total gravity load on wall

$P_{rf} = 0 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wal self weight load $P_w = 1.15 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2} \right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 3.304 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 1$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 132 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 109 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.6} \cdot n}{\Omega_s} = 335 \cdot plf$

$check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.w}}{w_{all.w}} = 0.394$

$check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.6} \cdot n}{\Omega_s} = 240 \cdot plf$

$check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.E}}{w_{all.E}} = 0.454$

$check_{wE} = "OK"$

Single Sided 7/16" sheathing w/ 8d @ 6**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Bottom Plate Nailing

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness

$dia_a := 16d$ Nail Size

$sp_a := 8in$ Nail spacing

$Z_{ll} := v_n \cdot C_D = 0.226 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := w_{v.w} \cdot sp_a = 0.088 \cdot kip$ Shear load to each nail

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.39$ $Check_a = "OK"$

Use 16d Nail at 8"o.c. Staggered

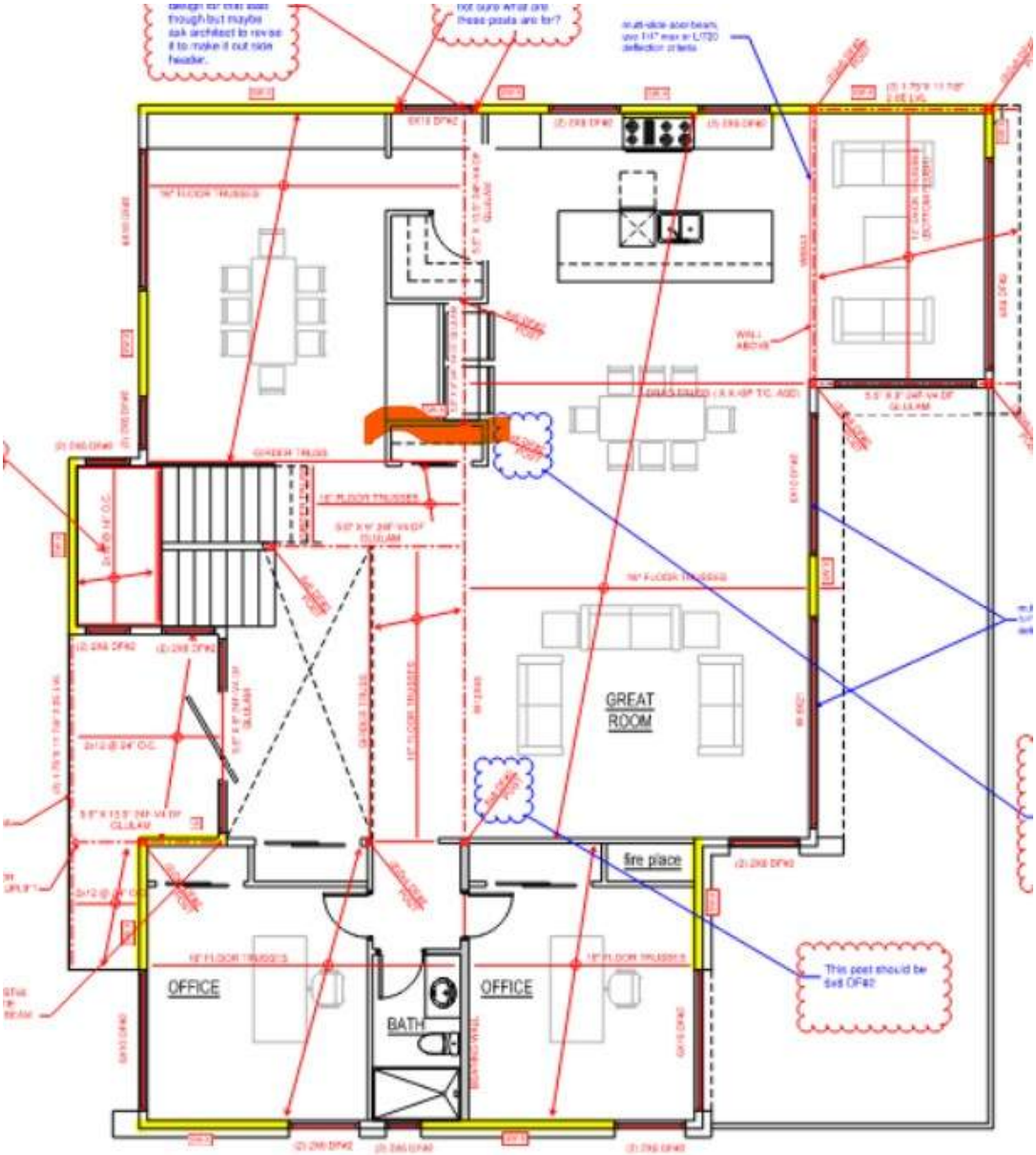
Holdown

$$T := \frac{\max(M_{ot.w}, M_{ot.E} \cdot \Omega_o) - M_{res}}{w_s} = 2.382 \cdot kip$$

$check_T := if(T > 150lbf, "HD\ REQ'D", "NOT\ REQ'D")$ $check_T = "HD\ REQ'D"$

$T_{all} := HDU4 = 4.565 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 0.522$ $check_{HD} = "OK"$



$$V_{EQ} := V_{story_2} \cdot \frac{840ft^2}{2250ft^2} = 10.258 \cdot kip$$

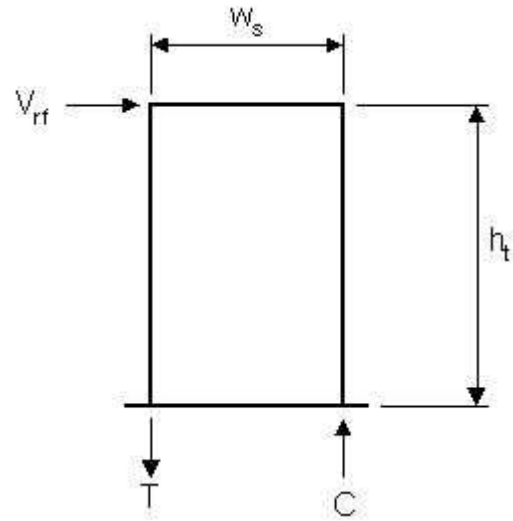
Tributary shear on the wall per plan dimensions

$$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 20ft \cdot \left(h_{floor_3} - h_{floor_1}\right) = 14.01 \cdot kip$$

Wind load

$h_t := 10 \cdot ft$ Wall height

$L_s := 5ft + 10in$ Total shear wall length



First Segment:

$w_s := 5ft + 10in$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 1.714$ $\quad check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $\quad check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $\quad (WSP) = 1.0$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $\quad V_{rf.w} = 8.41 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $\quad V_{rf.E} = 7.18 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.w} = 84.1 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.E} = 71.8 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := 5000lbf = 5 \times 10^3 \cdot lbf$

Total gravity load on wall from forte

$P_{rf} = 5 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wal self weight load $P_w = 0.7 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2} \right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 9.975 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 2$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 1441 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 1231 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.2} \cdot n}{\Omega_s} = 1640 \cdot plf$

$check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.w}}{w_{all.w}} = 0.879$

$check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.2} \cdot n}{\Omega_s} = 1170 \cdot plf$

$check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.E}}{w_{all.E}} = 1.05$

$check_{wE} = "NG"$

It is less than 5% above-EOR is OK

double Sided 7/16" sheathing w/ 8d @ 2**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Bottom Plate Nailing

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness

$dia_a := 16d$ Nail Size

$sp_a := 1.5in$ Nail spacing

$Z_{ll} := v_n \cdot C_D = 0.226 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := w_{v.w} \cdot sp_a = 0.18 \cdot kip$ Shear load to each nail

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.798$ $Check_a = "OK"$

Use 16d Nail at 8"o.c. Staggered

Holdown

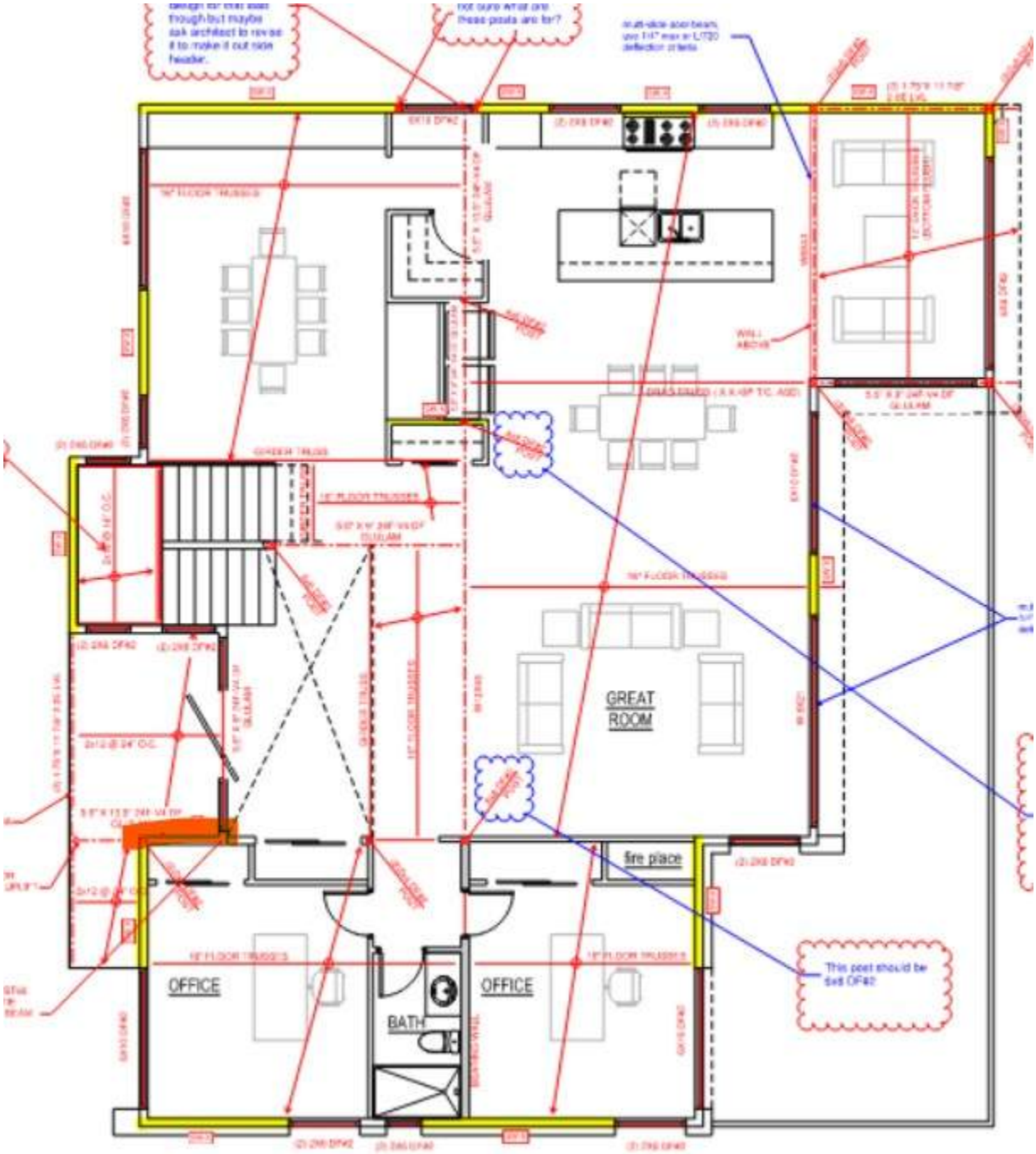
$$T := \frac{\max(M_{ot.w}, M_{ot.E} \cdot \Omega_o) - M_{res}}{w_s} = 29.065 \cdot kip$$

$check_T := if(T > 150lbf, "HD REQ'D", "NOT REQ'D")$ $check_T = "HD REQ'D"$

$T_{all} := 3CMST12_38 = 27.645 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 1.05$ $check_{HD} = "NG"$

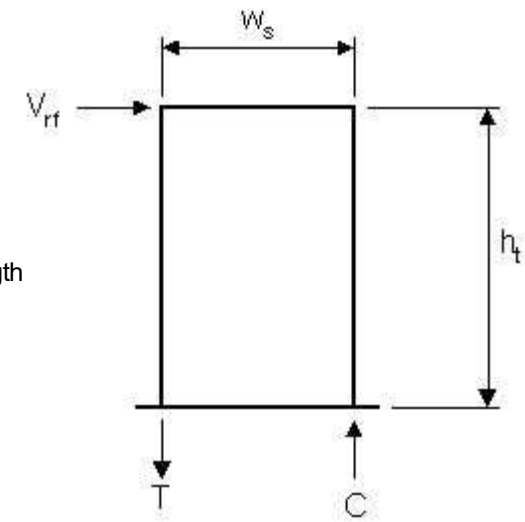
It is less than 5% above-EOR is OK


GREAT ROOM
OFFICE
OFFICE
BATH
fire place
This post should be 6x6 DF#2

$V_{EQ} := V_{story_2} \cdot \frac{483ft^2}{2250ft^2} = 5.898 \cdot kip$ Tributary shear on the wall per plan dimensions

$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 17ft \cdot \left(h_{floor_3} - h_{floor_1}\right) = 11.909 \cdot kip$

Wind load



$h_t := 10ft$ Wall height

$L_s := 5ft$ Total shear wall length

First Segment:

$w_s := 5ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 2$ $check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $(WSP) = 1.0$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $V_{rf.w} = 7.15 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $V_{rf.E} = 4.13 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $M_{ot.w} = 71.5 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $M_{ot.E} = 41.3 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := 0$

Total gravity load on wall

$P_{rf} = 0 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wall self weight load $P_w = 0.6 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2} \right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 0.9 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 2$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 1429 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 826 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.2} \cdot n}{\Omega_s} = 1640 \cdot pl$ $check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.w}}{w_{all.w}} = 0.871$ $check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.2} \cdot n}{\Omega_s} = 1170 \cdot plf$ $check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.E}}{w_{all.E}} = 0.706$ $check_{wE} = "OK"$

Double Sided 7/16" sheathing w/ 8d @ 2**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Bottom Plate Nailing

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness

$dia_a := 16d$ Nail Size

$sp_a := 1.5in$ Nail spacing

$Z_{ll} := v_n \cdot C_D = 0.226 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := w_{v.w} \cdot sp_a = 0.179 \cdot kip$ Shear load to each nail

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.792$ $Check_a = "OK"$

Use 16d Nail at 5"o.c. Staggered

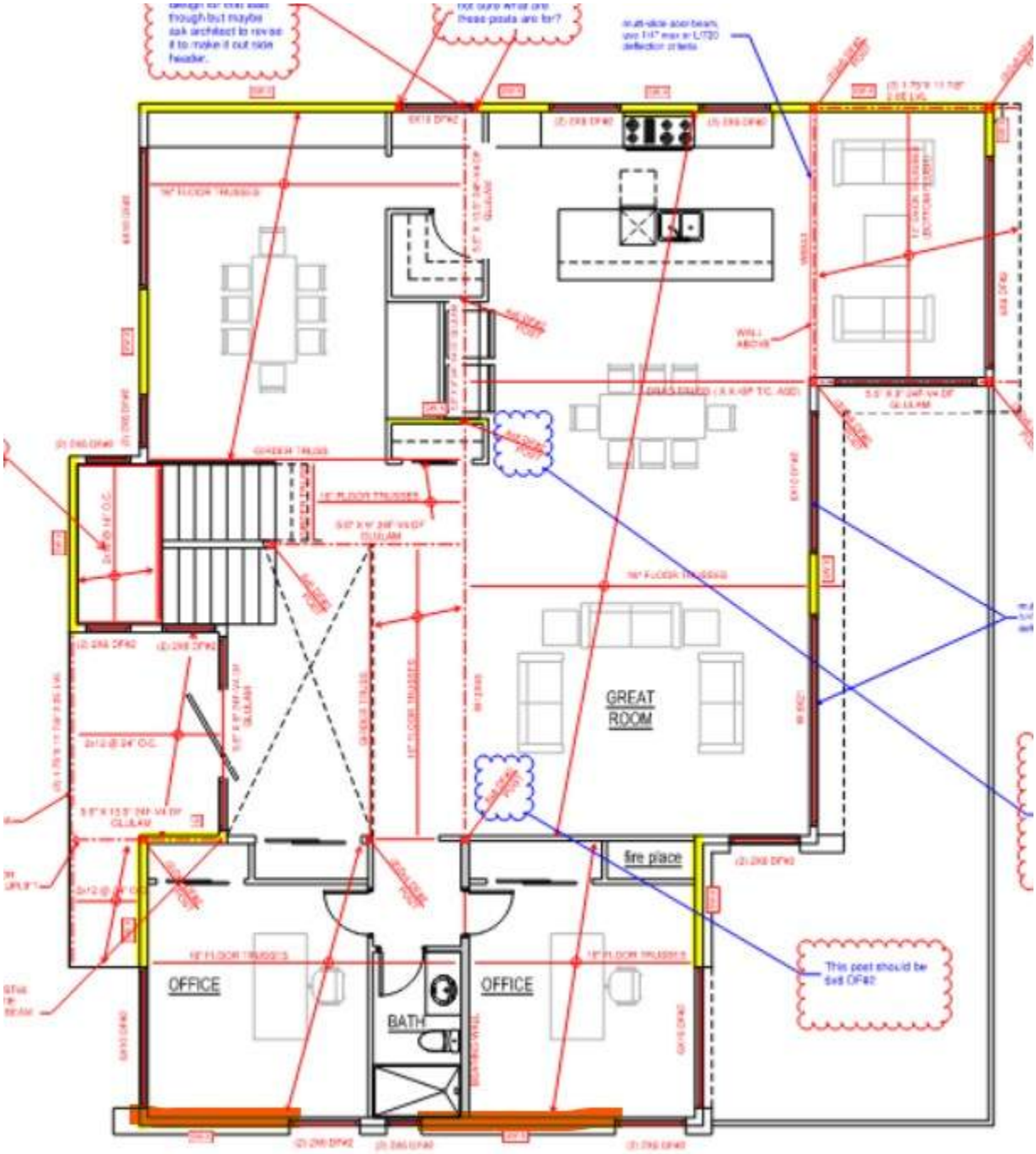
Holdown

$$T := \frac{\max(M_{ot.w}, M_{ot.E} \cdot \Omega_o) - M_{res}}{w_s} = 20.465 \cdot kip$$

$check_T := if(T > 150lbf, "HD REQ'D", "NOT REQ'D")$ $check_T = "HD REQ'D"$

$T_{all} := 3CMST12_38 = 27.645 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 0.74$ $check_{HD} = "OK"$



$$V_{EQ} := V_{story_2} \cdot \frac{281ft^2}{2250ft^2} = 3.432 \cdot kip$$

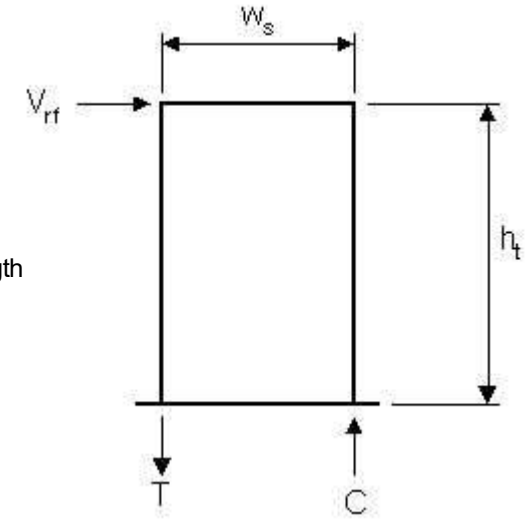
Tributary shear on the wall per plan dimensions

$$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 9ft \cdot \left(h_{floor_3} - h_{floor_1}\right) = 6.305 \cdot kip$$

Wind load

$h_t := 10ft$ Wal height

$L_s := 6.5ft + 3.5ft + 11ft$ Total shear wall length



First Segment:

$w_s := 3.5ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 2.857$ $\quad check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $\quad check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $\quad (WSP) = 0.9$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $\quad V_{rf.w} = 0.63 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $\quad V_{rf.E} = 0.4 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.w} = 6.3 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.E} = 4 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := 0 = 0 \cdot lbf$

Total gravity load on wall

$P_{rf} = 0 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wall self weight load $P_w = 0.42 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2} \right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 0.441 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 1$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 180 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 114 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.6} \cdot n}{\Omega_s} = 299.1 \cdot pl$ $check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.w}}{w_{all.w}} = 0.602$ $check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.6} \cdot n}{\Omega_s} = 214.3 \cdot plf$ $check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.E}}{w_{all.E}} = 0.534$ $check_{wE} = "OK"$

Single Sided 7/16" sheathing w/ 8d @ 2**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Bottom Plate Nailing $C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness $dia_a := 16d$ Nail Size $sp_a := 8in$ Nail spacing

$Z_{ll} := v_n \cdot C_D = 0.226 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := w_{v.w} \cdot sp_a = 0.12 \cdot kip$ Shear load to each nail

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.532$ $Check_a = "OK"$

Use 16d Nail at 8"o.c. Staggered

Holdown

$$T := \frac{\max(M_{ot.w}, M_{ot.E} \cdot \Omega_o) - M_{res}}{w_s} = 2.734 \cdot kip$$

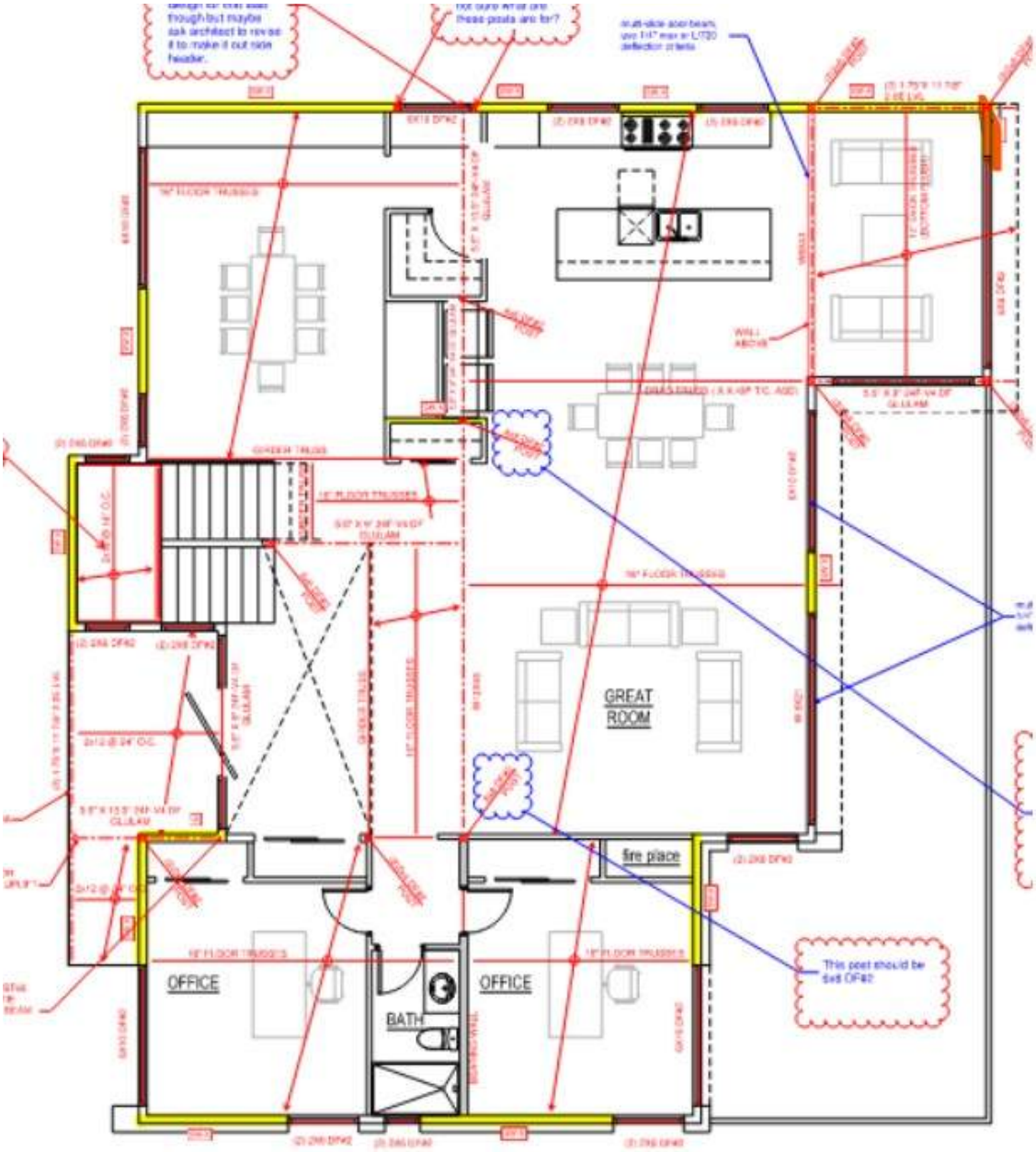
$check_T := if(T > 150lbf, "HD REQ'D", "NOT REQ'D")$ $check_T = "HD REQ'D"$

$T_{all} := HDU4 = 4.565 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 0.6$ $check_{HD} = "OK"$

Shear Wall Design for Lateral Load in North-South Direction per NDS-SDPWS2015

Second Floor- Shear wall



$$V_{EQ} := V_{story_2} \cdot \frac{80ft^2}{2250ft^2} = 0.977 \cdot kip$$

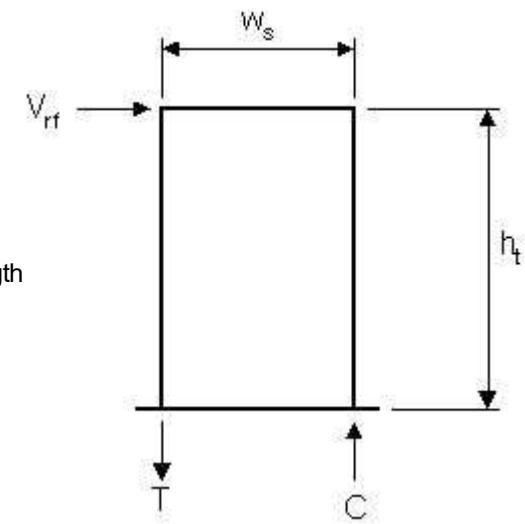
Tributary shear on the wall per plan dimensions

$$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 6ft \cdot \left(h_{floor_3} - h_{floor_1}\right) = 4.203 \cdot kip$$

Wind load

$h_t := 10ft$ Wall height

$L_s := 3ft$ Total shear wall length



First Segment:

$w_s := 3ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 3.333$ $\quad check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $\quad check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $\quad (WSP) = 0.8$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $V_{rf.w} = 2.52 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $V_{rf.E} = 0.68 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $M_{ot.w} = 25.2 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $M_{ot.E} = 6.8 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := 0 = 0 \cdot lbf$

Total gravity load on wall

$P_{rf} = 0 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wall self weight load $P_w = 0.36 \cdot kip$

$M_{res} := \left[\left(P_{rf} + P_w\right) \cdot \frac{w_s}{2}\right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 0.324 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 2$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 841 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 228 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.4} \cdot n}{\Omega_s} = 816.7 \cdot pl$ $check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK"\right)$ It is less than 5% above-EOR is OK

$\frac{w_{v.w}}{w_{all.w}} = 1.029$ $check_{wv} = "NG"$

$w_{all.E} := \frac{(WSP)\cdot v_{s.7_16.8d.4}\cdot n}{\Omega_s} = 583.3\cdot plf$ $\quad check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK"\right)$

$\frac{w_{v.E}}{w_{all.E}} = 0.391$ $\quad check_{wE} = "OK"$

Double Sided 7/16" sheathing w/ 8d @ 4**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Bottom Plate Nailing

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness $\quad dia_a := 16d$ Nail Size $\quad sp_a := 3in$ Nail spacing

$Z_{ll} := v_n\cdot C_D = 0.226\cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := w_{v.w}\cdot sp_a = 0.21\cdot kip$ Shear load to each nail

$Check_a := if\left(V_{sp} > Z_{ll}, "NG", "OK"\right)$ $\quad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.932$ $\quad Check_a = "OK"$

Use 16d Nail at 3"o.c. Staggered two row

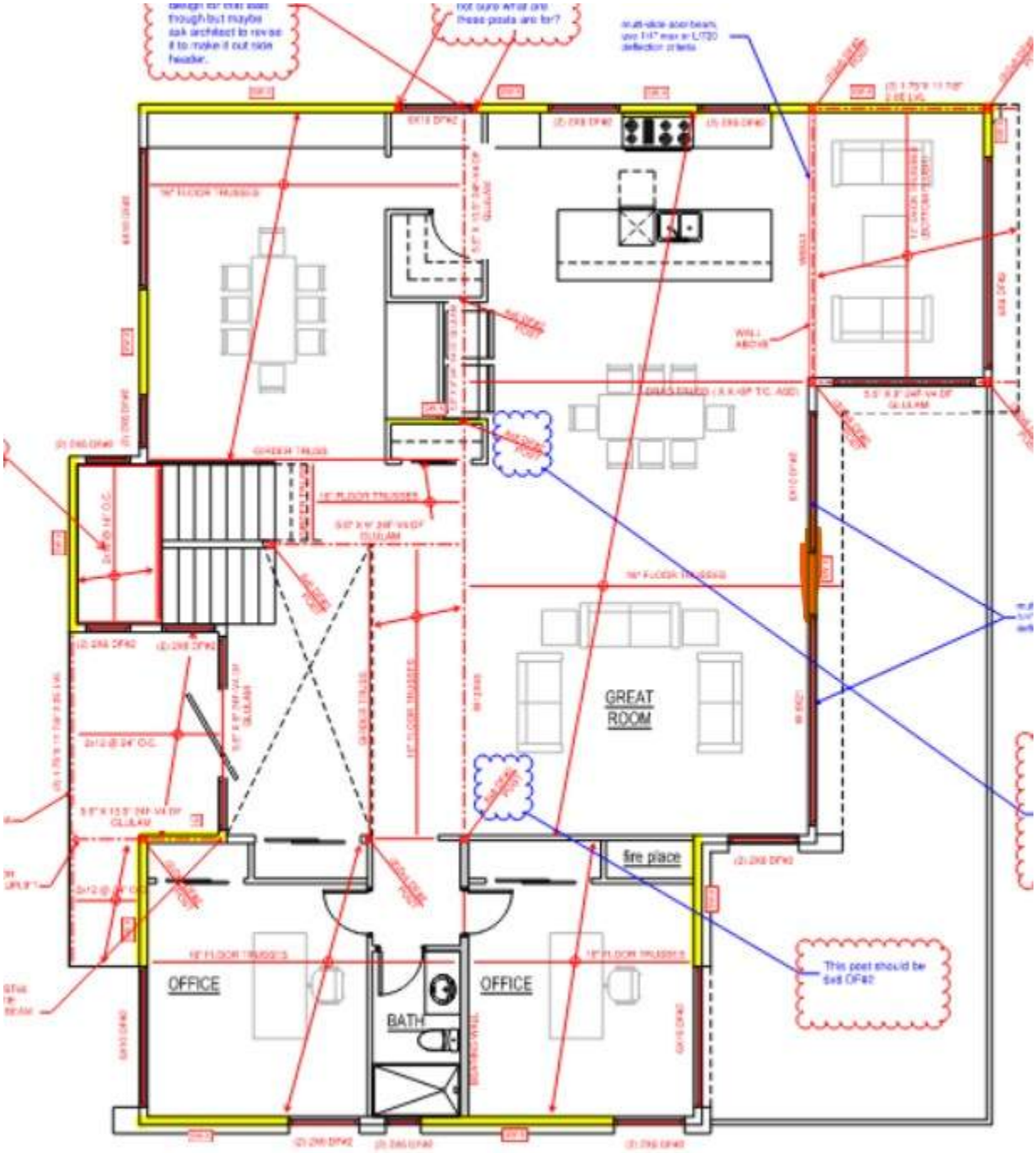
Holdown

$$T := \frac{\max\left(M_{ot.w}, M_{ot.E}\cdot\Omega_o\right) - M_{res}}{w_s} = 8.298\cdot kip$$

$check_T := if(T > 150lbf, "HD\ REQ'D", "NOT\ REQ'D")$ $\quad check_T = "HD\ REQ'D"$

$T_{all} := 2MST48 = 8.4\cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $\quad ratio := \frac{T}{T_{all}} = 0.988$ $\quad check_{HD} = "OK"$



$$V_{EQ} := V_{story_2} \cdot \frac{215ft^2}{2250ft^2} = 2.626 \cdot kip$$

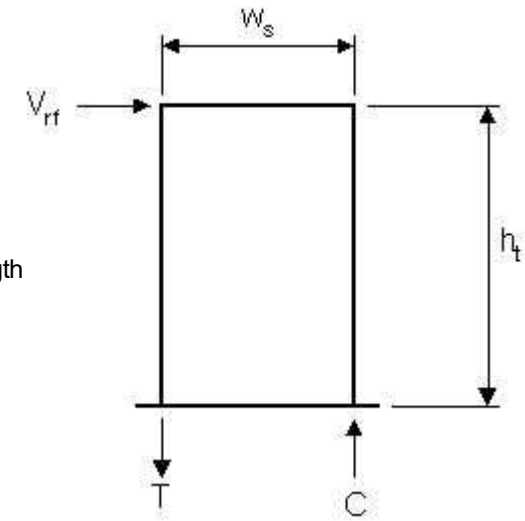
Tributary shear on the wall per plan dimensions

$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 8.5ft \cdot \left(h_{floor_3} - h_{floor_1}\right) = 5.954 \cdot kip$

Wind load

$h_t := 10ft$ Wal height

$L_s := 3.5ft$ Total shear wall length



First Segment:

$w_s := 3.5ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 2.857$ $\quad check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $\quad check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $\quad (WSP) = 0.9$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $\quad V_{rf.w} = 3.57 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $\quad V_{rf.E} = 1.84 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.w} = 35.7 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.E} = 18.4 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := \left(DL_{roof} \cdot \frac{19ft}{2} \cdot w_s + DL_{floor} \cdot \frac{19ft}{2} \cdot w_s\right)$ Total gravity load on wall

$P_{rf} = 0.997 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wal self weight load $P_w = 0.42 \cdot kip$

$M_{res} := \left[\left(P_{rf} + P_w\right) \cdot \frac{w_s}{2}\right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 1.488 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 2$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 1021 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 525 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.3} \cdot n}{\Omega_s} = 1125 \cdot pl$ $check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK"\right)$ It is less than 5% above-EOR is OK

$\frac{w_{v.w}}{w_{all.w}} = 0.907$ $check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.3} \cdot n}{\Omega_s} = 803.6 \cdot plf$ $check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK"\right)$

$\frac{w_{v.E}}{w_{all.E}} = 0.653$ $check_{wE} = "OK"$

Double Sided 7/16" sheathing w/ 8d @ 3**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Bottom Plate Nailing

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness $dia_a := 16d$ Nail Size $sp_a := 2.5in$ Nail spacing

$Z_{ll} := v_n \cdot C_D = 0.226 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := w_{v.w} \cdot sp_a = 0.213 \cdot kip$ Shear load to each nail

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.943$ $Check_a = "OK"$

Use 16d Nail at 2.5"o.c. Staggered two row

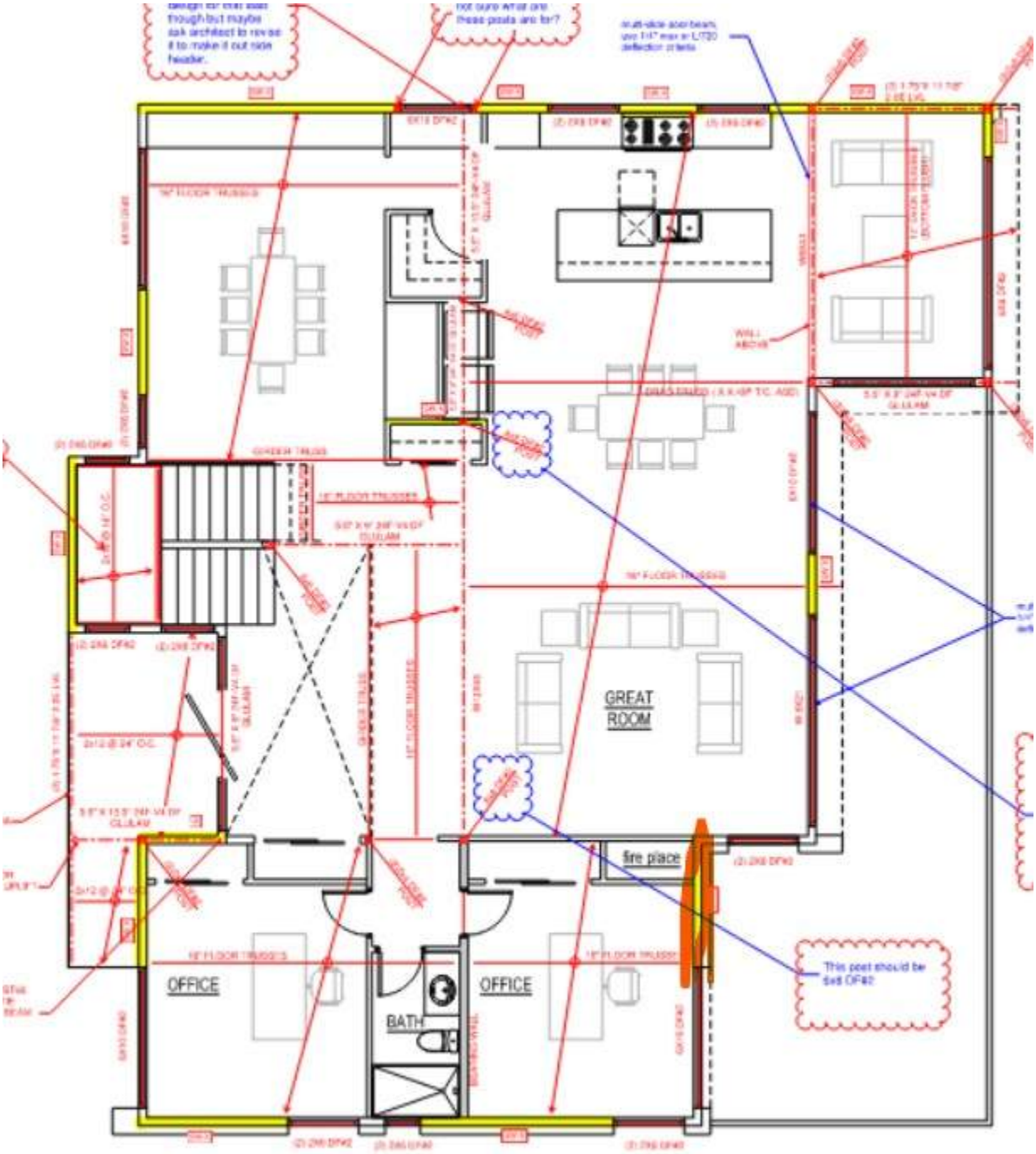
Holdown

$$T := \frac{\max(M_{ot.w}, M_{ot.E} \cdot \Omega_o) - M_{res}}{w_s} = 12.703 \cdot kip$$

$check_T := if(T > 150lbf, "HD REQ'D", "NOT REQ'D")$ $check_T = "HD REQ'D"$

$T_{all} := 4MSTC48B3 = 15.9 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 0.799$ $check_{HD} = "OK"$



$$V_{EQ} := V_{story_2} \cdot \frac{912ft^2}{2250ft^2} = 11.138 \cdot kip$$

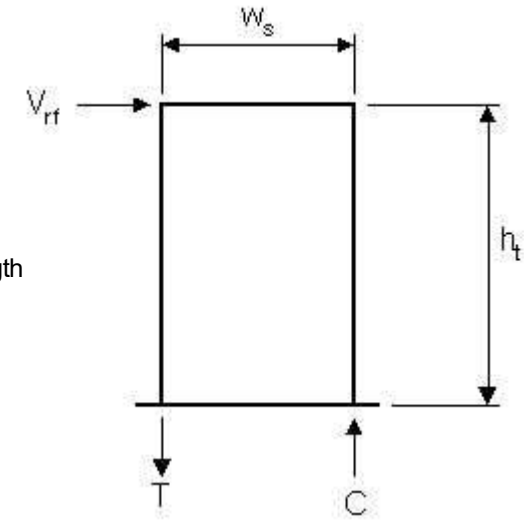
Tributary shear on the wall per plan dimensions

$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right)\cdot(16ft + 8in)\cdot\left(h_{floor_3} - h_{floor_1}\right) = 11.675\cdot kip$

Wind load

$h_t := 10ft$ Wall height

$L_s := 7.5ft$ Total shear wall length



First Segment:

$w_s := 7.5ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 1.333$ $\quad check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $\quad check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125\cdot\frac{h_t}{w_s}\right)$ Aspect ratio factor $\quad (WSP) = 1.0$

Overturning Forces

$V_{rf.w} := \left(0.6\cdot V_{wind}\cdot\frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $\quad V_{rf.w} = 7.01\cdot kip$

$V_{rf.E} := \left(0.7\cdot V_{EQ}\cdot\frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $\quad V_{rf.E} = 7.8\cdot kip$

$M_{ot.w} := V_{rf.w}\cdot h_t$ Overturning moment (ASD) $\quad M_{ot.w} = 70.1\cdot kip\cdot ft$

$M_{ot.E} := V_{rf.E}\cdot h_t$ Overturning moment (ASD) $\quad M_{ot.E} = 78\cdot kip\cdot ft$

Resisting Forces

$P_{rf} := \left(DL_{roof} \cdot \frac{13ft}{2} \cdot w_s + DL_{floor} \cdot \frac{13ft}{2} \cdot w_s\right)$ Total gravity load on wall

$P_{rf} = 1.463 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wall self weight load $P_w = 0.9 \cdot kip$

$M_{res} := \left[\left(P_{rf} + P_w\right) \cdot \frac{w_s}{2}\right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 5.316 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 2$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 934 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 1040 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.2} \cdot n}{\Omega_s} = 1640 \cdot pl$ $check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK"\right)$

$\frac{w_{v.w}}{w_{all.w}} = 0.57$ $check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.2} \cdot n}{\Omega_s} = 1170 \cdot plf$ $check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK"\right)$

$\frac{w_{v.E}}{w_{all.E}} = 0.888$ $check_{wE} = "OK"$

Double Sided 7/16" sheathing w/ 8d @ 2**" O.C.** Panel Edges @ 12" O.C.

Interior Supports (ref. table 4.3A)

Bottom Plate Nailing

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness

$dia_a := 16d$ Nail Size

$sp_a := 3in$ Nail spacing

$Z_{ll} := v_n \cdot C_D = 0.226 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := w_{v.w} \cdot sp_a = 0.234 \cdot kip$ Shear load to each nail

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 1.035$ $Check_a = "NG"$

Use 16d Nail at 2.5"o.c. Staggered two row

It is less than 5% above-EOR is OK

Holdown

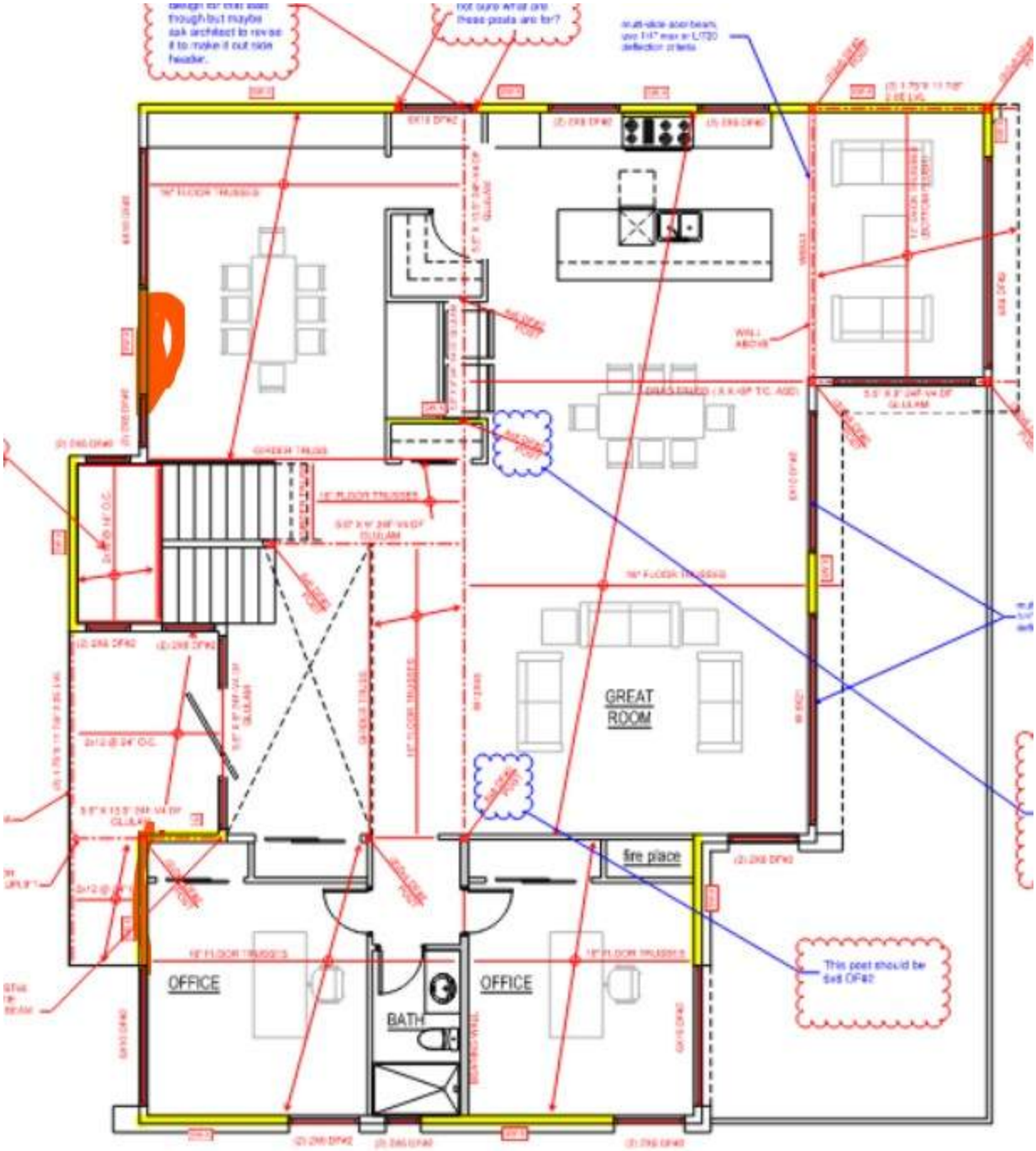
$$T := \frac{\max(M_{ot.w}, M_{ot.E} \cdot \Omega_o) - M_{res}}{w_s} = 25.279 \cdot kip$$

$check_T := if(T > 150lbf, "HD REQ'D", "NOT REQ'D")$ $check_T = "HD REQ'D"$

$T_{all} := 4MST60 = 24.94 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 1.014$ $check_{HD} = "NG"$

It is less than 5% above-EOR is OK

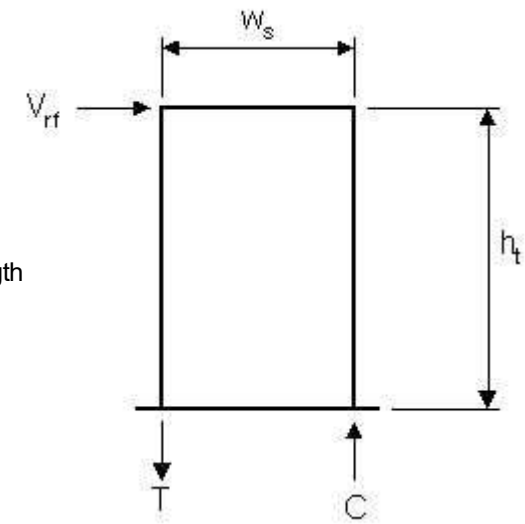

GREAT ROOM
fire place
OFFICE
OFFICE
BATH
This post should be 6x6 DFir

$V_{EQ} := V_{story_2} \cdot \frac{1230ft^2}{2250ft^2} = 15.021 \cdot kip$ Tributary shear on the wall per plan dimensions

$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot (16ft + 8in) \cdot \left(h_{floor_3} - h_{floor_1}\right) = 11.675 \cdot kip$ Wind load

$h_t := 10ft$ Wall height

$L_s := 7.5ft + 6ft$ Total shear wall length



First Segment:

$w_s := 6ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 1.667$ $check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $(WSP) = 1.0$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $V_{rf.w} = 3.11 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $V_{rf.E} = 4.67 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $M_{ot.w} = 31.1 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $M_{ot.E} = 46.7 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := DL_{roof} \cdot \frac{18ft}{2} \cdot w_s + DL_{floor} \cdot \frac{18ft}{2} \cdot w_s$ Total gravity load on wall

$P_{rf} = 1.62 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wal self weight load $P_w = 0.72 \cdot kip$

$M_{res} := \left[\left(P_{rf} + P_w\right) \cdot \frac{w_s}{2}\right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 4.212 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 2$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 519 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 779 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP)\cdot v_{w.7_16.8d.3}\cdot n}{\Omega_s} = 1260\cdot pl$ $\quad check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK"\right)$

$\frac{w_{v.w}}{w_{all.w}} = 0.412$ $\quad check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP)\cdot v_{s.7_16.8d.3}\cdot n}{\Omega_s} = 900\cdot plf$ $\quad check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK"\right)$

$\frac{w_{v.E}}{w_{all.E}} = 0.865$ $\quad check_{wE} = "OK"$

Double Sided 7/16" sheathing w/ 8d @ 3**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Bottom Plate Nailing

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness $\quad dia_a := 16d$ Nail Size $\quad sp_a := 5in$ Nail spacing

$Z_{ll} := v_n\cdot C_D = 0.226\cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := w_{v.w}\cdot sp_a = 0.216\cdot kip$ Shear load to each nail

$Check_a := if\left(V_{sp} > Z_{ll}, "NG", "OK"\right)$ $\quad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.958$ $\quad Check_a = "OK"$

Use 16d Nail at 5"o.c. Staggered two row

Holdown

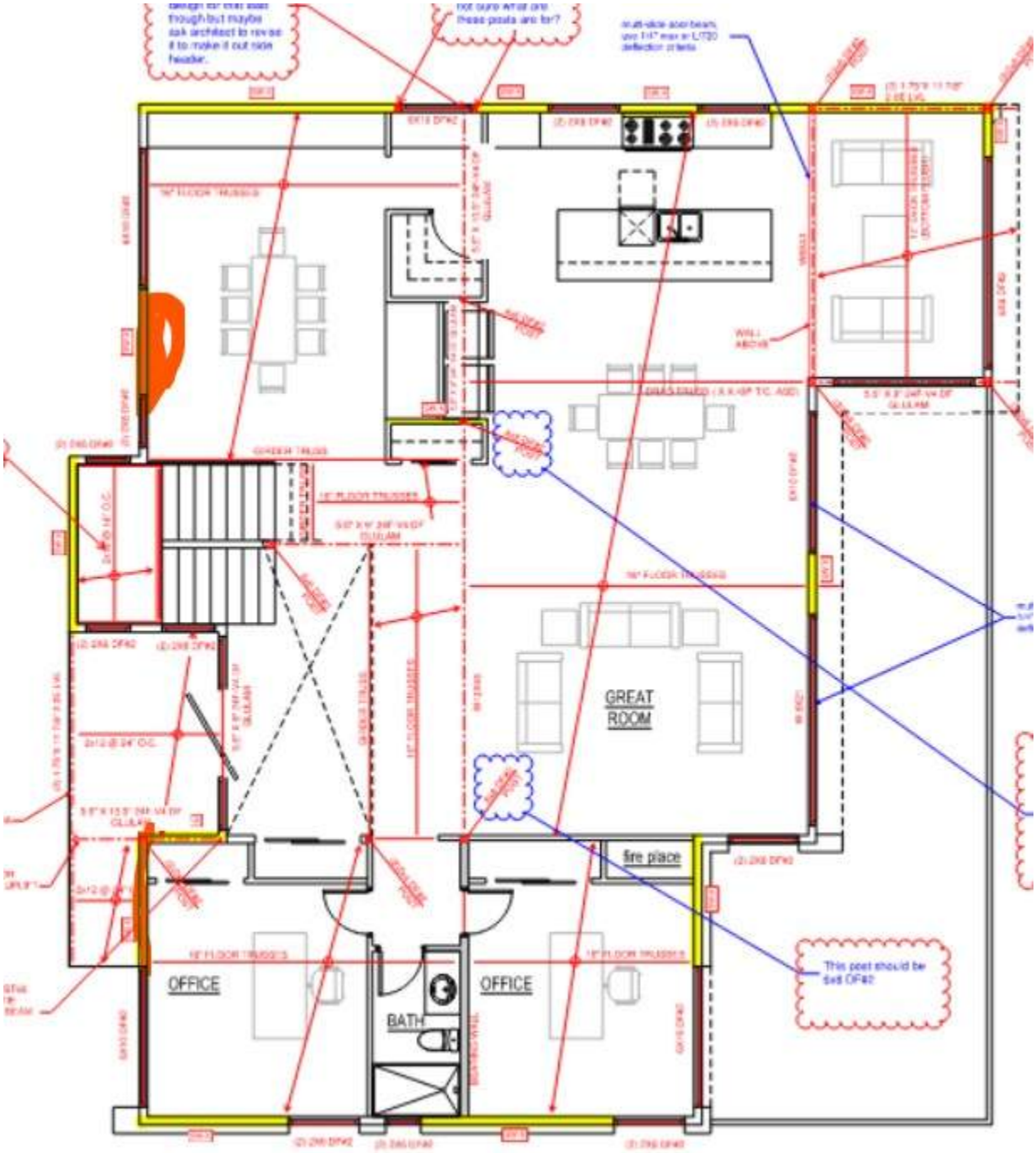
$$T := \frac{\max\left(M_{ot.w}, M_{ot.E}\cdot\Omega_o\right) - M_{res}}{w_s} = 18.77\cdot kip$$

$check_T := if(T > 150lbf, "HD REQ'D", "NOT REQ'D")$ $\quad check_T = "HD REQ'D"$

$T_{all} := 3MST60 = 18.705\cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $\quad ratio := \frac{T}{T_{all}} = 1.003$ $\quad check_{HD} = "NG"$

It is less than 5% above-EOR is OK


GREAT ROOM
fire place
OFFICE
OFFICE
BATH
This post should be sized OF&P

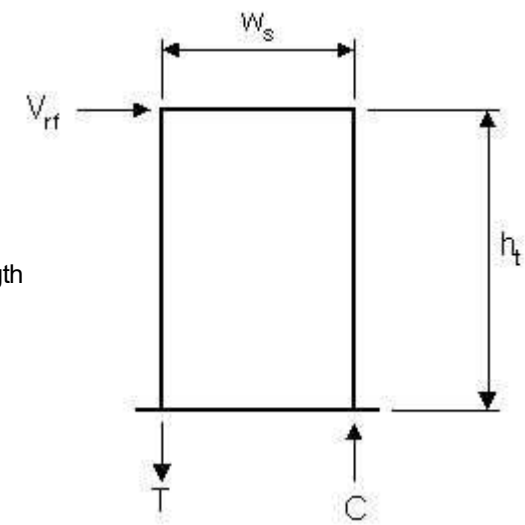
$V_{EQ} := V_{story_2} \cdot \frac{30ft^2}{2250ft^2} = 0.366 \cdot kip$ Tributary shear on the wall per plan dimensions

$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot (3ft) \cdot \left(h_{floor_3} - h_{floor_1}\right) = 2.102 \cdot kip$

Wind load

$h_t := 10ft$ Wall height

$L_s := 9.5ft$ Total shear wall length



First Segment:

$w_s := 9.5ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 1.053$ $check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $(WSP) = 1.0$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $V_{rf.w} = 1.26 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $V_{rf.E} = 0.26 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $M_{ot.w} = 12.6 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $M_{ot.E} = 2.6 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := 0$

Total gravity load on wall

$P_{rf} = 0 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wal self weight load $P_w = 1.14 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2} \right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 3.249 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 1$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 133 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 27 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.6} \cdot n}{\Omega_s} = 335 \cdot plf$ $check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.w}}{w_{all.w}} = 0.396$ $check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.6} \cdot n}{\Omega_s} = 240 \cdot plf$ $check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.E}}{w_{all.E}} = 0.112$ $check_{wE} = "OK"$

Single Sided 7/16" sheathing w/ 8d @ 6**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Bottom Plate Nailing

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness

$dia_a := 16d$ Nail Size

$sp_a := 8in$ Nail spacing

$Z_{ll} := v_n \cdot C_D = 0.226 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := w_{v.w} \cdot sp_a = 0.088 \cdot kip$ Shear load to each nail

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.392$ $Check_a = "OK"$

Use 16d Nail at 5"o.c. Staggered two row

Holdown

$$T := \frac{\max(M_{ot.w}, M_{ot.E} \cdot \Omega_o) - M_{res}}{w_s} = 0.985 \cdot kip$$

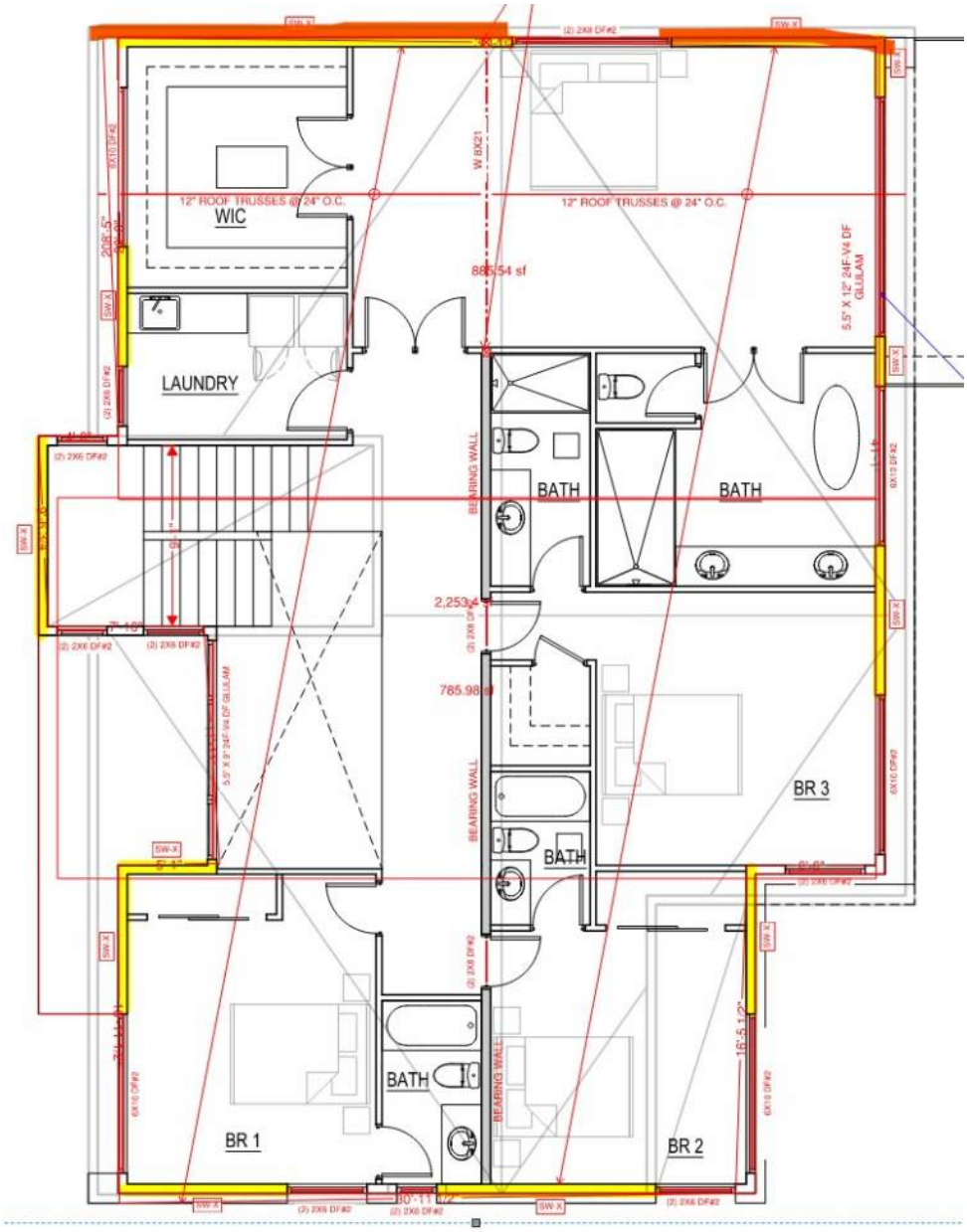
$check_T := if(T > 150lbf, "HD\ REQ'D", "NOT\ REQ'D")$ $check_T = "HD\ REQ'D"$

$T_{all} := MST37 = 2.705 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 0.364$ $check_{HD} = "OK"$

Shear Wall Design for Lateral Load in East-West Direction per NDS-SDPWS2015

Third Floor- Shear wall



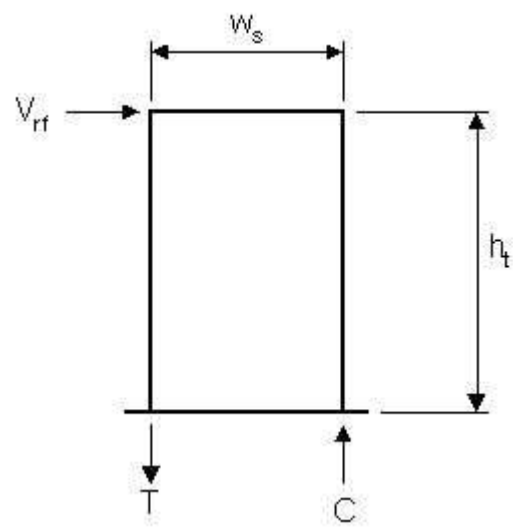
$V_{EQ} := V_{story_3} \cdot \frac{907ft^2}{2250ft^2} = 6.075 \cdot kip$ Tributary shear on the wall per plan dimensions

$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 24ft \cdot \left(h_{floor_3} - h_{floor_2}\right) = 8.772 \cdot kip$

Wind load

$h_t := 9 \cdot ft$ Wall height

$L_s := 16ft + 8in + 19ft + 9in$ Total shear wall length



First Segment:

$w_s := 16ft + 8in$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 0.54$ $check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $(WSP) = 1.0$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $V_{rf.w} = 2.41 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $V_{rf.E} = 1.95 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $M_{ot.w} = 21.7 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $M_{ot.E} = 17.5 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := 0$

Total gravity load on wall

$P_{rf} = 0 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wal self weight load $P_w = 1.8 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2} \right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 9 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 1$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 145 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 117 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.6} \cdot n}{\Omega_s} = 335 \cdot plf$

$check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.w}}{w_{all.w}} = 0.431$

$check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.6} \cdot n}{\Omega_s} = 240 \cdot plf$

$check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK" \right)$

$check_{wE} = "OK"$

Single Sided 7/16" sheathing w/ 8d @ 6**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Bottom Plate Nailing

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness

$dia_a := 16d$ Nail Size

$sp_a := 8in$ Nail spacing

$Z_{ll} := v_n \cdot C_D = 0.226 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := w_{v.w} \cdot sp_a = 0.096 \cdot kip$ Shear load to each nail

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.427$ $Check_a = "OK"$

Use 16d Nail at 8"o.c. Staggered

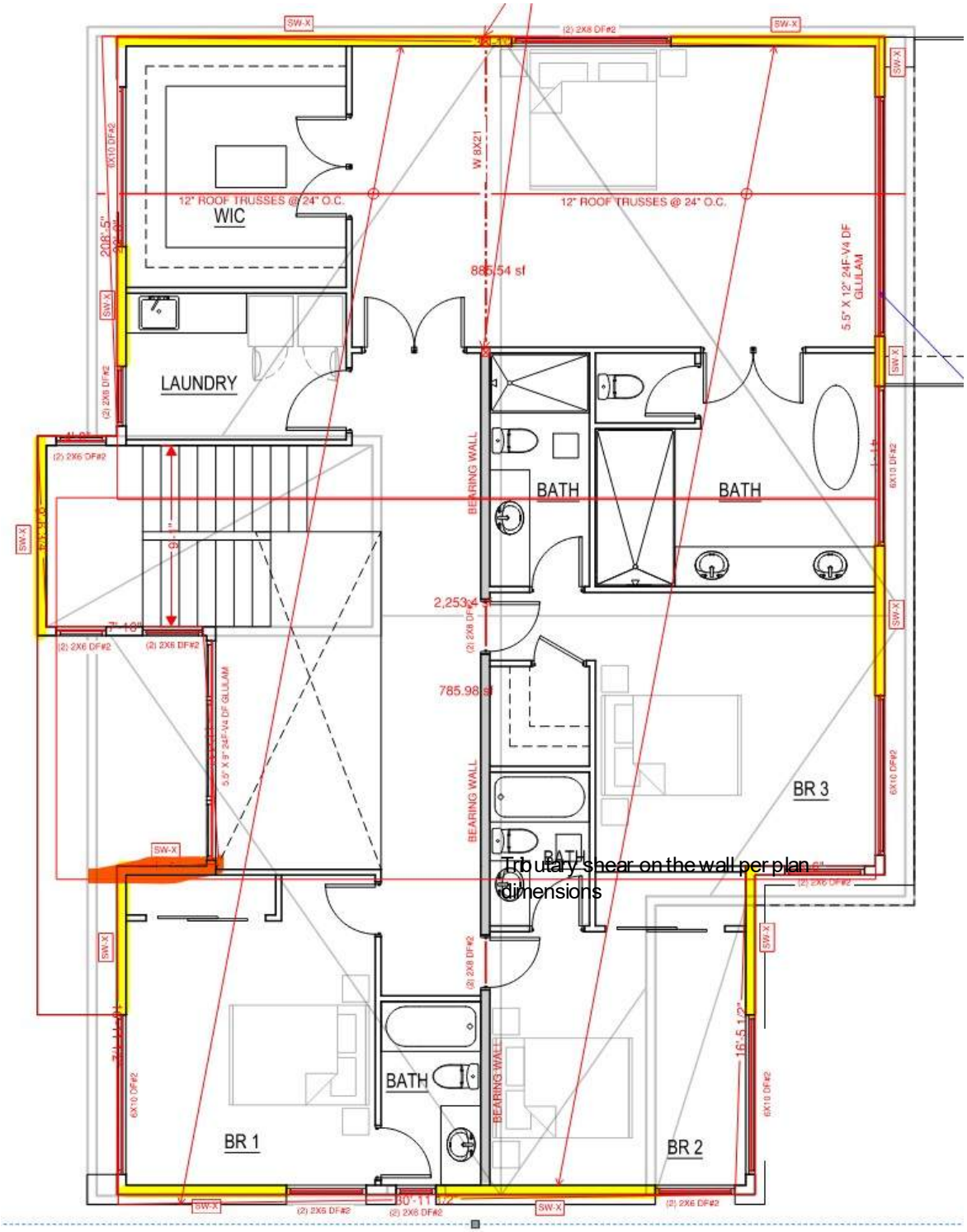
Holdown

$$T := \frac{\max(M_{ot.w}, M_{ot.E} \cdot \Omega_o) - M_{res}}{w_s} = 2.087 \cdot kip$$

$check_T := if(T > 150lbf, "HD\ REQ'D", "NOT\ REQ'D")$ $check_T = "HD\ REQ'D"$

$T_{all} := MST37 = 2.705 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 0.772$ $check_{HD} = "OK"$


SW-X
(2) 2X8 DF#2
12" ROOF TRUSSES @ 24" O.C.
WIC
LAUNDRY
W 8X21
885.54 sf
5.5" X 12" 24F-V4 DF GLULAM
BEARING WALL
BATH
BATH
2,253.4
785.98 sf
BR 3
BATH
Tributary shear on the wall per plan dimensions
BATH
BR 1
BR 2
(2) 2X6 DF#2
6X10 DF#2
208'-5"
16'-5 1/2"
30'-11 1/2"

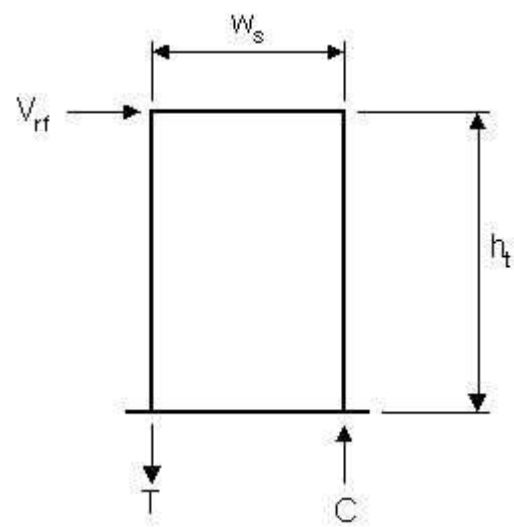
$$V_{EQ} := V_{story_3} \cdot \frac{925ft^2}{2250ft^2} = 6.195 \cdot kip$$

$$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 26.5ft \cdot \left(h_{floor_3} - h_{floor_2}\right) = 9.685 \cdot kip$$

Wind load

$h_t := 9 \cdot ft$ Wal height

$L_s := 4.5ft$ Total shear wall length



First Segment:

$w_s := 4.5ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 2$ $\quad check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $\quad check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $\quad (WSP) = 1.0$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $\quad V_{rf.w} = 5.81 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $\quad V_{rf.E} = 4.34 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $M_{ot.w} = 52.3 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $M_{ot.E} = 39 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := 0 = 0 \cdot lbf$

Total gravity load on wall

$P_{rf} = 0 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wal self weight load $P_w = 0.486 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2} \right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 0.656 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 1$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 1291 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 964 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.2} \cdot n}{\Omega_s} = 820 \cdot plf$

$check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.w}}{w_{all.w}} = 1.575$

$check_{wv} = "NG"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.6} \cdot n}{\Omega_s} = 240 \cdot plf$

$check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK" \right)$

$check_{wE}$ = "NG"

Single Sided 7/16" sheathing w/ 8d @ 6**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Bottom Plate Nailing

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness

$dia_a := 16d$ Nail Size

$sp_a := 8in$ Nail spacing

$Z_{ll} := v_n \cdot C_D = 0.226 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := w_{v.w} \cdot sp_a = 0.861 \cdot kip$ Shear load to each nail

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 3.816$ $Check_a$ = "NG"

Use 16d Nail at 8"o.c. Staggered

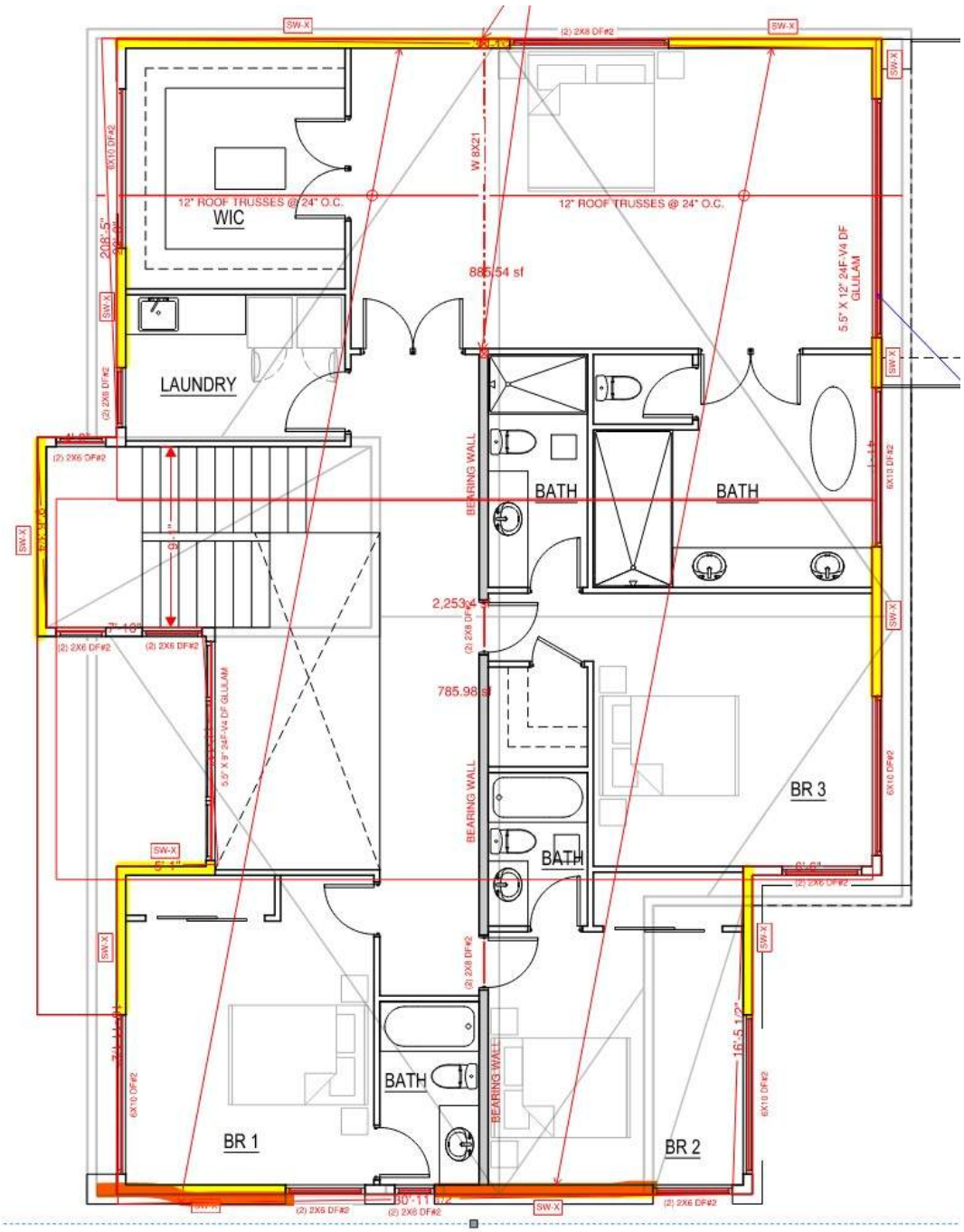
Holdown

$$T := \frac{\max(M_{ot.w}, M_{ot.E} \cdot \Omega_o) - M_{res}}{w_s} = 21.537 \cdot kip$$

$check_T := if(T > 150lbf, "HD REQ'D", "NOT REQ'D")$ $check_T$ = "HD REQ'D"

$T_{all} := MST60 = 6.235 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 3.454$ $check_{HD}$ = "NG"



$$V_{EQ} := V_{story_3} \cdot \frac{260ft^2}{2250ft^2} = 1.741 \cdot kip$$

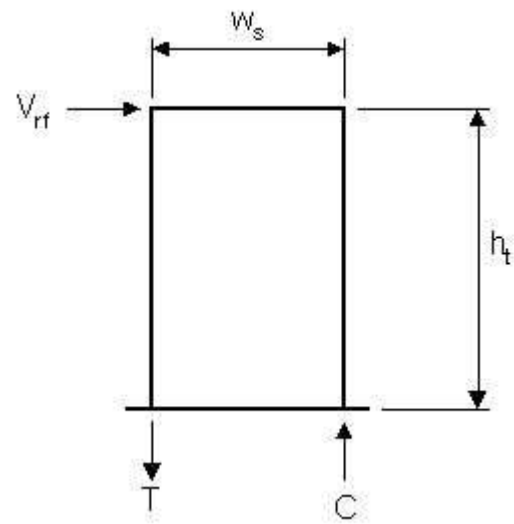
Tributary shear on the wall per plan dimensions

$$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 9ft \cdot \left(h_{floor_3} - h_{floor_2}\right) = 3.289 \cdot kip$$

Wind load

$h_t := 9 \cdot ft$ Wall height

$L_s := 6.5ft + 3.5ft + 11ft$ Total shear wall length



First Segment:

$w_s := 3.5ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 2.571$ $\quad check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $\quad check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $\quad (WSP) = 0.9$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $\quad V_{rf.w} = 0.33 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $\quad V_{rf.E} = 0.2 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.w} = 3 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.E} = 1.8 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := 0$ Total gravity load on wall

$P_{rf} = 0 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wall self weight load $P_w = 0.378 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2} \right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 0.397 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 1$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 94 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 58 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.6} \cdot n}{\Omega_s} = 311.1 \cdot plf$ $check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.w}}{w_{all.w}} = 0.302$ $check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.6} \cdot n}{\Omega_s} = 222.9 \cdot plf$ $check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.E}}{w_{all.E}} = 0.26$ $check_{wE} = "OK"$

Single Sided 7/16" sheathing w/ 8d @ 6**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Bottom Plate Nailing

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness $dia_a := 16d$ Nail Size $sp_a := 8in$ Nail spacing

$Z_{ll} := v_n \cdot C_D = 0.226 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := w_{v.w} \cdot sp_a = 0.063 \cdot kip$ Shear load to each nail

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.278$ $Check_a = "OK"$

Use 16d Nail at 8"o.c. Staggered

Holdown

$$T := \frac{\max(M_{ot.w}, M_{ot.E} \cdot \Omega_o) - M_{res}}{w_s} = 1.193 \cdot kip$$

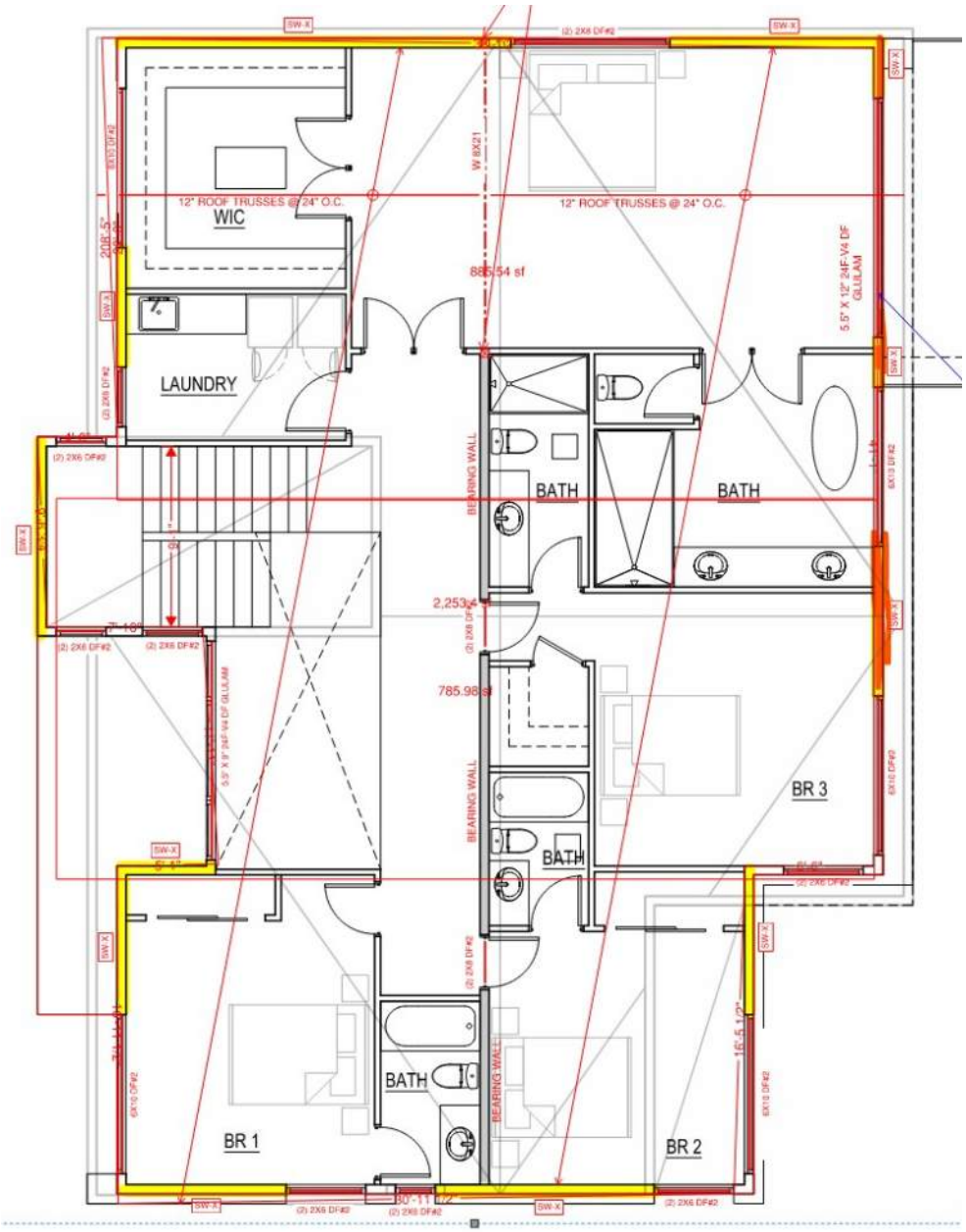
$check_T := if(T > 150lbf, "HD\ REQ'D", "NOT\ REQ'D")$ $check_T = "HD\ REQ'D"$

$T_{all} := MST37 = 2.705 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 0.441$ $check_{HD} = "OK"$

Shear Wall Design for Lateral Load in North-South Direction per NDS-SDPWS2015

Third Floor- Shear wall



$$V_{EQ} := V_{story_3} \cdot \frac{160ft^2}{2250ft^2} = 1.072 \cdot kip$$

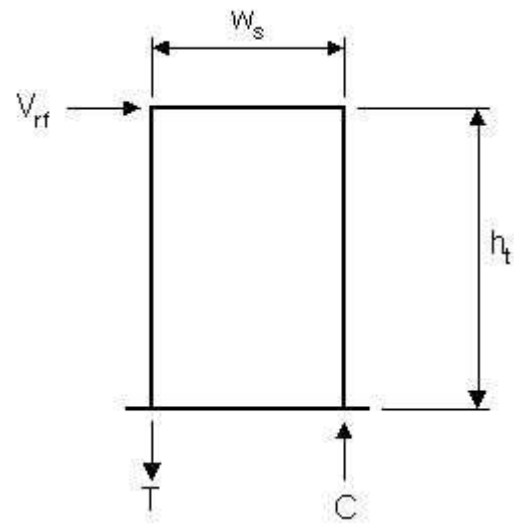
Tributary shear on the wall per plan dimensions

$$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 4ft \cdot \left(h_{floor_3} - h_{floor_2}\right) = 1.462 \cdot kip$$

Wind load

$h_t := 9 \cdot ft$ Wall height

$L_s := 3ft + 7.5ft$ Total shear wall length



First Segment:

$w_s := 3ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 3$ $\quad check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $\quad check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $\quad (WSP) = 0.9$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $\quad V_{rf.w} = 0.25 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $\quad V_{rf.E} = 0.21 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.w} = 2.3 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.E} = 1.9 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := DL_{roof} \cdot \frac{20ft}{2} \cdot w_s$

Total gravity load on wall

$P_{rf} = 0.45 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wal self weight load $P_w = 0.324 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2} \right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 0.697 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 1$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 84 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 71 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.6} \cdot n}{\Omega_s} = 293.1 \cdot plf$

$check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.w}}{w_{all.w}} = 0.285$

$check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.6} \cdot n}{\Omega_s} = 210 \cdot plf$

$check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK" \right)$

$check_{wE} = "OK"$

Single Sided 7/16" sheathing w/ 8d @ 6**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Bottom Plate Nailing

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness

$dia_a := 16d$ Nail Size

$sp_a := 8in$ Nail spacing

$Z_{ll} := v_n \cdot C_D = 0.226 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := w_{v.w} \cdot sp_a = 0.056 \cdot kip$ Shear load to each nail

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.247$ $Check_a = "OK"$

Use 16d Nail at 8"o.c. Staggered

Holdown

$$T := \frac{\max(M_{ot.w}, M_{ot.E} \cdot \Omega_o) - M_{res}}{w_s} = 1.375 \cdot kip$$

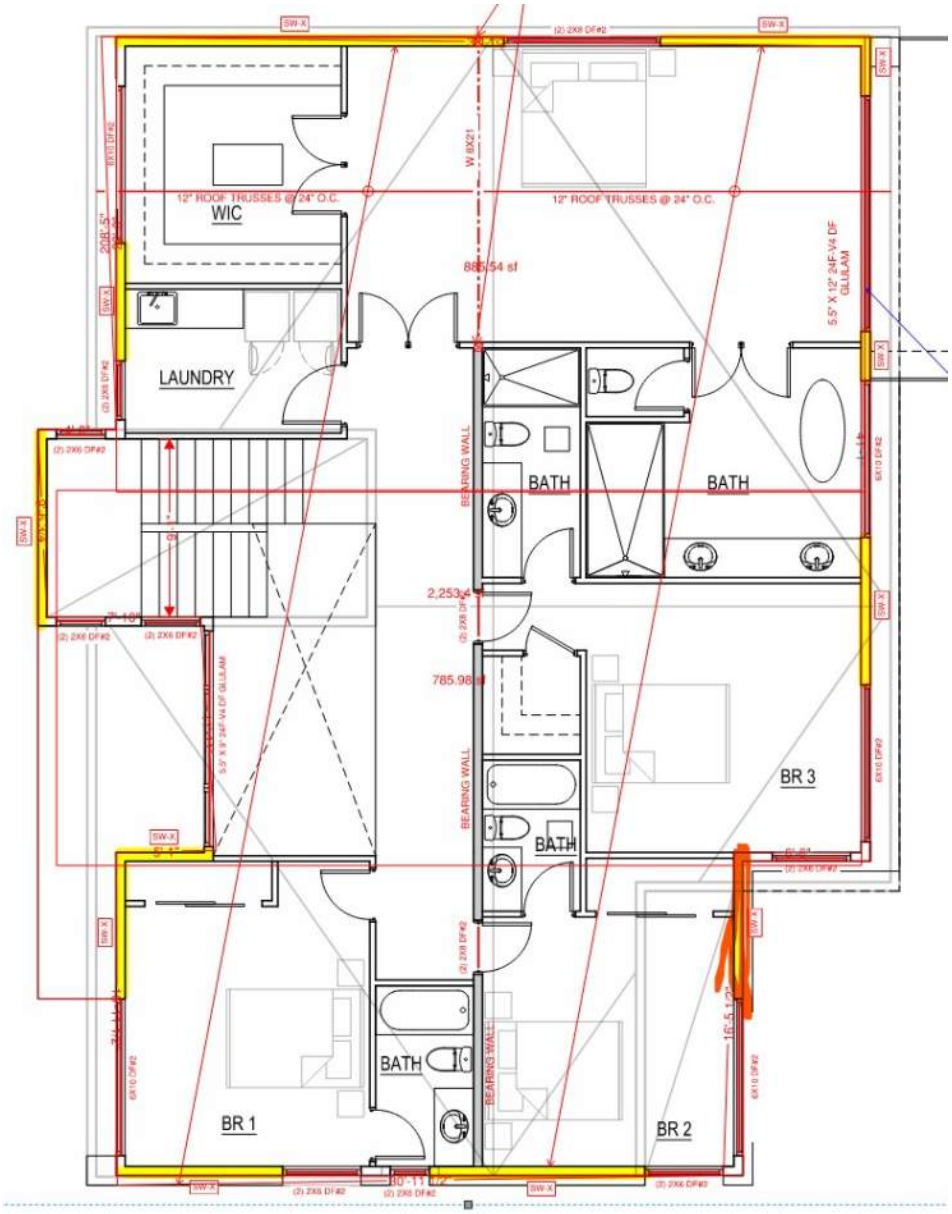
$check_T := if(T > 150lbf, "HD REQ'D", "NOT REQ'D")$ $check_T = "HD REQ'D"$

$T_{all} := MST37 = 2.705 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 0.508$ $check_{HD} = "OK"$

$T_{all} := DTT2Z = 2.145 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 0.641$ $check_{HD} = "OK"$



$$V_{EQ} := V_{story_3} \cdot \frac{1100ft^2}{2250ft^2} = 7.367 \cdot kip$$

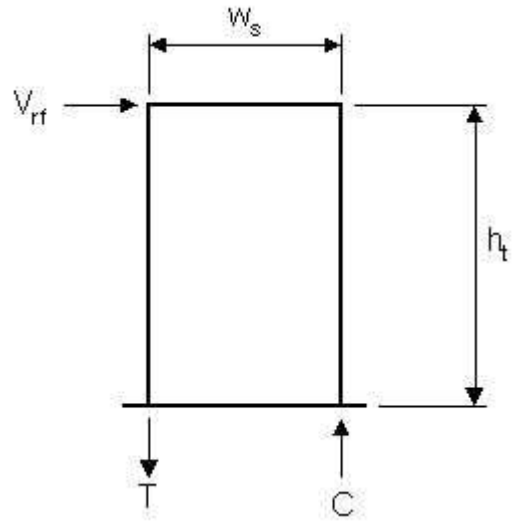
Tributary shear on the wall per plan dimensions

$$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 20ft \cdot \left(h_{floor_3} - h_{floor_2}\right) = 7.31 \cdot kip$$

Wind load

$h_t := 9 \cdot ft$ Wal height

$L_s := 7.5ft$ Total shear wall length



First Segment:

$w_s := 7.5ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 1.2$ $\quad check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $\quad check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $\quad (WSP) = 1.0$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $\quad V_{rf.w} = 4.39 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $\quad V_{rf.E} = 5.16 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.w} = 39.5 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.E} = 46.4 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := DL_{roof} \cdot \frac{13ft}{2} \cdot w_s$ Total gravity load on wall

$P_{rf} = 0.731 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wall self weight load $P_w = 0.81 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2} \right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 3.468 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 2$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 585 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 688 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.4} \cdot n}{\Omega_s} = 980 \cdot plf$

$check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.w}}{w_{all.w}} = 0.597$ $check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.4} \cdot n}{\Omega_s} = 700 \cdot plf$

$check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.E}}{w_{all.E}} = 0.982$ $check_{wE} = "OK"$

Double Sided 7/16" sheathing w/ 8d @ 4**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Bottom Plate Nailing

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness $dia_a := 16d$ Nail Size $sp_a := 4.5in$ Nail spacing

$Z_{ll} := v_n \cdot C_D = 0.226 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := w_{v.w} \cdot sp_a = 0.219 \cdot kip$ Shear load to each nail

$Check_a := if\left(V_{sp} > Z_{ll}, "NG", "OK"\right)$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.972$ $Check_a = "OK"$

Use 16d Nail at 4.5"o.c. Staggered

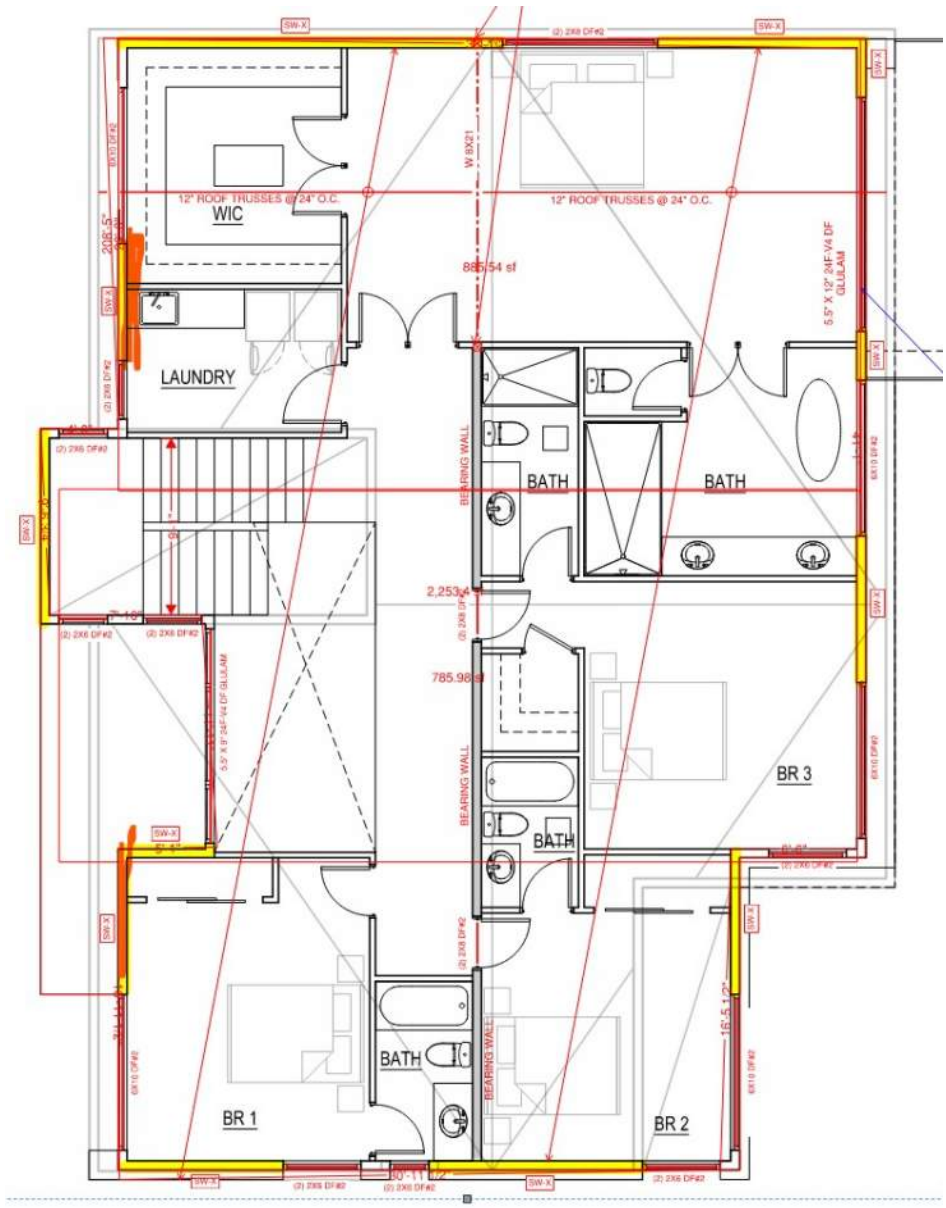
Holdown

$$T := \frac{\max\left(M_{ot.w}, M_{ot.E} \cdot \Omega_o\right) - M_{res}}{w_s} = 15.009 \cdot kip$$

$check_T := if(T > 150lbf, "HD\ REQ'D", "NOT\ REQ'D")$ $check_T = "HD\ REQ'D"$

$T_{all} := 3MST60 = 18.705 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 0.802$ $check_{HD} = "OK"$



$$V_{EQ} := V_{story_3} \cdot \frac{900ft^2}{2250ft^2} = 6.028 \cdot kip$$

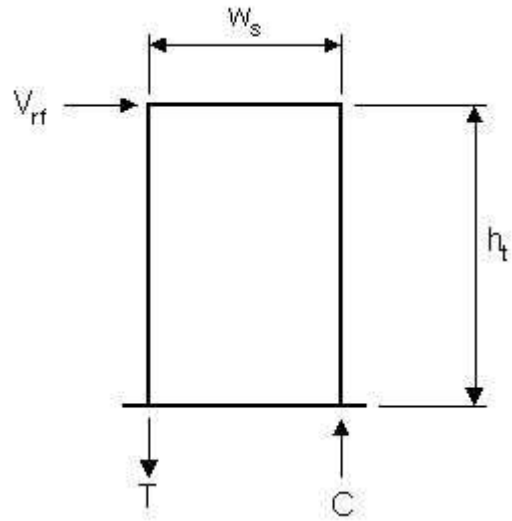
Tributary shear on the wall per plan dimensions

$$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 17ft \cdot \left(h_{floor_3} - h_{floor_2}\right) = 6.213 \cdot kip$$

Wind load

$h_t := 9 \cdot ft$ Wal height

$L_s := 6ft + 2in + 7.5ft$ Total shear wall length



First Segment:

$w_s := 6ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 1.5$ $\quad check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $\quad check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $\quad (WSP) = 1.0$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $\quad V_{rf.w} = 1.64 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $\quad V_{rf.E} = 1.85 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.w} = 14.7 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.E} = 16.7 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := DL_{roof} \cdot \frac{17ft + 9in}{2} \cdot w_s$ Total gravity load on wall

$P_{rf} = 0.799 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wall self weight load $P_w = 0.648 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2} \right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 2.604 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 1$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 273 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 309 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.4} \cdot n}{\Omega_s} = 490 \cdot plf$

$check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.w}}{w_{all.w}} = 0.557$ $check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.4} \cdot n}{\Omega_s} = 350 \cdot plf$

$check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.E}}{w_{all.E}} = 0.882$ $check_{wE} = "OK"$

Single Sided 7/16" sheathing w/ 8d @ 4**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Bottom Plate Nailing

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness

$dia_a := 16d$ Nail Size

$sp_a := 8in$ Nail spacing

$Z_{ll} := v_n \cdot C_D = 0.226 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := w_{v.w} \cdot sp_a = 0.182 \cdot kip$ Shear load to each nail

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.806$ $Check_a = "OK"$

Use 16d Nail at 4.5"o.c. Staggered

Holdown

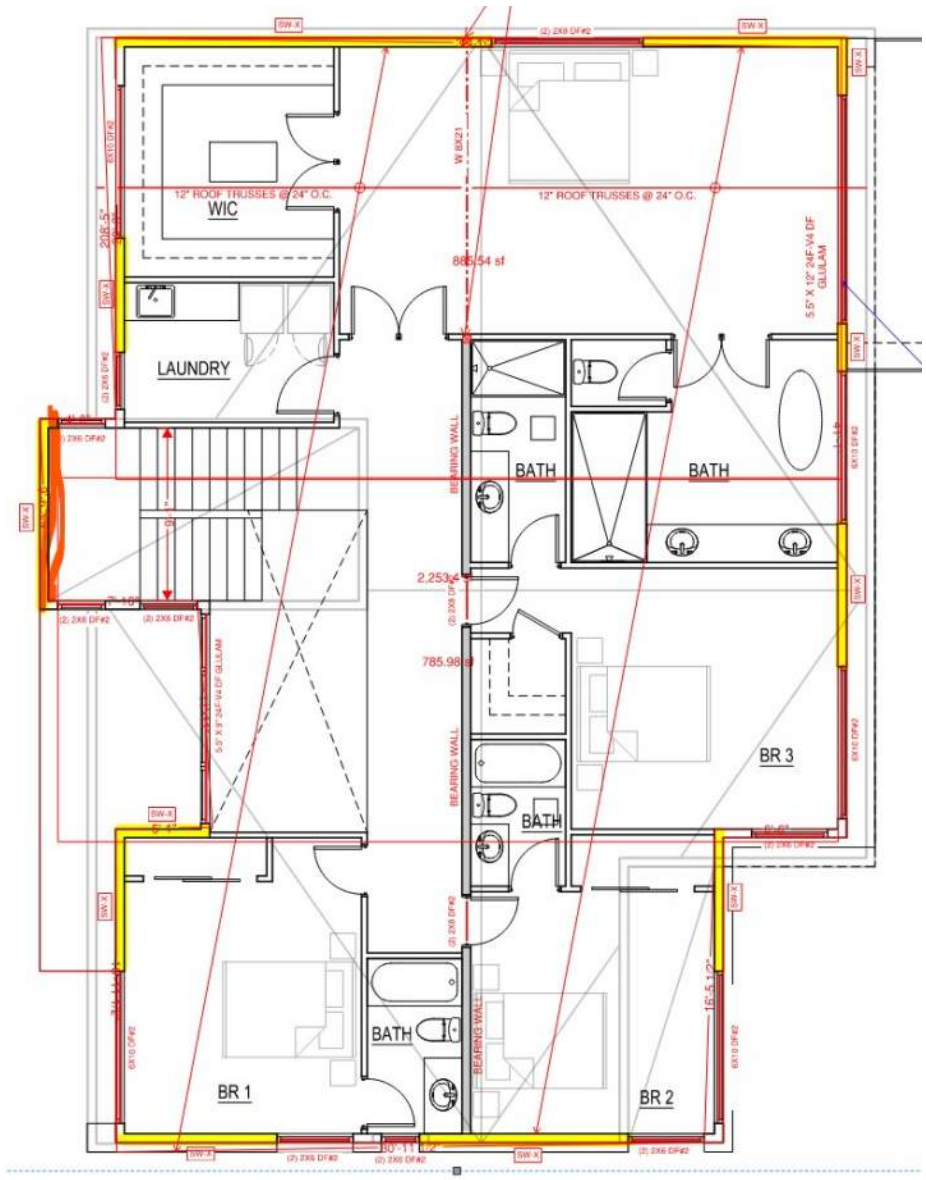
$$T := \frac{\max(M_{ot.w}, M_{ot.E} \cdot \Omega_o) - M_{res}}{w_s} = 6.512 \cdot kip$$

$check_T := if(T > 150lbf, "HD REQ'D", "NOT REQ'D")$ $check_T = "HD REQ'D"$

$T_{all} := MST60 = 6.235 \cdot kip$ Allowable tension load

$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 1.045$ $check_{HD} = "NG"$

It is less than 5% above-EOR is OK



$$V_{EQ} := V_{story_3} \cdot \frac{20ft^2}{2250ft^2} = 0.134 \cdot kip$$

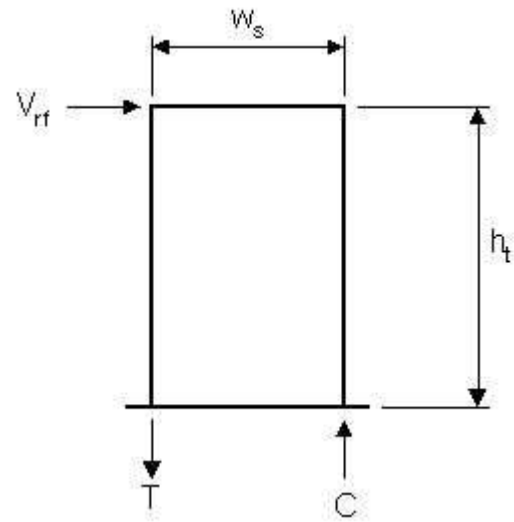
Tributary shear on the wall per plan dimensions

$$V_{wind} := \left(p_{wind_wall_windward.A} - p_{wind_wall_leeward.A}\right) \cdot 4.5ft \cdot \left(h_{floor_3} - h_{floor_2}\right) = 1.645 \cdot kip$$

Wind load

$h_t := 9 \cdot ft$ Wall height

$L_s := 10ft$ Total shear wall length



First Segment:

$w_s := 10ft$ Segment wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 0.9$ $\quad check_{ratio} := if\left(\frac{h_t}{w_s} > 3.5, "NG", "OK"\right)$ $\quad check_{ratio} = "OK"$

$(WSP) := if\left(\frac{h_t}{w_s} < 2.0, 1.0, 1.25 - 0.125 \cdot \frac{h_t}{w_s}\right)$ Aspect ratio factor $\quad (WSP) = 1.0$

Overturning Forces

$V_{rf.w} := \left(0.6 \cdot V_{wind} \cdot \frac{w_s}{L_s}\right)$ Wind shear load at top of wall (ASD) $\quad V_{rf.w} = 0.99 \cdot kip$

$V_{rf.E} := \left(0.7 \cdot V_{EQ} \cdot \frac{w_s}{L_s}\right)$ Seismic shear load at top of wall (ASD) $\quad V_{rf.E} = 0.09 \cdot kip$

$M_{ot.w} := V_{rf.w} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.w} = 8.9 \cdot kip \cdot ft$

$M_{ot.E} := V_{rf.E} \cdot h_t$ Overturning moment (ASD) $\quad M_{ot.E} = 0.8 \cdot kip \cdot ft$

Resisting Forces

$P_{rf} := DL_{roof} \cdot \frac{17ft + 9in}{2} \cdot w_s$ Total gravity load on wall

$P_{rf} = 1.331 \cdot kip$

$P_w := W_{ext} \cdot (h_t) \cdot (w_s)$ Wal self weight load $P_w = 1.08 \cdot kip$

$M_{res} := \left[(P_{rf} + P_w) \cdot \frac{w_s}{2} \right] \cdot 0.6$ Resisting moment (ASD) $M_{res} = 7.234 \cdot kip \cdot ft$

Plywood Shear (ref. ANSI/AF&PA SDPWS)

$n := 1$ sides

$\Omega_s := 2.0$ (ASD shear capacity factor ref. section 4.3.3)

$\Omega_o := 2.5$ Overstrength factor

$w_{v.w} := \frac{V_{rf.w}}{w_s} = 99 \cdot plf$ Wind shear flow

$w_{v.E} := \frac{V_{rf.E}}{w_s} = 9 \cdot plf$ Seismic shear flow

$w_{all.w} := \frac{(WSP) \cdot v_{w.7_16.8d.6} \cdot n}{\Omega_s} = 335 \cdot plf$

$check_{wv} := if\left(\frac{w_{v.w}}{w_{all.w}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.w}}{w_{all.w}} = 0.295$ $check_{wv} = "OK"$

$w_{all.E} := \frac{(WSP) \cdot v_{s.7_16.8d.6} \cdot n}{\Omega_s} = 240 \cdot plf$

$check_{wE} := if\left(\frac{w_{v.E}}{w_{all.E}} > 1.0, "NG", "OK" \right)$

$\frac{w_{v.E}}{w_{all.E}} = 0.039$ $check_{wE} = "OK"$

Single Sided 7/16" sheathing w/ 8d @ 6**" O.C.** Panel Edges @ 12" O.C.
Interior Supports (ref. table 4.3A)

Bottom Plate Nailing

$C_D := 1.6$

$t_{sp} := 1.5in$ Sill plate thickness

$dia_a := 16d$ Nail Size

$sp_a := 8in$ Nail spacing

$Z_{ll} := v_n \cdot C_D = 0.226 \cdot kip$ Allowable load parallel to grain (ref. NDS table 12)

$V_{sp} := w_{v.w} \cdot sp_a = 0.066 \cdot kip$ Shear load to each nail

$Check_a := if(V_{sp} > Z_{ll}, "NG", "OK")$ $ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.292$ $Check_a = "OK"$

Use 16d Nail at 4.5"o.c. Staggered

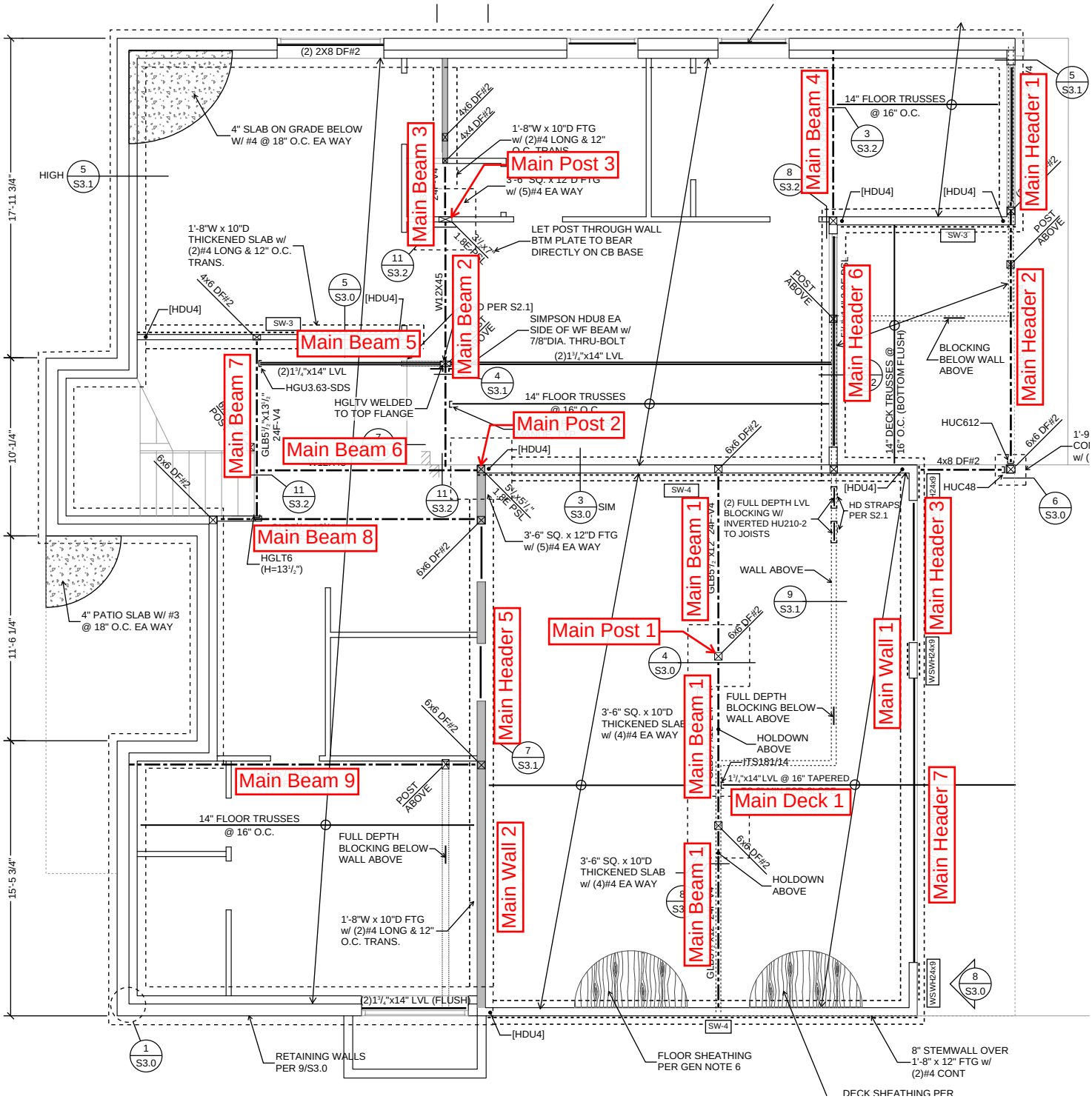
Holdown

$$T := \frac{\max(M_{ot.w}, M_{ot.E} \cdot \Omega_o) - M_{res}}{w_s} = 0.165 \cdot kip$$

$check_T := if(T > 150lbf, "HD REQ'D", "NOT REQ'D")$ $check_T = "HD REQ'D"$

$T_{all} := MST37 = 2.705 \cdot kip$ Allowable tension load

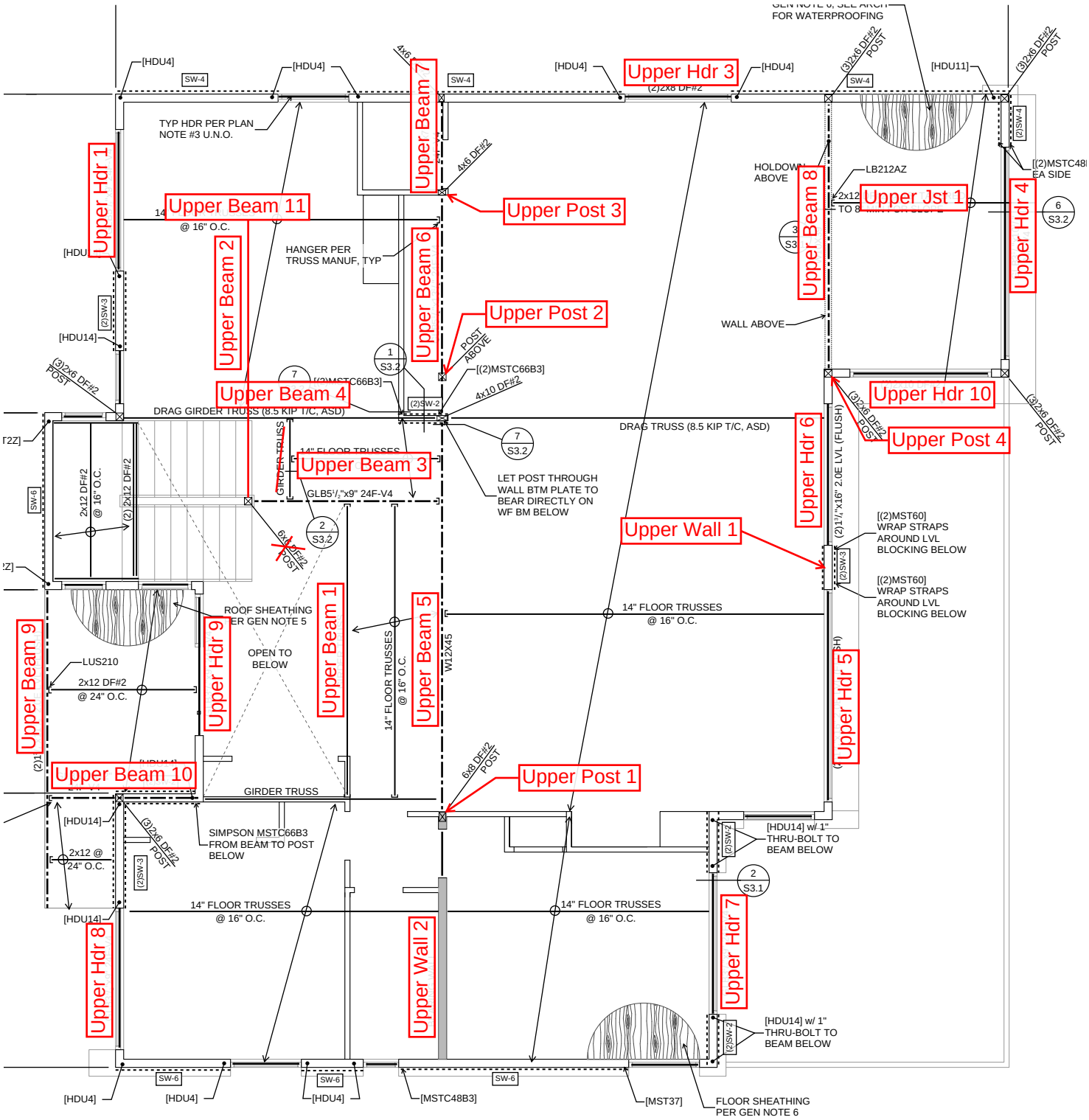
$check_{HD} := if\left(\frac{T}{T_{all}} > 1.0, "NG", "OK"\right)$ $ratio := \frac{T}{T_{all}} = 0.061$ $check_{HD} = "OK"$



PROJECT: 3804 House

DESCRIPTION: Main Floor Framing Keyplan

BY: NKH NKH Engineering DATE: 9/7/2023 JOB #: 22-112S105/248

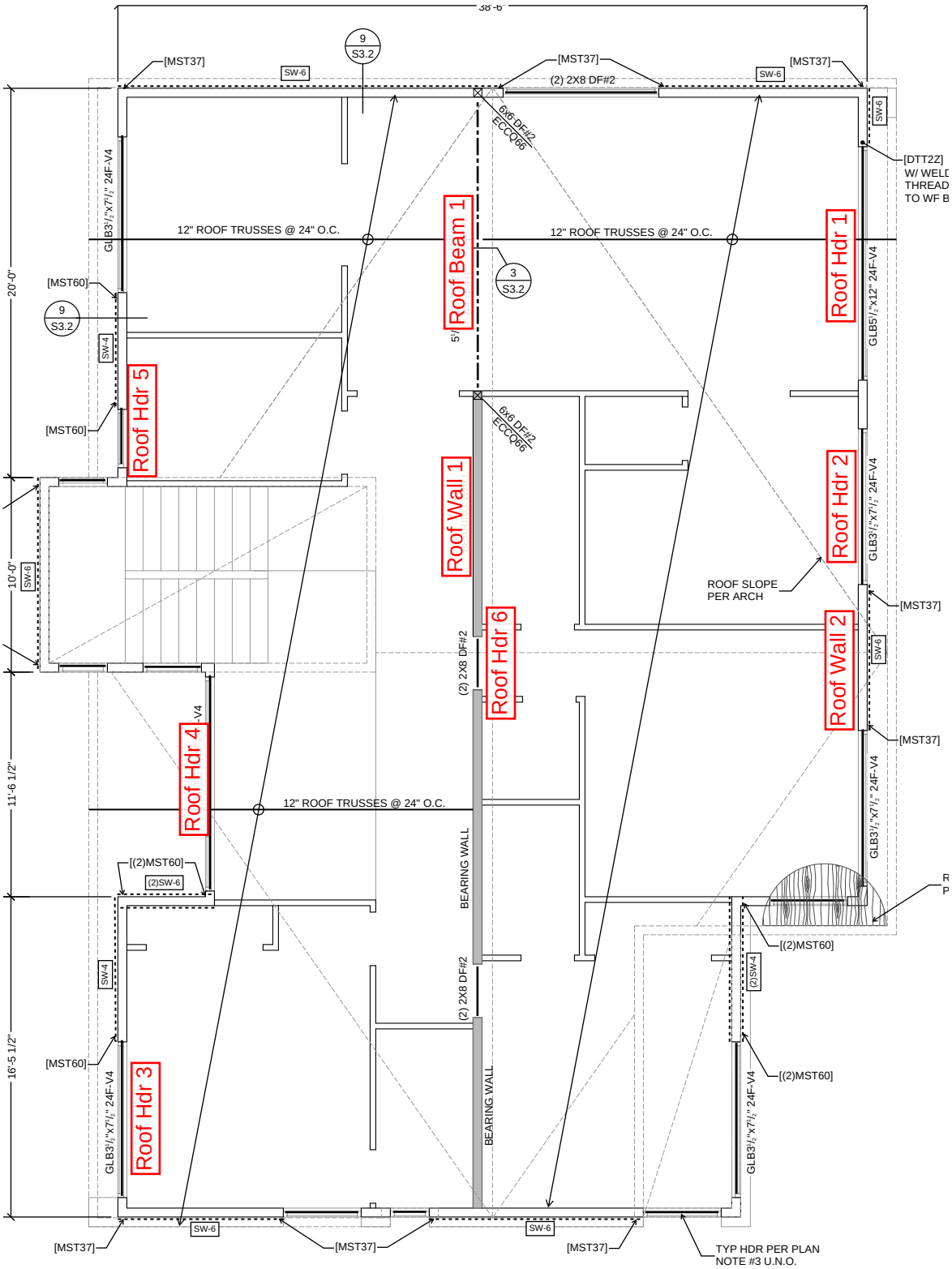


NKH ENGINEERING

PROJECT: 3804 House

DESCRIPTION: Upper Floor Framing Keyplan

BY: NKH NKH Engineering DATE: 9/7/2023 JOB #: 22-112S106/248



NKH ENGINEERING

PROJECT: 3804 House

DESCRIPTION: Roof Framing Keyplan

BY: NKH NKH Engineering DATE: 9/7/2023 JOB #: 22-112S107/248

Roof			
Member Name	**Results (Max UTIL %)**	**Current Solution**	**Comments**
(Loading Only) Roof Truss 1	Passed (74% ΔT)	1 piece(s) 11 7/8" TJI® 230 @ 16" OC	
(Loading Only) Roof Truss 2	Passed (46% ΔT)	1 piece(s) 11 7/8" TJI® 230 @ 16" OC	
(Loading Only) Roof Truss 3	Failed (27% R)	1 piece(s) 11 7/8" TJI® 230 @ 16" OC	Left cantilever exceeds the maximum braced cantilever length of 5'.
Roof Header 1	Passed (84% ΔT)	1 piece(s) 5 1/2" x 12" 24F-V4 DF Glulam	
Roof Header 2	Passed (62% ΔL)	1 piece(s) 3 1/2" x 7 1/2" 24F-V4 DF Glulam	
Roof Header 3	Passed (53% ΔL)	1 piece(s) 3 1/2" x 7 1/2" 24F-V4 DF Glulam	
Roof Header 4	Passed (75% ΔL)	1 piece(s) 5 1/2" x 9" 24F-V4 DF Glulam	
Roof Header 5	Passed (29% M)	2 piece(s) 2 x 6 DF No.2	
Roof Header 6	Passed (43% M)	2 piece(s) 2 x 8 DF No.2	
Roof Beam 1	Passed (94% ΔT)	1 piece(s) 5 1/4" x 11 7/8" 2.2E Parallam® PSL	
Roof Post 1	Passed (54% f_{cp})	1 piece(s) 6 x 6 DF No.2	
Roof Wall 1	Passed (77% f_c)	1 piece(s) 2 x 4 DF No.2 @ 16" OC	
Roof Wall 2	Passed (15% f_{cp})	1 piece(s) 2 x 6 DF No.2 @ 16" OC	

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Weyerhaeuser

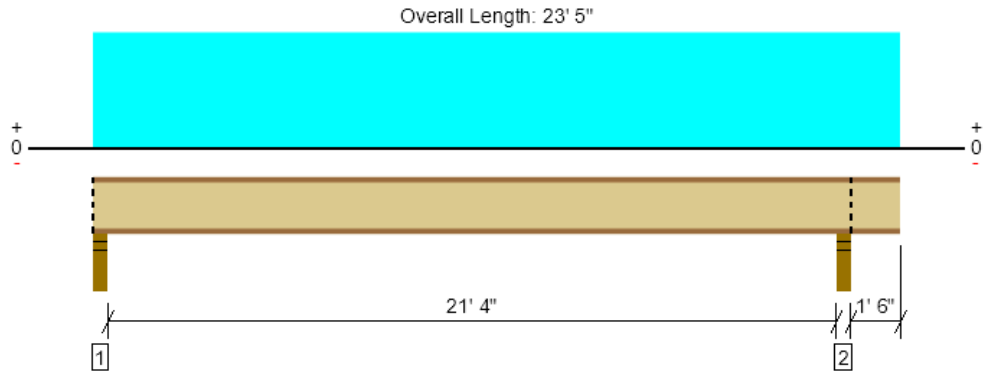
2/11/2025 7:28:20 PM UTC
ForteWEB v3.8
File Name: 22-112 3804 House

Upper Floor			
Member Name	**Results (Max UTIL %)**	**Current Solution**	**Comments**
(Loading Only) Upper Truss 1	Passed (41% R)	1 piece(s) 11 7/8" TJI® 230 @ 16" OC	
(Loading Only) Upper Truss 2	Passed (80% ΔL)	1 piece(s) 11 7/8" TJI® 230 @ 16" OC	
(Loading Only) Upper Truss 3	Passed (100% M)	1 piece(s) 14" TJI® 110 @ 16" OC	
(Loading Only) Upper Truss 4	Passed (80% ΔL)	1 piece(s) 11 7/8" TJI® 230 @ 16" OC	
(Loading Only) Upper Truss 5	Passed (53% M)	1 piece(s) 2 x 12 DF No.2 @ 24" OC	
(Loading Only) Upper Truss 6	Passed (25% R)	1 piece(s) 2 x 12 DF No.2 @ 24" OC	
(Loading Only) Upper Truss 7	Passed (39% M)	1 piece(s) 2 x 12 DF No.2 @ 24" OC	
(Loading Only) Upper Truss 8	Passed (57% ΔL)	1 piece(s) 11 7/8" TJI® 360 @ 16" OC	
(Loading Only) Upper Truss 9	Passed (99% M)	1 piece(s) 2 x 12 DF No.2 @ 16" OC	
(Loading Only) Upper Joist 10	Passed (101% ΔL)	1 piece(s) 2 x 8 DF No.2 @ 16" OC	
Upper Joist 1	Passed (84% M)	1 piece(s) 2 x 8 DF No.2 @ 16" OC	
Upper Beam 1	Passed (31% ΔT)	2 piece(s) 1 1/2" x 14" 1.5E TimberStrand® LSL	
Upper Beam 11	Passed (82% ΔL)	2 piece(s) 1 3/4" x 14" 1.55E TimberStrand® LSL	
Upper Beam 3	Passed (53% R)	2 piece(s) 1 3/4" x 14" 1.55E TimberStrand® LSL	
Upper Beam 4	Passed (65% R)	1 piece(s) W8X21 (A992) ASTM Steel	
Upper Beam 5	Passed (100% R)	1 piece(s) W12X45 (A992) ASTM Steel	
Upper Beam 6	Passed (98% R)	1 piece(s) 5 1/2" x 13 1/2" 24F-V4 DF Glulam	
Upper Beam 7	Passed (47% M+)	1 piece(s) 5 1/2" x 7 1/2" 24F-V4 DF Glulam	
Upper Beam 8	Passed (97% ΔT)	1 piece(s) W10X39 (A992) ASTM Steel	
Upper Beam 9	Failed (93% ΔL)	2 piece(s) 1 3/4" x 11 7/8" 2.0E Microllam® LVL	Left cantilever exceeds the maximum braced cantilever length of 7'.
Upper Beam 10	Passed (96% M-)	1 piece(s) 5 1/2" x 12" 24F-V8 DF Glulam	
Upper Header 1	Passed (39% M+)	1 piece(s) 5 1/2" x 9" 24F-V4 DF Glulam	
Upper Header 3	Passed (67% M)	2 piece(s) 2 x 8 DF No.2	
Upper Header 4	Passed (63% ΔL)	1 piece(s) 3 1/2" x 10 1/2" 24F-V4 DF Glulam	
Upper Header 5	Passed (99% ΔT)	2 piece(s) 1 3/4" x 16" 2.0E Microllam® LVL	
Upper Header 6	Passed (70% R)	1 piece(s) 1 3/4" x 16" 2.0E Microllam® LVL	
Upper Header 7	Passed (41% M+)	1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam	
Upper Header 8	Passed (60% M+)	1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam	
Upper Header 9	Passed (45% M+)	1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam	
Upper Header 10	Passed (83% M)	2 piece(s) 2 x 10 DF No.2	
Upper Wall 1	Passed (27% B/C)	1 piece(s) 2 x 6 DF No.2 @ 16" OC	
Upper Wall 2	Passed (49% f_{cp})	1 piece(s) 2 x 6 DF No.2 @ 16" OC	
Upper Post 1	Passed (95% f_{cp})	1 piece(s) 6 x 8 DF No.2	
Upper Post 2	Failed (155% f_{cp})	1 piece(s) 4 x 10 DF No.2	
Upper Post 3	Passed (100% f_{cp})	1 piece(s) 4 x 6 DF No.2	
Upper Post 4	Passed (69% f_{cp})	3 piece(s) 2 x 6 DF No.2	

Main			
Member Name	**Results (Max UTIL %)**	**Current Solution**	**Comments**
(Loading Only) Main Truss 1	Passed (78% ΔL)	1 piece(s) 11 7/8" TJI® 230 @ 16" OC	
(Loading Only) Main Truss 2	Passed (39% R)	1 piece(s) 11 7/8" TJI® 230 @ 16" OC	
(Loading Only) Main Truss 3-2	Passed (36% R)	1 piece(s) 11 7/8" TJI® 230 @ 16" OC	
(Loading Only) Main Truss 4	Passed (66% ΔL)	1 piece(s) 11 7/8" TJI® 230 @ 16" OC	
(Loading Only) Main Truss 5	Passed (38% R)	1 piece(s) 11 7/8" TJI® 230 @ 16" OC	
(Loading Only) Main Truss 6	Passed (78% ΔL)	1 piece(s) 11 7/8" TJI® 230 @ 16" OC	
(Loading Only) Main Truss 7	Passed (78% ΔL)	1 piece(s) 14" TJI® 360 @ 16" OC	
Main Deck 1	Passed (66% ΔL)	1 piece(s) 1 3/4" x 9 1/4" 2.0E Microllam® LVL @ 16" OC	
Main Deck 1 w/ Wall Above	Passed (66% ΔL)	1 piece(s) 1 3/4" x 9 1/4" 2.0E Microllam® LVL @ 16" OC	
Main Deck 2	Passed (82% ΔL)	1 piece(s) 1 3/4" x 7 1/4" 2.0E Microllam® LVL @ 12" OC	
Main Beam 1	Passed (77% M+)	1 piece(s) 5 1/2" x 12" 24F-V4 DF Glulam	
Main Beam 1 Revised	Passed (96% ΔT)	1 piece(s) 7" x 14" 2.2E Parallam® PSL	
Main Beam 2	Passed (98% M)	1 piece(s) W12X45 (A992) ASTM Steel	
Main Beam 3	Passed (39% R)	1 piece(s) 3 1/2" x 7 1/2" 24F-V4 DF Glulam	
Main Beam 4	Passed (61% ΔL)	1 piece(s) 5 1/2" x 10 1/2" 24F-V4 DF Glulam	
Main Beam 5	Passed (46% R)	2 piece(s) 1 3/4" x 14" 2.0E Microllam® LVL	
Main Beam 6	Passed (86% M)	1 piece(s) W12X35 (A992) ASTM Steel	
Main Beam 7	Passed (100% R)	1 piece(s) 5 1/2" x 13 1/2" 24F-V4 DF Glulam	
Main Beam 8	Passed (74% V)	1 piece(s) 5 1/2" x 13 1/2" 24F-V4 DF Glulam	
Main Beam 9	Passed (99% V)	1 piece(s) 5 1/2" x 13 1/2" 24F-V4 DF Glulam	
Main Header 1	Passed (42% M+)	1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam	
Main Header 2	Passed (30% M+)	1 piece(s) 5 1/2" x 12" 24F-V4 DF Glulam	
Main Header 3	Passed (71% M+)	1 piece(s) 5 1/2" x 9" 24F-V4 DF Glulam	
Main Header 5	Passed (91% M)	2 piece(s) 2 x 6 DF No.2	
Main Header 6	Passed (100% ΔT)	1 piece(s) 5 1/4" x 14" 2.2E Parallam® PSL	
Main Header 7	Passed (100% M+)	1 piece(s) 5 1/2" x 15" 24F-V4 DF Glulam	
Main Wall 1	Passed (60% f_{cp})	1 piece(s) 2 x 6 DF No.2 @ 16" OC	
Main Wall 2	Passed (70% f_{cp})	1 piece(s) 2 x 6 DF No.2 @ 16" OC	
Main Post 1	Passed (93% f_c)	1 piece(s) 6 x 6 DF No.2	
Main Post 2	Passed (61% f_c)	1 piece(s) 5 1/4" x 5 1/4" 1.8E Parallam® PSL	
Main Post 3	Failed (137% f_{cp})	1 piece(s) 3 1/2" x 7" 1.8E Parallam® PSL	

Roof, (Loading Only) Roof Truss 1

1 piece(s) 11 7/8" TJI® 230 @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	584 @ 2 1/2"	1708 (3.50")	Passed (34%)	1.15	1.0 D + 1.0 S (Alt Spans)
Shear (lbs)	568 @ 3 1/2"	1903	Passed (30%)	1.15	1.0 D + 1.0 S (Alt Spans)
Moment (Ft-lbs)	3075 @ 10' 11 3/8"	4847	Passed (63%)	1.15	1.0 D + 1.0 S (Alt Spans)
Live Load Defl. (in)	0.499 @ 10' 11 3/4"	0.719	Passed (L/519)	--	1.0 D + 1.0 S (Alt Spans)
Total Load Defl. (in)	0.796 @ 10' 11 11/16"	1.078	Passed (L/325)	--	1.0 D + 1.0 S (Alt Spans)

Member Length : 23' 5"
System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/360) and TL (L/240).
- Overhang deflection criteria: LL (2L/360) and TL (2L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Roof Live	Snow	Factored	
1 - Stud wall - SPF	3.50"	3.50"	1.75"	219	292	365	584	Blocking
2 - Stud wall - SPF	3.50"	3.50"	3.50"	250	333	416	666	Blocking

- 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)	4' 10" o/c	
Bottom Edge (Lu)	9' 7" 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)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Uniform (PSF)	0 to 23' 5"	16"	15.0	20.0	25.0	Default Load

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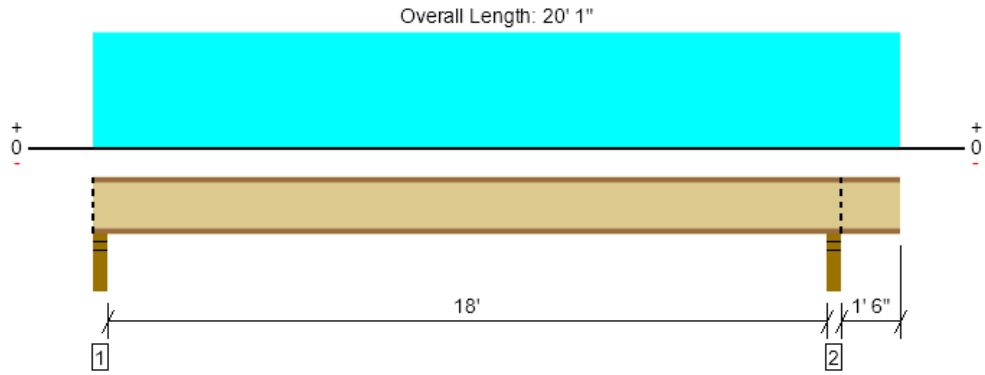
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Roof, (Loading Only) Roof Truss 2

1 piece(s) 11 7/8" TJI® 230 @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	494 @ 2 1/2"	1708 (3.50")	Passed (29%)	1.15	1.0 D + 1.0 S (Alt Spans)
Shear (lbs)	479 @ 3 1/2"	1903	Passed (25%)	1.15	1.0 D + 1.0 S (Alt Spans)
Moment (Ft-lbs)	2191 @ 9' 3 1/4"	4847	Passed (45%)	1.15	1.0 D + 1.0 S (Alt Spans)
Live Load Defl. (in)	0.261 @ 9' 3 3/4"	0.608	Passed (L/837)	--	1.0 D + 1.0 S (Alt Spans)
Total Load Defl. (in)	0.417 @ 9' 3 11/16"	0.911	Passed (L/525)	--	1.0 D + 1.0 S (Alt Spans)

Member Length : 20' 1"
System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/360) and TL (L/240).
- Overhang deflection criteria: LL (2L/360) and TL (2L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Roof Live	Snow	Factored	
1 - Stud wall - SPF	3.50"	3.50"	1.75"	185	248	310	494	Blocking
2 - Stud wall - SPF	3.50"	3.50"	3.50"	217	289	361	578	Blocking

- 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)	5' 9" o/c	
Bottom Edge (Lu)	9' 7" 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)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Uniform (PSF)	0 to 20' 1"	16"	15.0	20.0	25.0	Default Load

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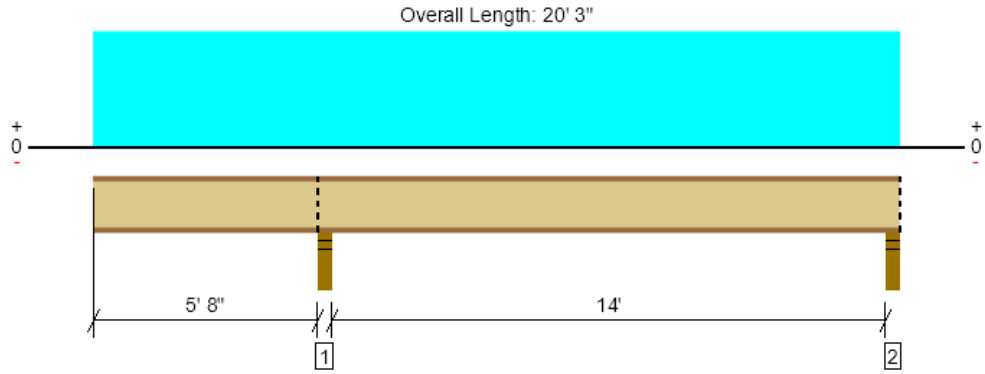
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Roof, (Loading Only) Roof Truss 3

1 piece(s) 11 7/8" TJI® 230 @ 16" OC

Left cantilever exceeds the maximum braced cantilever length of 5'.



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	753 @ 5' 9 3/4"	2772 (3.50")	Passed (27%)	1.15	1.0 D + 1.0 S (All Spans)
Shear (lbs)	414 @ 5' 11 1/2"	1903	Passed (22%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	-901 @ 5' 9 3/4"	3635	Passed (25%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.086 @ 13' 2"	0.474	Passed (L/999+)	--	1.0 D + 1.0 S (Alt Spans)
Total Load Defl. (in)	0.127 @ 13' 3 5/16"	0.711	Passed (L/999+)	--	1.0 D + 1.0 S (Alt Spans)

Member Length : 20' 3"
System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/360) and TL (L/240).
- Overhang deflection criteria: LL (2L/360) and TL (2L/240).
- Moment capacity over cantilever support 1 has been reduced by 25% to lessen the effects of buckling.
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Roof Live	Snow	Factored	
1 - Stud wall - SPF	3.50"	3.50"	3.50"	282	376	470	753	Blocking
2 - Stud wall - SPF	3.50"	3.50"	1.75"	123	179	224	347	Blocking

• 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)	8' 5" o/c	
Bottom Edge (Lu)	9' 2" 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)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Uniform (PSF)	0 to 20' 3"	16"	15.0	20.0	25.0	Default Load

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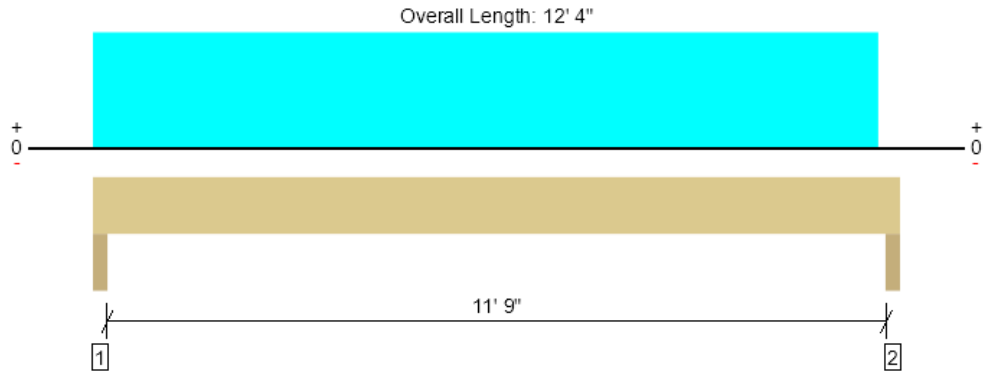
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Roof, Roof Header 1

1 piece(s) 5 1/2" x 12" 24F-V4 DF Glulam



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Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	3179 @ 2"	12513 (3.50")	Passed (25%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	2514 @ 11' 1/2"	13409	Passed (19%)	1.15	1.0 D + 1.0 S (All Spans)
Pos Moment (Ft-lbs)	9276 @ 6' 2"	30360	Passed (31%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.102 @ 6' 2"	0.300	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.169 @ 6' 2"	0.200	Passed (L/854)	--	1.0 D + 1.0 S (All Spans)

Member Length : 12' 4"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/720).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 12'.
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Roof Live	Snow	Factored	
1 - Trimmer - SPF	3.50"	3.50"	1.50"	1255	1540	1924	3179	None
2 - Trimmer - SPF	3.50"	3.50"	1.50"	1193	1457	1820	3013	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	12' 4" o/c	
Bottom Edge (Lu)	12' 4" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 12' 4"	N/A	16.0	--	--	
1 - Uniform (PLF)	0 to 12'	N/A	187.5	249.8	312.0	Linked from: Roof Truss 1, Support 2

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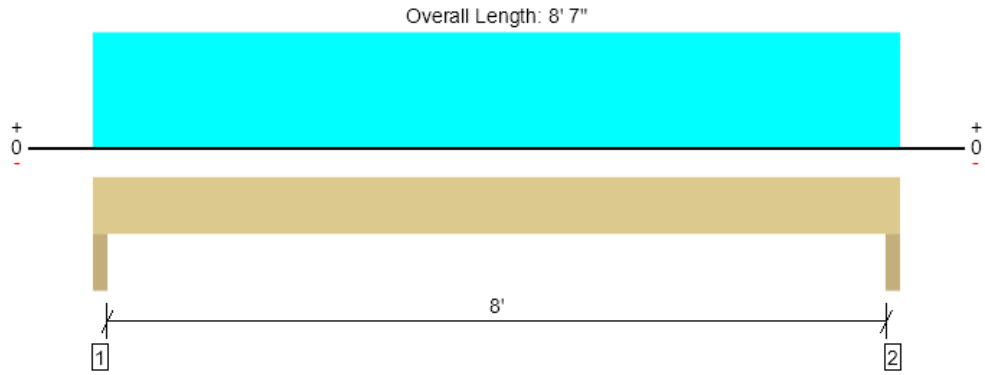
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Roof, Roof Header 2

1 piece(s) 3 1/2" x 7 1/2" 24F-V4 DF Glulam



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Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1907 @ 2"	7963 (3.50")	Passed (24%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	1500 @ 11"	5333	Passed (28%)	1.15	1.0 D + 1.0 S (All Spans)
Pos Moment (Ft-lbs)	3781 @ 4' 3 1/2"	7547	Passed (50%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.129 @ 4' 3 1/2"	0.206	Passed (L/768)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.209 @ 4' 3 1/2"	0.412	Passed (L/473)	--	1.0 D + 1.0 S (All Spans)

Member Length : 8' 7"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 8' 3".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Roof Live	Snow	Factored	
1 - Trimmer - SPF	3.50"	3.50"	1.50"	732	940	1175	1907	None
2 - Trimmer - SPF	3.50"	3.50"	1.50"	732	940	1175	1907	None

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

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 8' 7"	N/A	6.4	--	--	
1 - Uniform (PLF)	0 to 8' 7"	N/A	164.3	219.0	273.8	Linked from: Roof Truss 1, Support 1

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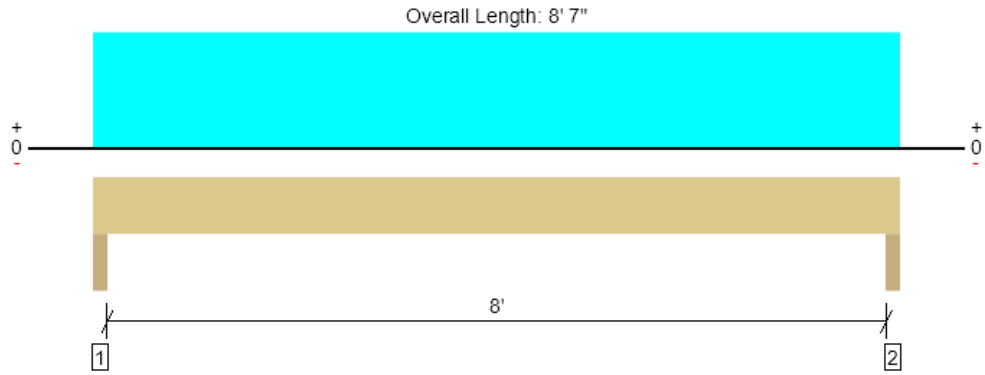
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Roof, Roof Header 3

1 piece(s) 3 1/2" x 7 1/2" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1621 @ 2"	7963 (3.50")	Passed (20%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	1275 @ 11"	5333	Passed (24%)	1.15	1.0 D + 1.0 S (All Spans)
Pos Moment (Ft-lbs)	3213 @ 4' 3 1/2"	7547	Passed (43%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.109 @ 4' 3 1/2"	0.206	Passed (L/905)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.178 @ 4' 3 1/2"	0.412	Passed (L/557)	--	1.0 D + 1.0 S (All Spans)

Member Length : 8' 7"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 8' 3".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Roof Live	Snow	Factored	
1 - Trimmer - SPF	3.50"	3.50"	1.50"	623	798	998	1621	None
2 - Trimmer - SPF	3.50"	3.50"	1.50"	623	798	998	1621	None

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

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 8' 7"	N/A	6.4	--	--	
1 - Uniform (PLF)	0 to 8' 7"	N/A	138.8	186.0	232.5	Linked from: Roof Truss 2, Support 1

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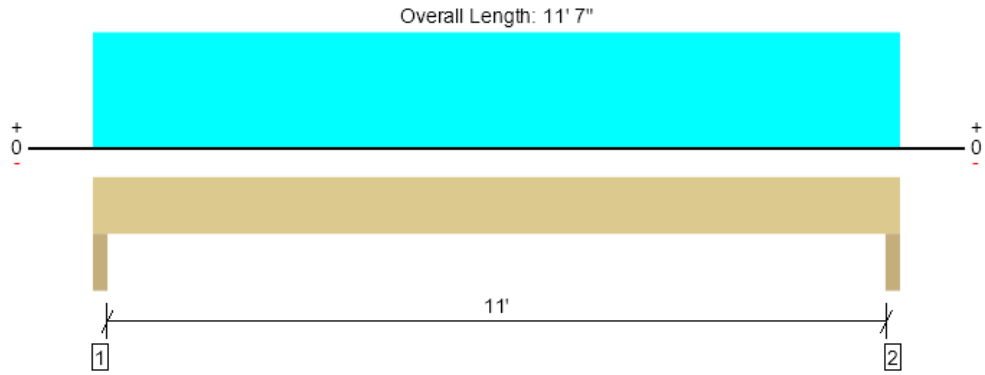
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Roof, Roof Header 4

1 piece(s) 5 1/2" x 9" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	3336 @ 2"	12513 (3.50")	Passed (27%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	2736 @ 1' 1/2"	10057	Passed (27%)	1.15	1.0 D + 1.0 S (All Spans)
Pos Moment (Ft-lbs)	9113 @ 5' 9 1/2"	17078	Passed (53%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.211 @ 5' 9 1/2"	0.281	Passed (L/639)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.345 @ 5' 9 1/2"	0.563	Passed (L/391)	--	1.0 D + 1.0 S (All Spans)

Member Length : 11' 7"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 11' 3".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Roof Live	Snow	Factored	
1 - Trimmer - SPF	3.50"	3.50"	1.50"	1295	1633	2042	3336	None
2 - Trimmer - SPF	3.50"	3.50"	1.50"	1295	1633	2042	3336	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	11' 7" o/c	
Bottom Edge (Lu)	11' 7" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 11' 7"	N/A	12.0	--	--	
1 - Uniform (PLF)	0 to 11' 7"	N/A	211.5	282.0	352.5	Linked from: Roof Truss 3, Support 1

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

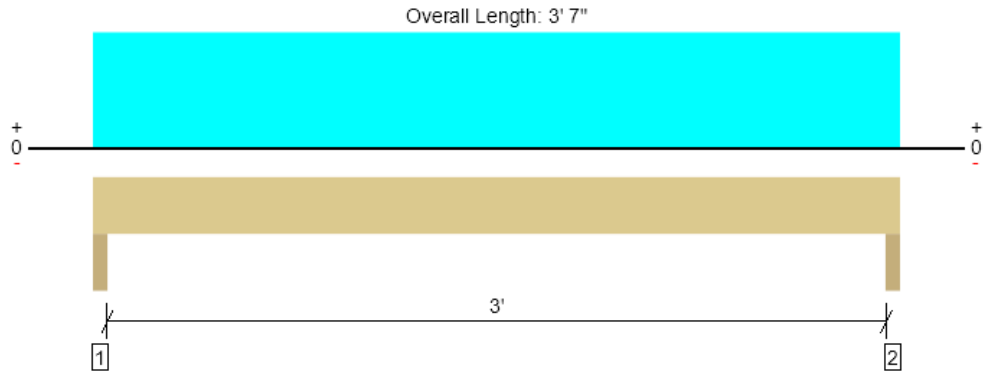
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

MEMBER REPORT

PASSED

Roof, Roof Header 5

2 piece(s) 2 x 6 DF No.2



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	673 @ 2"	6563 (3.50")	Passed (10%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	391 @ 9"	2277	Passed (17%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	496 @ 1' 9 1/2"	1696	Passed (29%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.009 @ 1' 9 1/2"	0.081	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.014 @ 1' 9 1/2"	0.162	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)

Member Length : 3' 7"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Roof Live	Snow	Factored	
1 - Trimmer - SPF	3.50"	3.50"	1.50"	256	333	417	673	None
2 - Trimmer - SPF	3.50"	3.50"	1.50"	256	333	417	673	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	3' 7" o/c	
Bottom Edge (Lu)	3' 7" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 3' 7"	N/A	4.2	--	--	
1 - Uniform (PLF)	0 to 3' 7"	N/A	138.8	186.0	232.5	Linked from: Roof Truss 2, Support 1

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

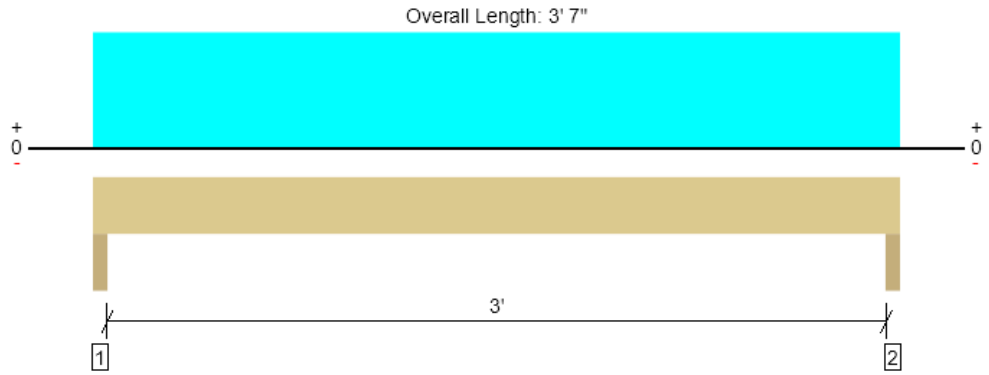
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

MEMBER REPORT

PASSED

Roof, Roof Header 6

2 piece(s) 2 x 8 DF No.2



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1571 @ 2"	6563 (3.50")	Passed (24%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	786 @ 10 3/4"	3002	Passed (26%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	1158 @ 1' 9 1/2"	2720	Passed (43%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.009 @ 1' 9 1/2"	0.081	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.014 @ 1' 9 1/2"	0.162	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)

Member Length : 3' 7"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Roof Live	Snow	Factored	
1 - Trimmer - SPF	3.50"	3.50"	1.50"	596	781	976	1571	None
2 - Trimmer - SPF	3.50"	3.50"	1.50"	596	781	976	1571	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	3' 7" o/c	
Bottom Edge (Lu)	3' 7" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 3' 7"	N/A	5.5	--	--	
1 - Uniform (PLF)	0 to 3' 7"	N/A	164.3	219.0	273.8	Linked from: Roof Truss 1, Support 1
2 - Uniform (PLF)	0 to 3' 7"	N/A	162.8	216.8	270.8	Linked from: Roof Truss 2, Support 2

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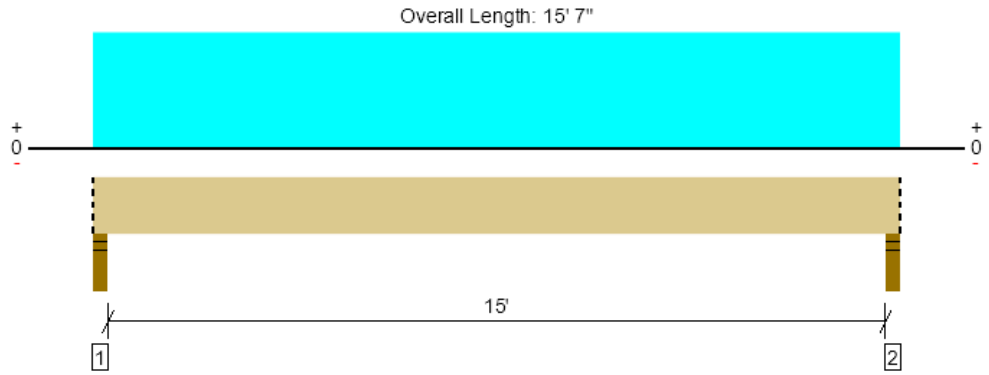
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Roof, Roof Beam 1

1 piece(s) 5 1/4" x 11 7/8" 2.2E Parallam® PSL



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Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	6942 @ 2"	7809 (3.50")	Passed (89%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	5801 @ 1' 3 3/8"	13861	Passed (42%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	25901 @ 7' 9 1/2"	34332	Passed (75%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.438 @ 7' 9 1/2"	0.508	Passed (L/418)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.716 @ 7' 9 1/2"	0.762	Passed (L/256)	--	1.0 D + 1.0 S (All Spans)

Member Length : 15' 7"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Roof Live	Snow	Factored	
1 - Stud wall - SPF	3.50"	3.50"	3.11"	2700	3395	4243	6942	Blocking
2 - Stud wall - SPF	3.50"	3.50"	3.11"	2700	3395	4243	6942	Blocking

- 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)	15' 7" o/c	
Bottom Edge (Lu)	15' 7" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 15' 7"	N/A	19.5	--	--	
1 - Uniform (PLF)	0 to 15' 7" (Front)	N/A	164.3	219.0	273.8	Linked from: Roof Truss 1, Support 1
2 - Uniform (PLF)	0 to 15' 7" (Front)	N/A	162.8	216.8	270.8	Linked from: Roof Truss 2, Support 2

- Side loads are assumed to not induce cross-grain tension.

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ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

FORTEWEB

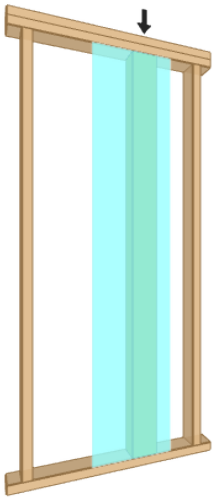
MEMBER REPORT

PASSED

Roof, Roof Post 1

1 piece(s) 6 x 6 DF No.2

Wall Height: 12' Member Height: 11' 7 1/2" Tributary Width: 1'



Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	25	50	Passed (51%)	--	--
Compression (lbs)	6943	14197	Passed (49%)	1.15	1.0 D + 1.0 S
Plate Bearing (lbs)	6943	12856	Passed (54%)	--	1.0 D + 1.0 S
Lateral Reaction (lbs)	84	--	--	1.60	1.0 D + 0.6 W
Lateral Shear (lbs)	78	5485	Passed (1%)	1.60	1.0 D + 0.6 W
Lateral Moment (ft-lbs)	245 @ mid-span	2773	Passed (9%)	1.60	1.0 D + 0.6 W
Total Deflection (in)	0.04 @ mid-span	1.16	Passed (L/3321)	--	1.0 D + 0.6 W
Bending/Compression	0.24	1	Passed (24%)	1.60	1.0 D + 0.45 W + 0.75 L + 0.75 S

- Lateral deflection criteria: Wind (L/120)
- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.
- This product has a square cross section. The analysis engine has checked both edge and plank orientations to allow for either installation.

Supports	Type	Material
Top	Dbl 2X	Spruce-Pine-Fir
Base	2X	Spruce-Pine-Fir

System : Wall
Member Type : Column
Building Code : IBC 2018
Design Methodology : ASD

Max Unbraced Length	Comments
1'	

Lateral Connections

Supports	Connector	Type/Model	Quantity	Connector Nailing
Top	Nails	8d (0.113" x 2 1/2") (Toe)	2	N/A
Base	Nails	8d (0.113" x 2 1/2") (Toe)	2	N/A

- Nailed connection at the top of the member is assumed to be nailed through the bottom 2x plate prior to placement of the top 2x of the double top plate assembly.

Vertical Loads	Tributary Width	Dead (0.90)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Point (lb)	N/A	-	-	-	
2 - Point (lb)	N/A	2700	3395	4243	Linked from: Roof Beam 1, Support 2

Lateral Load	Location	Tributary Width	Wind (1.60)	Comments
1 - Uniform (PSF)	Full Length	1'	24.1	

- ASCE/SEI 7 Sec. 30.4: Exposure Category (B), Mean Roof Height (33'), Topographic Factor (1.0), Wind Directionality Factor (0.85), Basic Wind Speed (115), Risk Category(II), Wind Zone (4), GCpi (+/- 0.18), Effective Wind Area determined using full member span and trib. width.
- IBC Table 1604.3, footnote f: Deflection checks are performed using 42% of this lateral wind load.

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ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

NKH Engineering

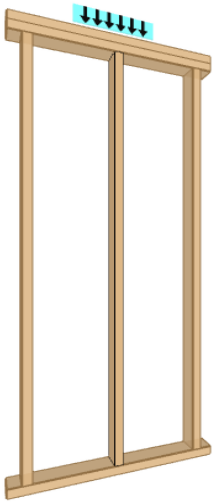
Weyerhaeuser

2/11/2025 7:28:20 PM UTC
ForteWEB v3.8, Engine: V8.4.1.24, Data: V8.1.6.3
File Name: 22-112 3804 House

Roof, Roof Wall 1

1 piece(s) 2 x 4 DF No.2 @ 16" OC

Wall Height: 12' Member Height: 11' 7 1/2" O. C. Spacing: 16.00"



Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	40	50	Passed (80%)	--	--
Compression (lbs)	1162	1517	Passed (77%)	1.15	1.0 D + 1.0 S
Plate Bearing (lbs)	1162	2789	Passed (42%)	--	1.0 D + 1.0 S
Lateral Reaction (lbs)	0	--	--	--	N/A
Lateral Shear (lbs)	0	N/A	Passed (N/A)	--	N/A
Lateral Moment (ft-lbs)	0 @ mid-span	N/A	Passed (N/A)	--	N/A
Total Deflection (in)	0.00 @ mid-span	N/A	Passed (N/A)	--	N/A
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Lateral deflection criteria: Wind (L/120)
- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.
- A bearing area factor of 1.25 has been applied to base plate bearing capacity.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.

Supports	Type	Material
Top	Dbl 2X	Spruce-Pine-Fir
Base	2X	Spruce-Pine-Fir

System : Wall
Member Type : Stud
Building Code : IBC 2018
Design Methodology : ASD

Max Unbraced Length	Comments
1'	

Vertical Loads	Spacing	Dead (0.90)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Point (PLF)	16.00"	164.3	219.0	273.8	Linked from: Roof Truss 1, Support 1
2 - Point (PLF)	16.00"	162.8	216.8	270.8	Linked from: Roof Truss 2, Support 2

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

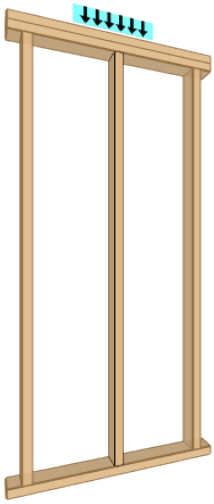
MEMBER REPORT

PASSED

Roof, Roof Wall 2

1 piece(s) 2 x 6 DF No.2 @ 16" OC

Wall Height: 12' Member Height: 11' 7 1/2" O. C. Spacing: 16.00"



Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	25	50	Passed (51%)	--	--
Compression (lbs)	666	5432	Passed (12%)	1.15	1.0 D + 1.0 S
Plate Bearing (lbs)	666	4383	Passed (15%)	--	1.0 D + 1.0 S
Lateral Reaction (lbs)	0	--	--	--	N/A
Lateral Shear (lbs)	0	N/A	Passed (N/A)	--	N/A
Lateral Moment (ft-lbs)	0 @ mid-span	N/A	Passed (N/A)	--	N/A
Total Deflection (in)	0.00 @ mid-span	N/A	Passed (N/A)	--	N/A
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Lateral deflection criteria: Wind (L/120)
- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.
- A bearing area factor of 1.25 has been applied to base plate bearing capacity.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.

Supports	Type	Material
Top	Dbl 2X	Spruce-Pine-Fir
Base	2X	Spruce-Pine-Fir

System : Wall
Member Type : Stud
Building Code : IBC 2018
Design Methodology : ASD

Max Unbraced Length	Comments
1'	

Vertical Load	Spacing	Dead (0.90)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Point (PLF)	16.00"	187.5	249.8	312.0	Linked from: Roof Truss 1, Support 2

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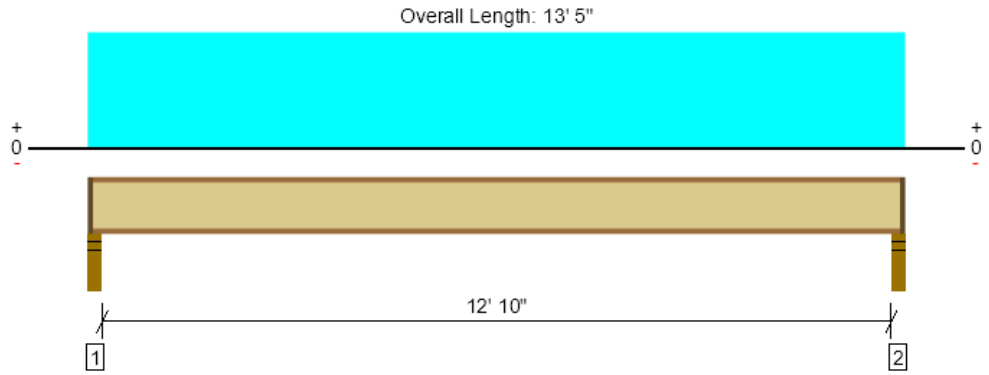
Upper Floor, (Loading Only) Upper Truss 1

1 piece(s) 11 7/8" TJI® 230 @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	484 @ 2 1/2"	1183 (2.25")	Passed (41%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	471 @ 3 1/2"	1655	Passed (28%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	1549 @ 6' 8 1/2"	4215	Passed (37%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.102 @ 6' 8 1/2"	0.325	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.140 @ 6' 8 1/2"	0.650	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	56	40	Passed	--	--

Member Length : 13' 2 1/2"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- 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	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.75"	134	358	492	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	2.25"	1.75"	134	358	492	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)	6' 11" o/c	
Bottom Edge (Lu)	13' 3" 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 13' 5"	16"	15.0	40.0	Default Load

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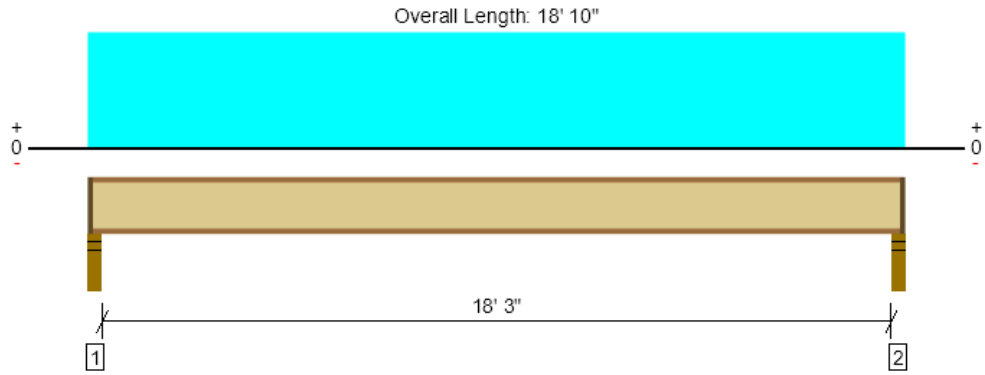
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, (Loading Only) Upper Truss 2

1 piece(s) 11 7/8" TJI® 230 @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	683 @ 2 1/2"	1183 (2.25")	Passed (58%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	669 @ 3 1/2"	1655	Passed (40%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	3109 @ 9' 5"	4215	Passed (74%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.368 @ 9' 5"	0.460	Passed (L/600)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.507 @ 9' 5"	0.921	Passed (L/436)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	39	35	Passed	--	--

Member Length : 18' 7 1/2"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- 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	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.75"	188	502	691	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	2.25"	1.75"	188	502	691	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)	4' 9" o/c	
Bottom Edge (Lu)	18' 8" 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 18' 10"	16"	15.0	40.0	Default Load

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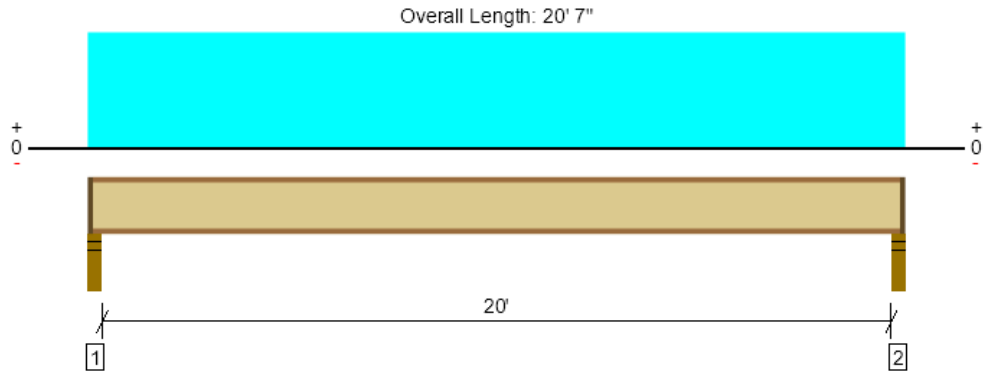
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, (Loading Only) Upper Truss 3

1 piece(s) 14" TJI® 110 @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	747 @ 2 1/2"	1041 (2.25")	Passed (72%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	733 @ 3 1/2"	1860	Passed (39%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	3728 @ 10' 3 1/2"	3740	Passed (100%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.448 @ 10' 3 1/2"	0.504	Passed (L/540)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.616 @ 10' 3 1/2"	1.008	Passed (L/393)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	35	35	Passed	--	--

Member Length : 20' 4 1/2"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- 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	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.75"	206	549	755	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	2.25"	1.75"	206	549	755	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)	3' 1" o/c	
Bottom Edge (Lu)	20' 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 20' 7"	16"	15.0	40.0	Default Load

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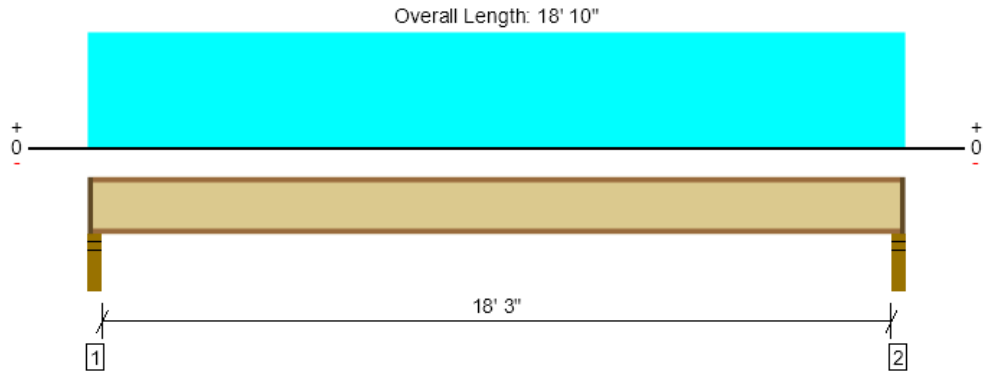
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, (Loading Only) Upper Truss 4

1 piece(s) 11 7/8" TJI® 230 @ 16" OC



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Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	683 @ 2 1/2"	1183 (2.25")	Passed (58%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	669 @ 3 1/2"	1655	Passed (40%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	3109 @ 9' 5"	4215	Passed (74%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.368 @ 9' 5"	0.460	Passed (L/600)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.507 @ 9' 5"	0.921	Passed (L/436)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	39	35	Passed	--	--

Member Length : 18' 7 1/2"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- 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	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.75"	188	502	691	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	2.25"	1.75"	188	502	691	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)	4' 9" o/c	
Bottom Edge (Lu)	18' 8" 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 18' 10"	16"	15.0	40.0	Default Load

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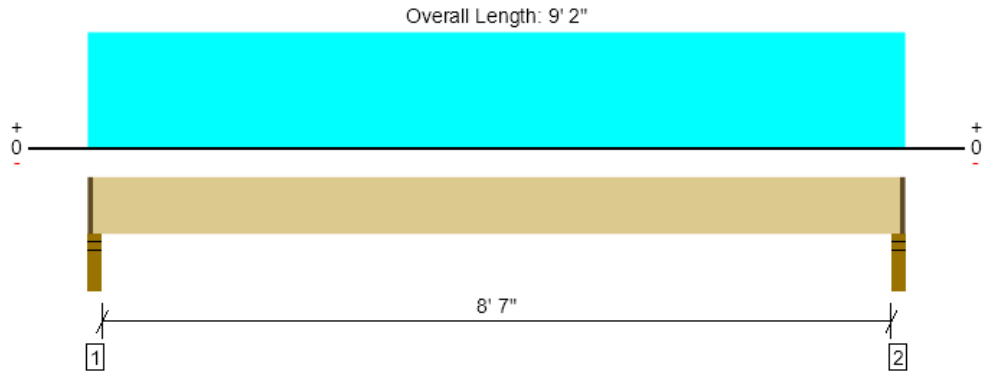
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, (Loading Only) Upper Truss 5

1 piece(s) 2 x 12 DF No.2 @ 24" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	672 @ 2 1/2"	1434 (2.25")	Passed (47%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	503 @ 1' 2 3/4"	2025	Passed (25%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	1436 @ 4' 7"	2729	Passed (53%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.056 @ 4' 7"	0.219	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.069 @ 4' 7"	0.438	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	N/A	N/A	N/A	--	N/A

Member Length : 8' 11 1/2"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.
- Applicable calculations are based on NDS.
- No composite action between deck and joist was considered in analysis.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.50"	138	550	688	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	2.25"	1.50"	138	550	688	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)	9' o/c	
Bottom Edge (Lu)	9' o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 9' 2"	24"	15.0	60.0	Default Load

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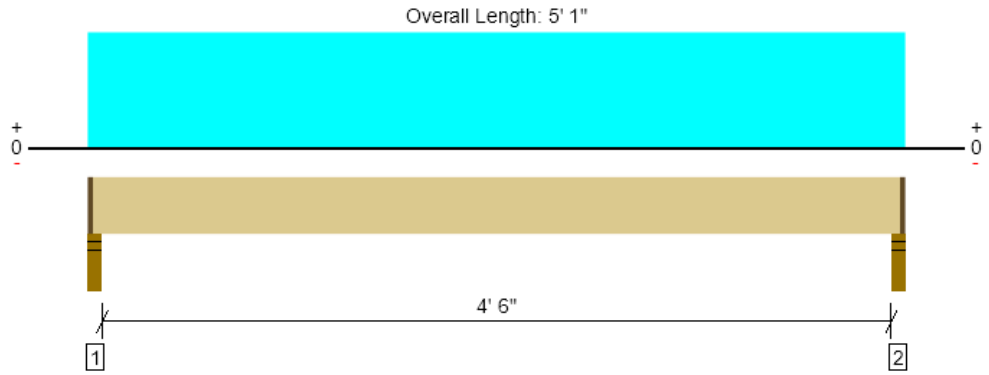
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, (Loading Only) Upper Truss 6

1 piece(s) 2 x 12 DF No.2 @ 24" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	366 @ 2 1/2"	1434 (2.25")	Passed (25%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	197 @ 1' 2 3/4"	2025	Passed (10%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	408 @ 2' 6 1/2"	2729	Passed (15%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.004 @ 2' 6 1/2"	0.117	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.006 @ 2' 6 1/2"	0.233	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	N/A	N/A	N/A	--	N/A

Member Length : 4' 10 1/2"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.
- Applicable calculations are based on NDS.
- No composite action between deck and joist was considered in analysis.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.50"	76	305	381	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	2.25"	1.50"	76	305	381	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)	4' 11" o/c	
Bottom Edge (Lu)	4' 11" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 5' 1"	24"	15.0	60.0	Default Load

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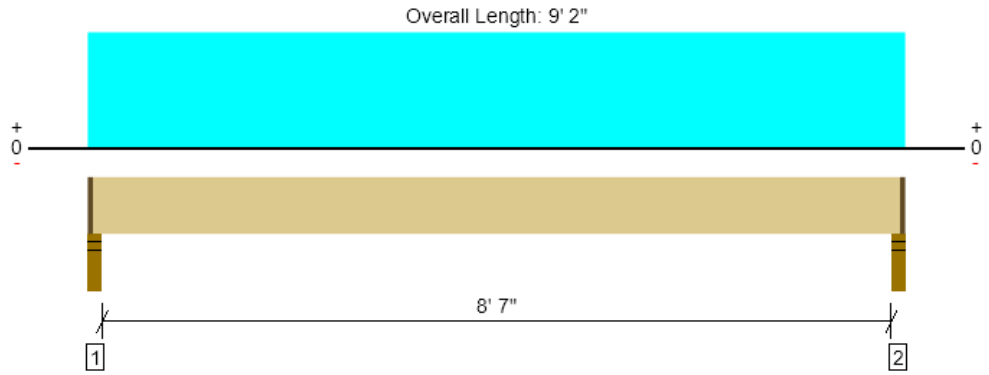
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, (Loading Only) Upper Truss 7

1 piece(s) 2 x 12 DF No.2 @ 24" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	493 @ 2 1/2"	1434 (2.25")	Passed (34%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	369 @ 1' 2 3/4"	2025	Passed (18%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	1053 @ 4' 7"	2729	Passed (39%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.037 @ 4' 7"	0.219	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.051 @ 4' 7"	0.438	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	N/A	N/A	N/A	--	N/A

Member Length : 8' 11 1/2"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.
- Applicable calculations are based on NDS.
- No composite action between deck and joist was considered in analysis.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.50"	138	367	504	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	2.25"	1.50"	138	367	504	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)	9' o/c	
Bottom Edge (Lu)	9' o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 9' 2"	24"	15.0	40.0	Default Load

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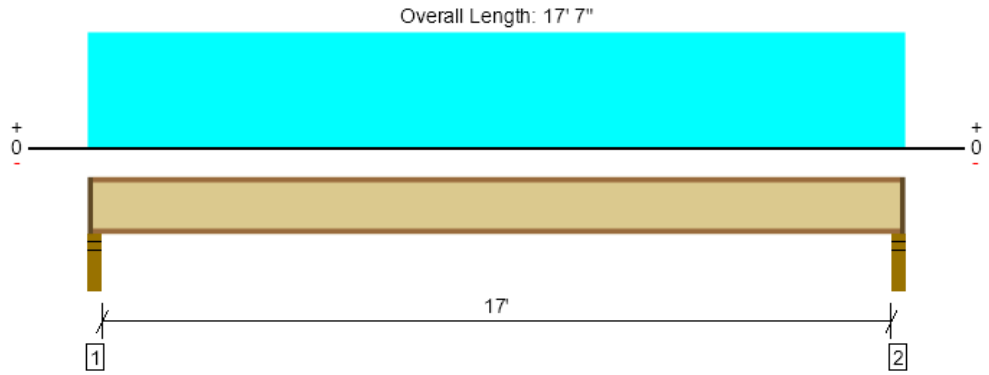
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, (Loading Only) Upper Truss 8

1 piece(s) 11 7/8" TJI® 360 @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	637 @ 2 1/2"	1202 (2.25")	Passed (53%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	623 @ 3 1/2"	1705	Passed (37%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	2701 @ 8' 9 1/2"	6180	Passed (44%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.245 @ 8' 9 1/2"	0.429	Passed (L/841)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.337 @ 8' 9 1/2"	0.858	Passed (L/611)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	46	35	Passed	--	--

Member Length : 17' 4 1/2"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- 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	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.75"	176	469	645	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	2.25"	1.75"	176	469	645	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)	5' 9" o/c	
Bottom Edge (Lu)	17' 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 17' 7"	16"	15.0	40.0	Default Load

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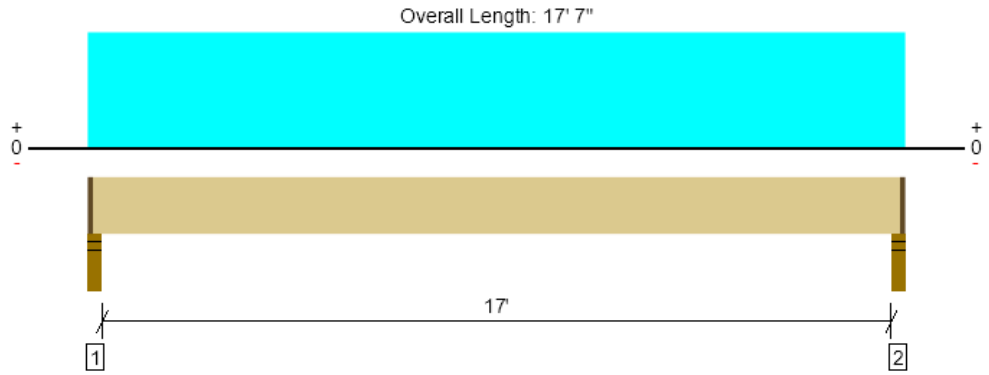
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, (Loading Only) Upper Truss 9

1 piece(s) 2 x 12 DF No.2 @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	637 @ 2 1/2"	1434 (2.25")	Passed (44%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	555 @ 1' 2 3/4"	2025	Passed (27%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	2701 @ 8' 9 1/2"	2729	Passed (99%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.366 @ 8' 9 1/2"	0.429	Passed (L/563)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.503 @ 8' 9 1/2"	0.858	Passed (L/409)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	N/A	N/A	N/A	--	N/A

Member Length : 17' 4 1/2"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.
- Applicable calculations are based on NDS.
- No composite action between deck and joist was considered in analysis.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.50"	176	469	645	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	2.25"	1.50"	176	469	645	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)	11" o/c	
Bottom Edge (Lu)	17' 5" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 17' 7"	16"	15.0	40.0	Default Load

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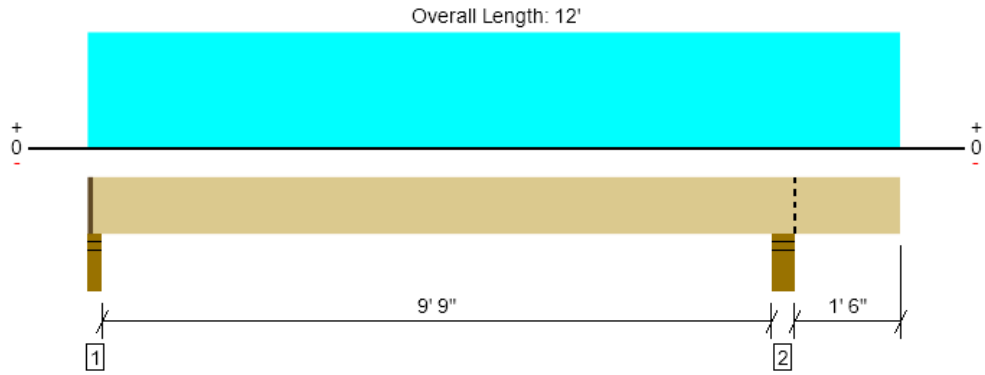
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, (Loading Only) Upper Joist 10

1 piece(s) 2 x 8 DF No.2 @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	534 @ 2 1/2"	1434 (2.25")	Passed (37%)	--	1.0 D + 0.75 L + 0.75 S (Alt Spans)
Shear (lbs)	435 @ 9' 5 1/4"	1305	Passed (33%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	1251 @ 5' 2 1/2"	1360	Passed (92%)	1.00	1.0 D + 1.0 L (Alt Spans)
Live Load Defl. (in)	0.255 @ 5' 2 13/16"	0.252	Passed (L/474)	--	1.0 D + 0.75 L + 0.75 S (Alt Spans)
Total Load Defl. (in)	0.311 @ 5' 2 11/16"	0.503	Passed (L/388)	--	1.0 D + 0.75 L + 0.75 S (Alt Spans)
TJ-Pro™ Rating	N/A	N/A	N/A	--	N/A

Member Length : 11' 10 3/4"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Overhang deflection criteria: LL (2L/480) and TL (2L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.
- Applicable calculations are based on NDS.
- No composite action between deck and joist was considered in analysis.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.50"	102	419/-4	172	545	1 1/4" Rim Board
2 - Stud wall - SPF	5.50"	5.50"	1.50"	138	553	230	725	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)	5' o/c	
Bottom Edge (Lu)	11' 11" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
1 - Uniform (PSF)	0 to 12'	16"	15.0	60.0	25.0	Default Load

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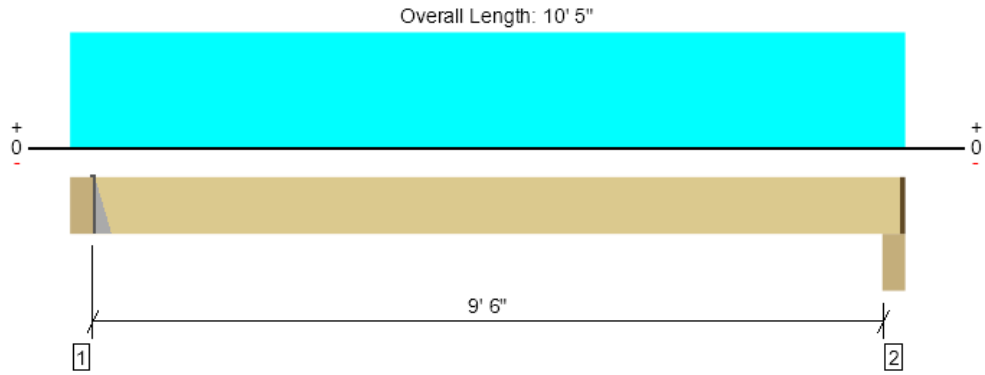
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, Upper Joist 1

1 piece(s) 2 x 8 DF No.2 @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	479 @ 5 1/2"	1406 (1.50")	Passed (34%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	419 @ 1' 3/4"	1305	Passed (32%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	1148 @ 5' 3"	1360	Passed (84%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.199 @ 5' 3"	0.240	Passed (L/577)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.249 @ 5' 3"	0.479	Passed (L/462)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	N/A	N/A	N/A	--	N/A

Member Length : 9' 10 1/4"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.
- Applicable calculations are based on NDS.
- No composite action between deck and joist was considered in analysis.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Hanger on 7 1/4" DF beam	5.50"	Hanger[1]	1.50"	105	420	525	See note [1]
2 - Beam - DF	5.50"	4.25"	1.50"	103	413	517	1 1/4" Rim Board

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	7' 2" o/c	
Bottom Edge (Lu)	9' 10" o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie

Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Top Mount Hanger	THA29	2.25"	4-10d	6-10d	4-10d	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 10' 5"	16"	15.0	60.0	Floor

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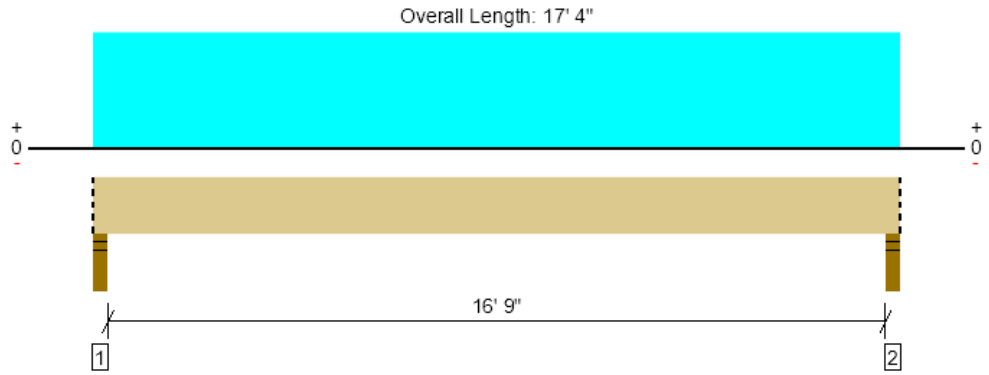
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, Upper Beam 1

2 piece(s) 1 1/2" x 14" 1.5E TimberStrand® LSL



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1151 @ 2"	4463 (3.50")	Passed (26%)	--	1.0 D (All Spans)
Shear (lbs)	958 @ 1' 5 1/2"	7560	Passed (13%)	0.90	1.0 D (All Spans)
Moment (Ft-lbs)	4799 @ 8' 8"	16305	Passed (29%)	0.90	1.0 D (All Spans)
Live Load Defl. (in)	0.000 @ 0	0.425	Passed (2L/999+)	--	1.0 D (All Spans)
Total Load Defl. (in)	0.260 @ 8' 8"	0.850	Passed (L/784)	--	1.0 D (All Spans)

Member Length : 17' 4"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)		Accessories
	Total	Available	Required	Dead	Factored	
1 - Stud wall - SPF	3.50"	3.50"	1.50"	1151	1151	Blocking
2 - Stud wall - SPF	3.50"	3.50"	1.50"	1151	1151	Blocking

- 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)	17' 4" o/c	
Bottom Edge (Lu)	17' 4" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Comments
0 - Self Weight (PLF)	0 to 17' 4"	N/A	12.8	
1 - Uniform (PLF)	0 to 17' 4" (Front)	N/A	120.0	Floor

- Side loads are assumed to not induce cross-grain tension.

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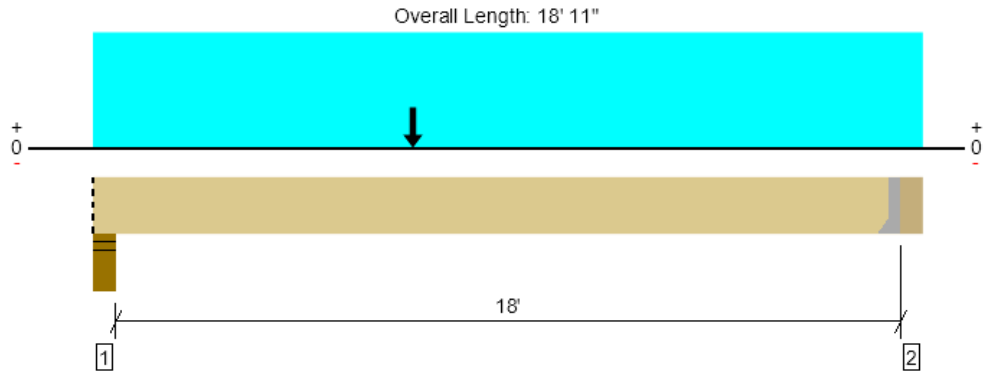
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, Upper Beam 11

2 piece(s) 1 3/4" x 14" 1.55E TimberStrand® LSL



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1531 @ 18' 5 1/2"	4725 (1.50")	Passed (32%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1801 @ 1' 7 1/2"	10127	Passed (18%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	11453 @ 7' 6"	21840	Passed (52%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.372 @ 9' 3/16"	0.453	Passed (L/584)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.505 @ 9' 9/16"	0.906	Passed (L/431)	--	1.0 D + 1.0 L (All Spans)

Member Length : 18' 5 1/2"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - SPF	5.50"	5.50"	1.50"	537	1408	1945	Blocking
2 - Hanger on 14" SPF beam	5.50"	Hanger[1]	1.50"	464	1101	1564	See note [1]

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	10' 11" o/c	
Bottom Edge (Lu)	18' 6" o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie

Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
2 - Face Mount Hanger	LUS410	2.00"	N/A	8-16d	6-16d	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 18' 5 1/2"	N/A	15.3	--	
1 - Uniform (PSF)	0 to 18' 11" (Top)	1' 4"	15.0	40.0	Floor
2 - Point (lb)	7' 6" (Front)	N/A	340	1500	Upper Beam 2

- Side loads are assumed to not induce cross-grain tension.

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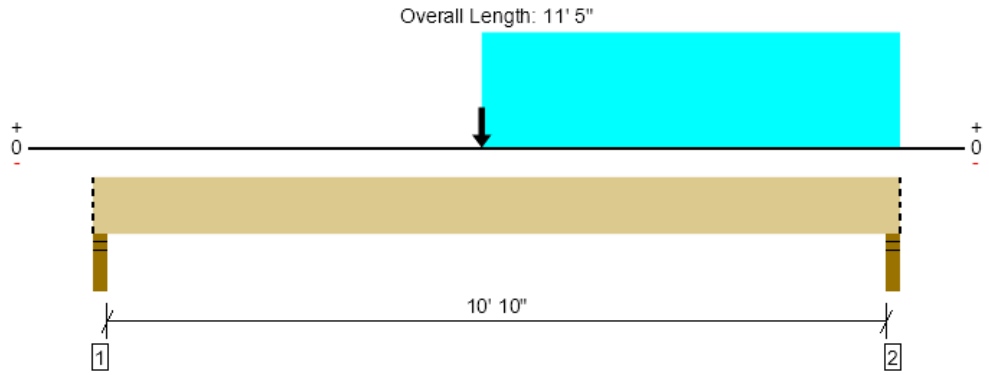
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, Upper Beam 3

2 piece(s) 1 3/4" x 14" 1.55E TimberStrand® LSL



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2782 @ 11' 3"	5206 (3.50")	Passed (53%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	2054 @ 9' 11 1/2"	10127	Passed (20%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	7297 @ 5' 10 1/8"	21840	Passed (33%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.061 @ 6' 1 3/16"	0.277	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.142 @ 5' 11"	0.554	Passed (L/936)	--	1.0 D + 1.0 L (All Spans)

Member Length : 11' 5"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - SPF	3.50"	3.50"	1.50"	881	525	1406	Blocking
2 - Stud wall - SPF	3.50"	3.50"	1.87"	1225	1557	2782	Blocking

- 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)	11' 5" o/c	
Bottom Edge (Lu)	11' 5" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 11' 5"	N/A	15.3	--	
1 - Uniform (PLF)	5' 6" to 11' 5" (Front)	N/A	132.0	351.8	Linked from: Upper Truss 8, Support 2
2 - Point (lb)	5' 6" (Front)	N/A	1151	-	Linked from: Upper Beam 1, Support 2

- Side loads are assumed to not induce cross-grain tension.

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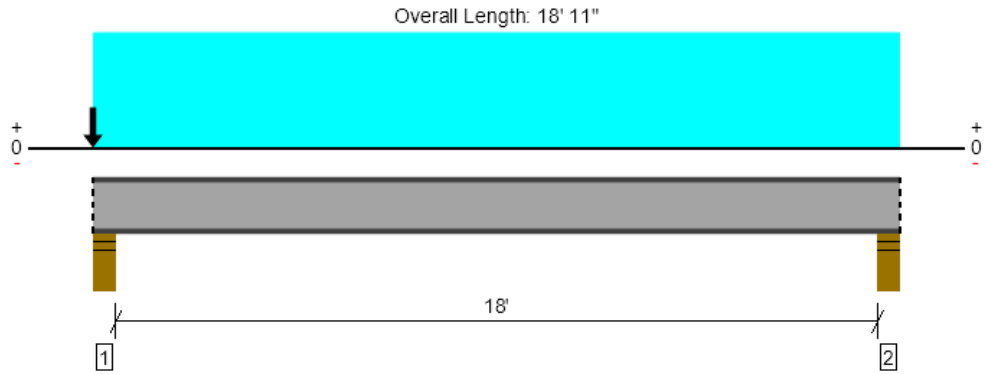
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, Upper Beam 4

1 piece(s) W8X21 (A992) ASTM Steel



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	8050 @ 4"	12319 (5.50")	Passed (65%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1161 @ 5 1/2"	41400	Passed (3%)	--	1.0 D (All Spans)
Moment (Ft-lbs)	5371 @ 9' 5 1/2"	24373	Passed (22%)	--	1.0 D (All Spans)
Live Load Defl. (in)	0.000 @ 0	0.456	Passed (2L/999+)	--	1.0 D (All Spans)
Total Load Defl. (in)	0.147 @ 9' 5 1/2"	0.913	Passed (L/999+)	--	1.0 D (All Spans)

Member Length : 18' 11"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Applicable calculations are based on ANSI/AISC 360-16.
- A lateral-torsional buckling factor (Cb) of 1.0 has been assumed.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - SPF	5.50"	5.50"	5.50"	3960	4090	8050	Blocking
2 - Stud wall - SPF	5.50"	5.50"	5.50"	1220	-	1220	Blocking

- 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)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 18' 11"	N/A	21.0	--	
1 - Uniform (PLF)	0 to 18' 11" (Front)	N/A	108.0	-	Floor
2 - Point (lb)	0 (Front)	N/A	2740	4090	Beam 2 Point Load

- Side loads are assumed to not induce cross-grain tension.

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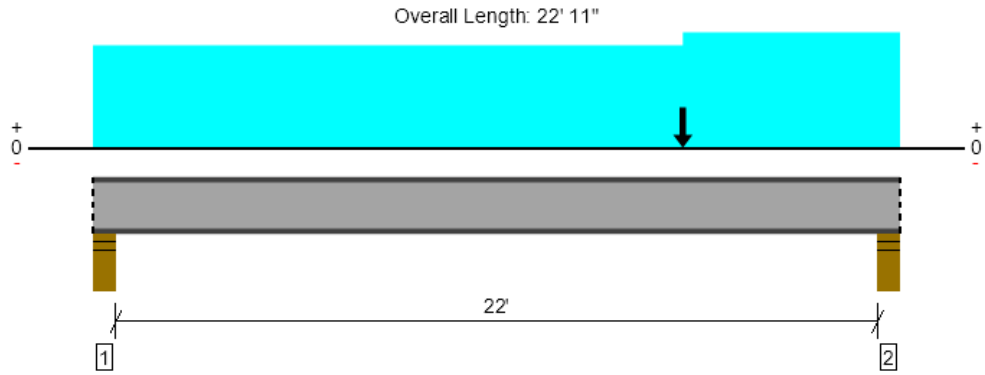
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Upper Floor, Upper Beam 5

1 piece(s) W12X45 (A992) ASTM Steel



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	18782 @ 22' 7"	18817 (5.50")	Passed (100%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	18051 @ 22' 5 1/2"	81070	Passed (22%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Moment (Ft-lbs)	94833 @ 12' 5/16"	101355	Passed (94%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Live Load Defl. (in)	0.437 @ 11' 7 1/16"	0.556	Passed (L/612)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.843 @ 11' 7 1/16"	1.112	Passed (L/317)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

Member Length : 22' 11"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Applicable calculations are based on ANSI/AISC 360-16.
- A lateral-torsional buckling factor (Cb) of 1.0 has been assumed.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Snow	Factored	
1 - Stud wall - SPF	5.50"	5.50"	5.50"	8057	5266	4993	6239	16686	Blocking
2 - Stud wall - SPF	5.50"	5.50"	5.50"	8959	6858	4993	6239	18782	Blocking

- 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)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 22' 11"	N/A	45.0	--	--	--	
1 - Uniform (PLF)	0 to 22' 11" (Front)	N/A	144.0	-	-	-	Floor
2 - Uniform (PLF)	0 to 22' 11" (Front)	N/A	164.3	-	219.0	273.8	Linked from: Roof Truss 1, Support 1
3 - Uniform (PLF)	0 to 22' 11" (Front)	N/A	162.8	-	216.8	270.8	Linked from: Roof Truss 2, Support 2
4 - Uniform (PLF)	0 to 22' 11" (Front)	N/A	154.5	411.8	-	-	Linked from: Upper Truss 3, Support 1
5 - Uniform (PLF)	16' 9" to 22' 11" (Front)	N/A	69.0	183.5	-	-	Linked from: Upper Truss 7, Support 2
6 - Point (lb)	16' 9" (Front)	N/A	1225	1557	-	-	Linked from: Upper Beam 3, Support 2

- Side loads are assumed to not induce cross-grain tension.

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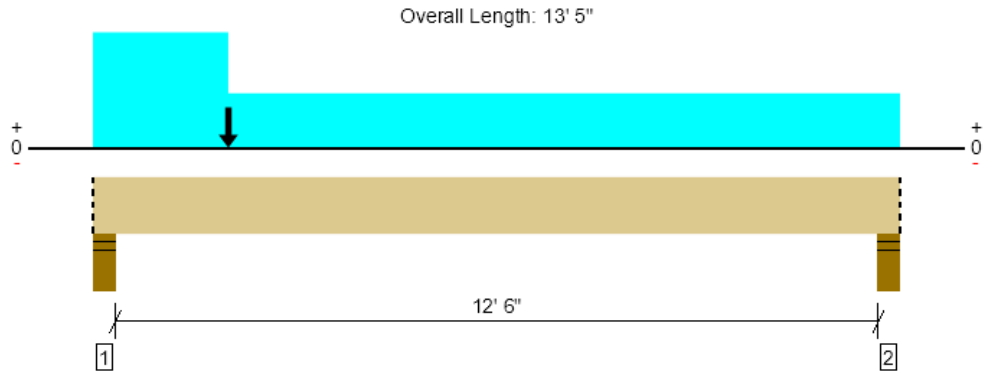
Upper Floor, Upper Beam 6

1 piece(s) 5 1/2" x 13 1/2" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	12581 @ 4"	12856 (5.50")	Passed (98%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	10067 @ 1' 7"	15085	Passed (67%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Pos Moment (Ft-lbs)	25437 @ 6' 3 7/16"	33413	Passed (76%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.231 @ 6' 8 1/2"	0.319	Passed (L/663)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.372 @ 6' 7 1/4"	0.637	Passed (L/411)	--	1.0 D + 1.0 L (All Spans)

Member Length : 13' 5"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 12' 9".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Snow	Factored	
1 - Stud wall - SPF	5.50"	5.50"	5.38"	5111	5288	3738	4671	12581	Blocking
2 - Stud wall - SPF	5.50"	5.50"	3.36"	2566	5288	569	711	7854	Blocking

- 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)	13' 5" o/c	
Bottom Edge (Lu)	13' 5" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 13' 5"	N/A	18.0	--	--	--	
1 - Uniform (PLF)	0 to 2' 3" (Top)	N/A	164.3	-	219.0	273.8	Linked from: (Loading Only) Roof Truss 1, Support 1
2 - Uniform (PLF)	0 to 2' 3" (Top)	N/A	138.8	-	186.0	232.5	Linked from: (Loading Only) Roof Truss 2, Support 1
3 - Point (lb)	2' 3" (Top)	N/A	2789	-	3395	4243	Linked from: Roof Post 1, Support 1
4 - Uniform (PLF)	0 to 13' 5" (Front)	N/A	154.5	411.8	-	-	Linked from: Upper Truss 3, Support 1
5 - Uniform (PLF)	0 to 13' 5" (Front)	N/A	141.0	376.5	-	-	Linked from: Upper Truss 4, Support 2

- Side loads are assumed to not induce cross-grain tension.

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

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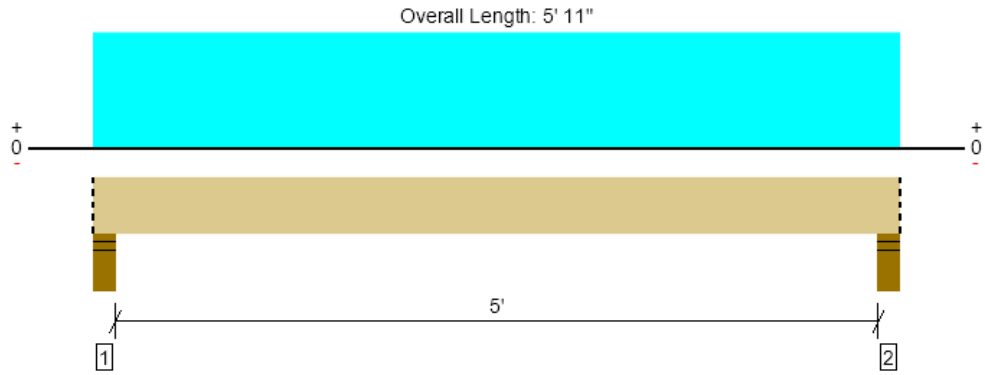
Upper Floor, Upper Beam 7

1 piece(s) 5 1/2" x 7 1/2" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	4672 @ 4"	12856 (5.50")	Passed (36%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	2619 @ 1' 1"	7288	Passed (36%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	4812 @ 2' 11 1/2"	10313	Passed (47%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.048 @ 2' 11 1/2"	0.131	Passed (L/999+)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.078 @ 2' 11 1/2"	0.262	Passed (L/812)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

Member Length : 5' 11"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 5' 3".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Snow	Factored	
1 - Stud wall - SPF	5.50"	5.50"	2.00"	1800	2332	1198	1498	4672	Blocking
2 - Stud wall - SPF	5.50"	5.50"	2.00"	1800	2332	1198	1498	4672	Blocking

- 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)	5' 11" o/c	
Bottom Edge (Lu)	5' 11" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 5' 11"	N/A	10.0	--	--	--	
1 - Uniform (PLF)	0 to 5' 11" (Top)	N/A	164.3	-	219.0	273.8	Linked from: (Loading Only) Roof Truss 1, Support 1
2 - Uniform (PLF)	0 to 5' 11" (Top)	N/A	138.8	-	186.0	232.5	Linked from: (Loading Only) Roof Truss 2, Support 1
3 - Uniform (PLF)	0 to 5' 11" (Front)	N/A	154.5	411.8	-	-	Linked from: Upper Truss 3, Support 1
4 - Uniform (PLF)	0 to 5' 11" (Front)	N/A	141.0	376.5	-	-	Linked from: Upper Truss 4, Support 2

- Side loads are assumed to not induce cross-grain tension.

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

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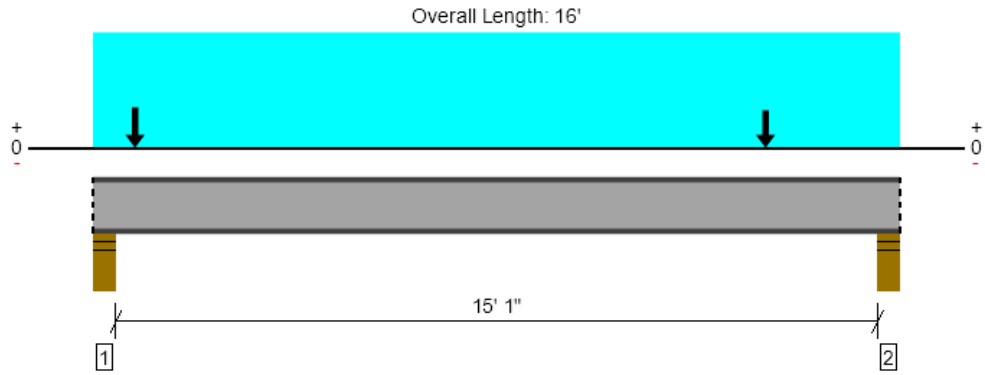
Upper Floor, Upper Beam 8

1 piece(s) W10X39 (A992) ASTM Steel



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern) [Group]
Member Reaction (lbs)	11441 @ 4"	18677 (5.50")	Passed (61%)	--	1.0 D + 0.75 L + 0.75 S (All Spans) [1]
Shear (lbs)	10958 @ 5 1/2"	62496	Passed (18%)	--	1.0 D + 0.75 L + 0.75 S (All Spans) [1]
Moment (Ft-lbs)	35218 @ 8' 1 1/2"	95863	Passed (37%)	--	1.0 D + 1.0 L (All Spans) [1]
Live Load Defl. (in)	0.149 @ 8'	0.383	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans) [1]
Total Load Defl. (in)	0.248 @ 8' 7/16"	0.256	Passed (L/742)	--	1.0 D + 1.0 L (All Spans) [1]

Member Length : 16'
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/720).
- Applicable calculations are based on ANSI/AISC 360-16.
- A lateral-torsional buckling factor (Cb) of 1.0 has been assumed.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Snow	Factored	
1 - Stud wall - SPF	5.50"	5.50"	5.50"	4708	5808	1712	3170	11441	Blocking
2 - Stud wall - SPF	5.50"	5.50"	5.50"	4364	5808	1286	2638	10699	Blocking

- 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)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 16'	N/A	39.0	--	--	--	
1 - Uniform (PLF)	0 to 16' (Front)	N/A	144.0	-	-	-	Floor
2 - Point (lb)	10" (Top)	N/A	1255	-	1540	1924	Linked from: Roof Header 1, Support 1
3 - Point (lb)	13' 4" (Top)	N/A	1193	-	1457	1820	Linked from: Roof Header 1, Support 2
4 - Uniform (PLF)	0 to 16' (Front)	N/A	154.5	411.8	-	-	Linked from: Upper Truss 3, Support 2
5 - Uniform (PLF)	0 to 16' (Back)	N/A	76.5	314.3/-3.0	-	129.0	Linked from: Upper Truss 10, Support 1

- Side loads are assumed to not induce cross-grain tension.

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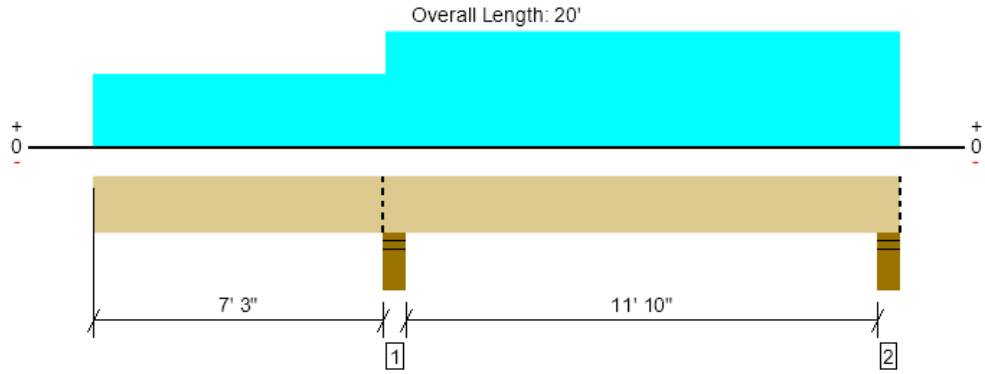
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, Upper Beam 9

2 piece(s) 1 3/4" x 11 7/8" 2.0E Microllam® LVL

Left cantilever exceeds the maximum braced cantilever length of 7'.



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	5329 @ 7' 5 3/4"	8181 (5.50")	Passed (65%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	2718 @ 8' 8 3/8"	7897	Passed (34%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	-7685 @ 7' 5 3/4"	13386	Passed (57%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.347 @ 0	0.374	Passed (2L/518)	--	1.0 D + 1.0 L (Alt Spans)
Total Load Defl. (in)	0.472 @ 0	0.748	Passed (2L/380)	--	1.0 D + 1.0 L (Alt Spans)

Member Length : 20'
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Overhang deflection criteria: LL (2L/480) and TL (2L/240).
- Left cantilever length exceeds 1/3 member length or 1/2 back span length. Additional bracing should be considered.
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Moment capacity over cantilever support 1 has been reduced by 25% to lessen the effects of buckling.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - SPF	5.50"	5.50"	3.58"	2134	3195	5329	Blocking
2 - Stud wall - SPF	5.50"	5.50"	1.66"	704	1767/-350	2471	Blocking

• 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)	20' o/c	
Bottom Edge (Lu)	19' 5" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 20'	N/A	12.1	--	
1 - Uniform (PLF)	0 to 20' (Front)	N/A	72.0	-	Floor
2 - Uniform (PLF)	7' 3" to 20' (Front)	N/A	69.0	275.0	Linked from: Upper Truss 5, Support 1
3 - Uniform (PLF)	0 to 7' 3" (Front)	N/A	38.0	152.5	Linked from: Upper Truss 6, Support 1

• Side loads are assumed to not induce cross-grain tension.

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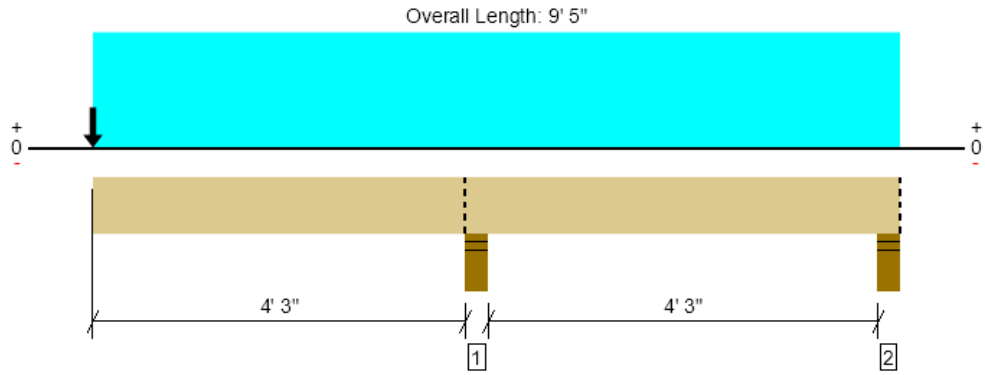
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, Upper Beam 10

1 piece(s) 5 1/2" x 12" 24F-V8 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	11947 @ 4' 5 3/4"	12856 (5.50")	Passed (93%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	5849 @ 3' 3"	11660	Passed (50%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	0 @ N/A	N/A	Passed (N/A)	--	N/A
Neg Moment (Ft-lbs)	-25475 @ 4' 5 3/4"	26400	Passed (96%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.235 @ 0	0.299	Passed (2L/456)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.412 @ 0	0.448	Passed (2L/260)	--	1.0 D + 1.0 L (All Spans)

Member Length : 9' 5"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Overhang deflection criteria: LL (2L/360) and TL (2L/240).
- Left cantilever length exceeds 1/3 member length or 1/2 back span length. Additional bracing should be considered.
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical negative moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 9' 1".
- An excessive uplift of -5111 lbs detected at support located at 9' 1".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - SPF	5.50"	5.50"	5.11"	5644	6303	11947	Blocking
2 - Stud wall - SPF	5.50"	5.50"	1.50"	-2003	-3108	-5111	Blocking

• 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)	9' 5" o/c	
Bottom Edge (Lu)	9' 5" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 9' 5"	N/A	16.0	--	
1 - Uniform (PLF)	0 to 9' 5" (Front)	N/A	144.0	-	Floor
2 - Point (lb)	0 (Front)	N/A	2134	3195	Linked from: Upper Beam 9, Support 1

• Side loads are assumed to not induce cross-grain tension.

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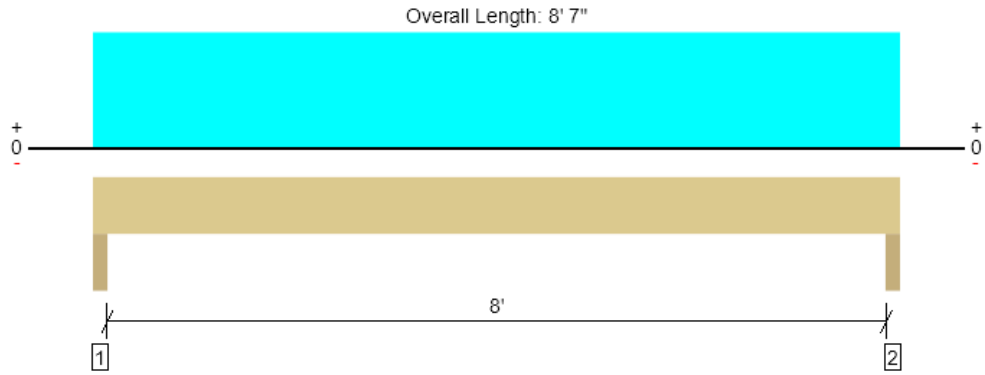
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, Upper Header 1

1 piece(s) 5 1/2" x 9" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2891 @ 2"	12513 (3.50")	Passed (23%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	2189 @ 1' 1/2"	8745	Passed (25%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	5730 @ 4' 3 1/2"	14850	Passed (39%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.065 @ 4' 3 1/2"	0.206	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.117 @ 4' 3 1/2"	0.412	Passed (L/848)	--	1.0 D + 1.0 L (All Spans)

Member Length : 8' 7"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 8' 3".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Trimmer - SPF	3.50"	3.50"	1.50"	1275	1616	2891	None
2 - Trimmer - SPF	3.50"	3.50"	1.50"	1275	1616	2891	None

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

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 8' 7"	N/A	12.0	--	
1 - Uniform (PLF)	0 to 8' 7"	N/A	144.0	-	Default Load
2 - Uniform (PLF)	0 to 8' 7"	N/A	141.0	376.5	Linked from: Upper Truss 4, Support 1

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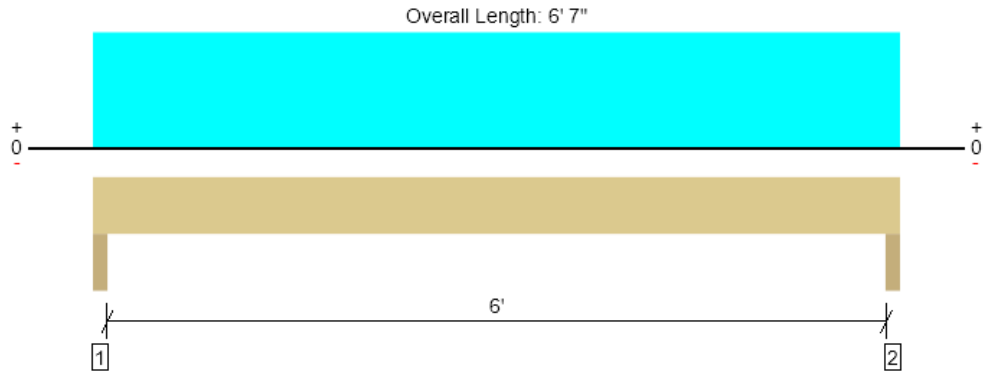
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

MEMBER REPORT

PASSED

Upper Floor, Upper Header 3

2 piece(s) 2 x 8 DF No.2



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	966 @ 2"	6563 (3.50")	Passed (15%)	--	1.0 D (All Spans)
Shear (lbs)	703 @ 10 3/4"	2349	Passed (30%)	0.90	1.0 D (All Spans)
Moment (Ft-lbs)	1433 @ 3' 3 1/2"	2129	Passed (67%)	0.90	1.0 D (All Spans)
Live Load Defl. (in)	0.000 @ 0	0.156	Passed (2L/999+)	--	1.0 D (All Spans)
Total Load Defl. (in)	0.066 @ 3' 3 1/2"	0.313	Passed (L/999+)	--	1.0 D (All Spans)

Member Length : 6' 7"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)		Accessories
	Total	Available	Required	Dead	Factored	
1 - Trimmer - SPF	3.50"	3.50"	1.50"	966	966	None
2 - Trimmer - SPF	3.50"	3.50"	1.50"	966	966	None

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

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Comments
0 - Self Weight (PLF)	0 to 6' 7"	N/A	5.5	
1 - Uniform (PLF)	0 to 6' 7"	N/A	288.0	Default Load

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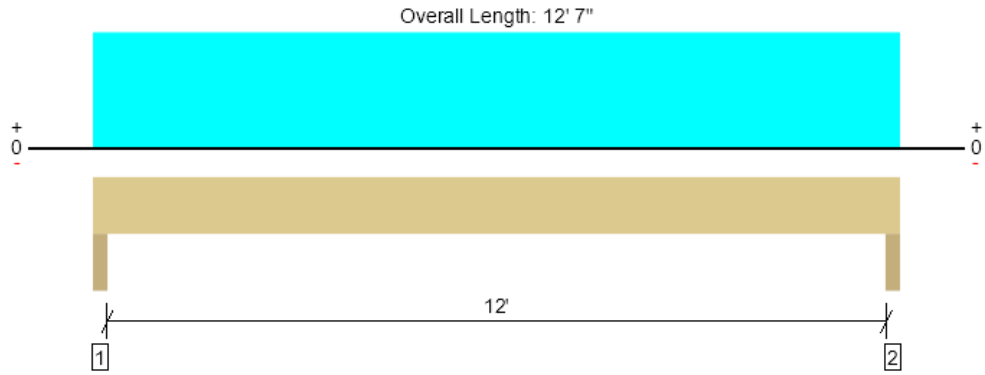
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, Upper Header 4

1 piece(s) 3 1/2" x 10 1/2" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2491 @ 2"	7963 (3.50")	Passed (31%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	2029 @ 1' 2"	6493	Passed (31%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	7427 @ 6' 3 1/2"	12863	Passed (58%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.258 @ 6' 3 1/2"	0.408	Passed (L/569)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.330 @ 6' 3 1/2"	0.613	Passed (L/445)	--	1.0 D + 1.0 L (All Spans)

Member Length : 12' 7"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 12' 3".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Trimmer - SPF	3.50"	3.50"	1.50"	542	1949	2491	None
2 - Trimmer - SPF	3.50"	3.50"	1.50"	542	1949	2491	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	12' 7" o/c	
Bottom Edge (Lu)	12' 7" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 12' 7"	N/A	8.9	--	
1 - Uniform (PLF)	0 to 12' 7"	N/A	77.3	309.8	Linked from: Upper Joist 1, Support 2

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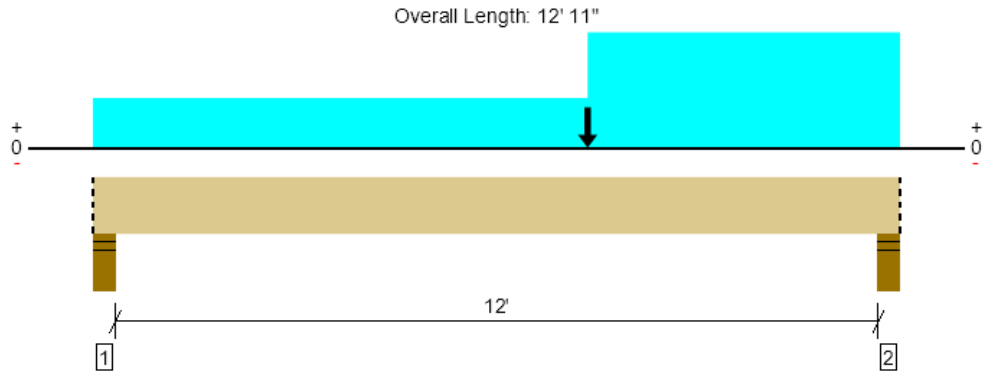
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, Upper Header 5

2 piece(s) 1 3/4" x 16" 2.0E Microllam® LVL



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	5829 @ 12' 7"	8181 (5.50")	Passed (71%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	4215 @ 11' 1 1/2"	12236	Passed (34%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Moment (Ft-lbs)	15989 @ 7' 11"	35781	Passed (45%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Live Load Defl. (in)	0.123 @ 6' 7 3/4"	0.306	Passed (L/999+)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.203 @ 6' 8"	0.204	Passed (L/725)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

Member Length : 12' 11"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/720).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Snow	Factored	
1 - Stud wall - SPF	5.50"	5.50"	2.83"	1549	2659	580	725	4208	Blocking
2 - Stud wall - SPF	5.50"	5.50"	3.92"	2327	2659	1609	2010	5829	Blocking

- 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)	11' 2" o/c	
Bottom Edge (Lu)	12' 11" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 12' 11"	N/A	16.3	--	--	--	
1 - Uniform (PLF)	7' 11" to 12' 11" (Top)	N/A	187.5	-	249.8	312.0	Linked from: (Loading Only) Roof Truss 1, Support 2
2 - Point (lb)	7' 11" (Top)	N/A	732	-	940	1175	Linked from: Roof Header 2, Support 2
3 - Uniform (PLF)	0 to 12' 11" (Front)	N/A	154.5	411.8	-	-	Linked from: Upper Truss 3, Support 2

- Side loads are assumed to not induce cross-grain tension.

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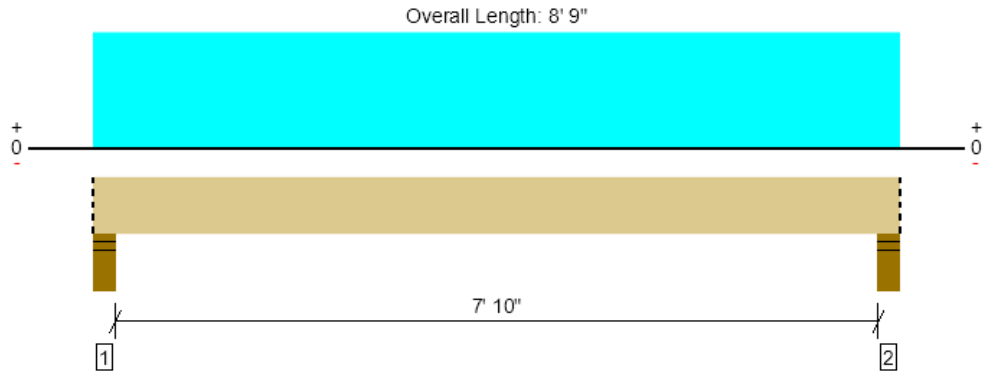
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, Upper Header 6

1 piece(s) 1 3/4" x 16" 2.0E Microllam® LVL



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2863 @ 4"	4091 (5.50")	Passed (70%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1691 @ 1' 9 1/2"	5320	Passed (32%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	5345 @ 4' 4 1/2"	15557	Passed (34%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.047 @ 4' 4 1/2"	0.202	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.075 @ 4' 4 1/2"	0.404	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)

Member Length : 8' 9"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - SPF	5.50"	5.50"	3.85"	1062	1801	2863	Blocking
2 - Stud wall - SPF	5.50"	5.50"	3.85"	1062	1801	2863	Blocking

- 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)	8' 9" o/c	
Bottom Edge (Lu)	8' 9" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 8' 9"	N/A	8.2	--	
1 - Uniform (PSF)	0 to 8' 9" (Front)	8'	10.0	-	Wall
2 - Uniform (PLF)	0 to 8' 9" (Front)	N/A	154.5	411.8	Linked from: Upper Truss 3, Support 2

- Side loads are assumed to not induce cross-grain tension.

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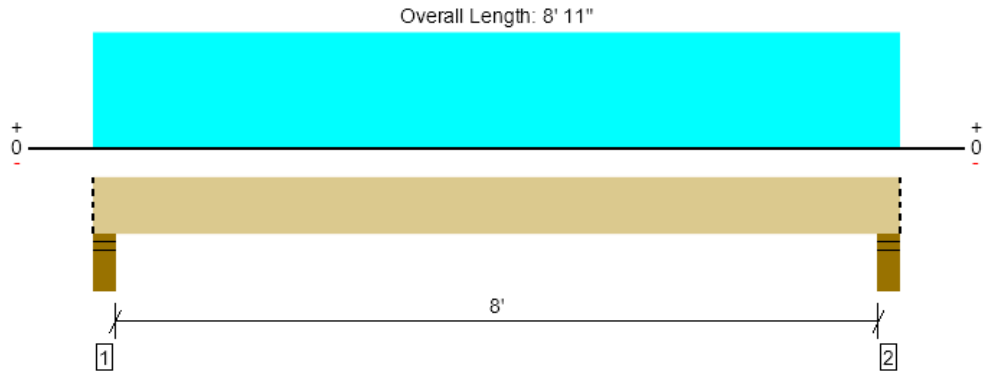
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, Upper Header 7

1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2036 @ 4"	8181 (5.50")	Passed (25%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1484 @ 1' 2 1/2"	5565	Passed (27%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	3885 @ 4' 5 1/2"	9450	Passed (41%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.073 @ 4' 5 1/2"	0.206	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.124 @ 4' 5 1/2"	0.412	Passed (L/796)	--	1.0 D + 1.0 L (All Spans)

Member Length : 8' 11"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 8' 3".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - SPF	5.50"	5.50"	1.50"	839	1197	2036	Blocking
2 - Stud wall - SPF	5.50"	5.50"	1.50"	839	1197	2036	Blocking

- 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)	8' 11" o/c	
Bottom Edge (Lu)	8' 11" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 8' 11"	N/A	7.7	--	
1 - Uniform (PSF)	0 to 8' 11" (Top)	8'	10.0	-	Wall
2 - Uniform (PLF)	0 to 8' 11" (Front)	N/A	100.5	268.5	Linked from: Upper Truss 1, Support 2

- Side loads are assumed to not induce cross-grain tension.

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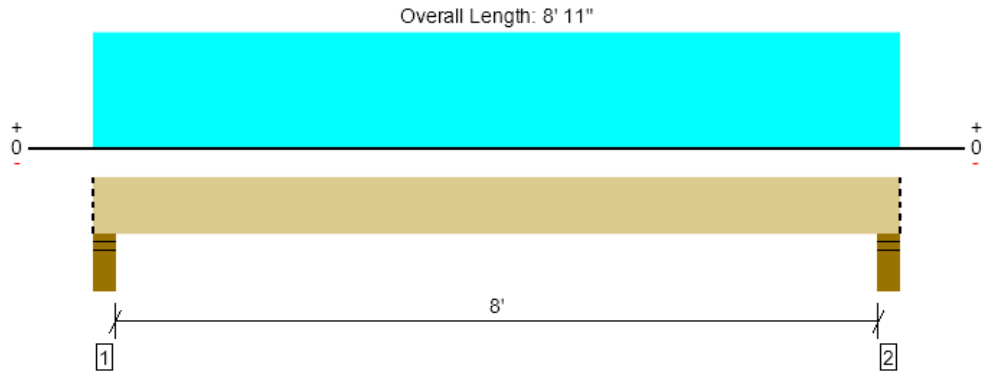
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, Upper Header 8

1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2983 @ 4"	8181 (5.50")	Passed (36%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	2175 @ 1' 2 1/2"	5565	Passed (39%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	5693 @ 4' 5 1/2"	9450	Passed (60%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.103 @ 4' 5 1/2"	0.206	Passed (L/966)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.182 @ 4' 5 1/2"	0.412	Passed (L/543)	--	1.0 D + 1.0 L (All Spans)

Member Length : 8' 11"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 8' 3".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - SPF	5.50"	5.50"	2.01"	1305	1679	2983	Blocking
2 - Stud wall - SPF	5.50"	5.50"	2.01"	1305	1679	2983	Blocking

- 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)	8' 11" o/c	
Bottom Edge (Lu)	8' 11" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 8' 11"	N/A	7.7	--	
1 - Uniform (PLF)	0 to 8' 11" (Front)	N/A	144.0	-	Floor
2 - Uniform (PLF)	0 to 8' 11" (Front)	N/A	141.0	376.5	Linked from: Upper Truss 2, Support 1

- Side loads are assumed to not induce cross-grain tension.

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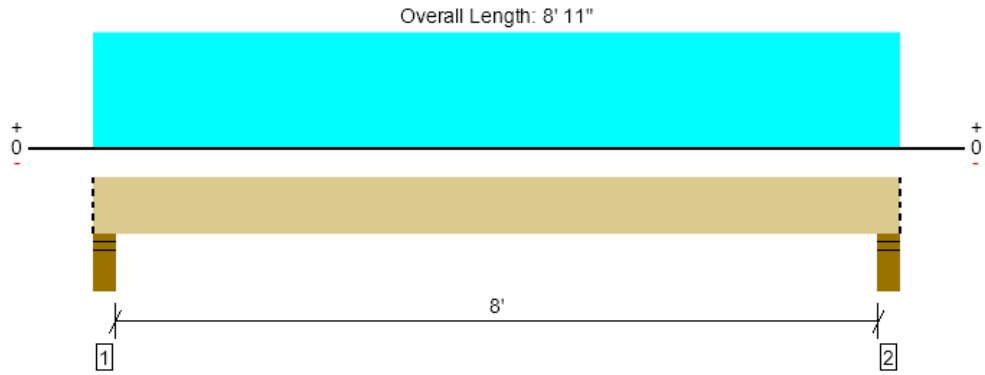
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, Upper Header 9

1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2210 @ 4"	8181 (5.50")	Passed (27%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1611 @ 1' 2 1/2"	5565	Passed (29%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	4217 @ 4' 5 1/2"	9450	Passed (45%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.075 @ 4' 5 1/2"	0.206	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.135 @ 4' 5 1/2"	0.412	Passed (L/733)	--	1.0 D + 1.0 L (All Spans)

Member Length : 8' 11"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 8' 3".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - SPF	5.50"	5.50"	1.50"	984	1226	2210	Blocking
2 - Stud wall - SPF	5.50"	5.50"	1.50"	984	1226	2210	Blocking

- 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)	8' 11" o/c	
Bottom Edge (Lu)	8' 11" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 8' 11"	N/A	7.7	--	
1 - Uniform (PLF)	0 to 8' 11" (Front)	N/A	144.0	-	Floor
2 - Uniform (PLF)	0 to 8' 11" (Front)	N/A	69.0	275.0	Linked from: Upper Truss 5, Support 2

- Side loads are assumed to not induce cross-grain tension.

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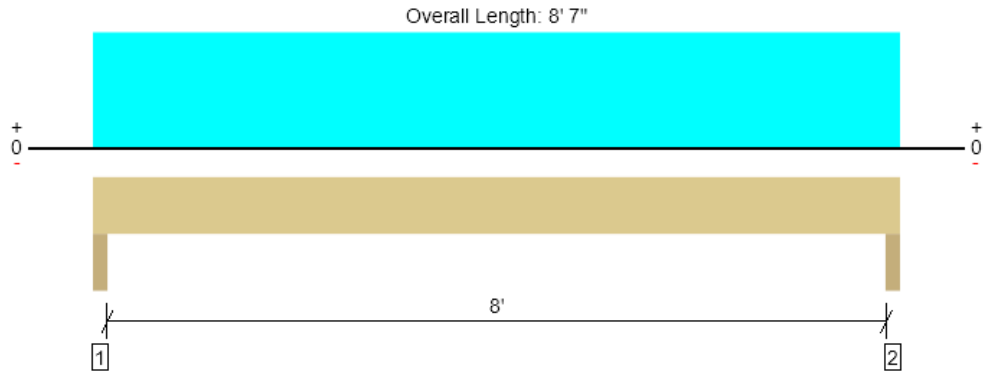
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, Upper Header 10

2 piece(s) 2 x 10 DF No.2



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1551 @ 2"	6563 (3.50")	Passed (24%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	1113 @ 1' 3/4"	3330	Passed (33%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	2931 @ 4' 3 1/2"	3529	Passed (83%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.094 @ 4' 3 1/2"	0.275	Passed (L/999+)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.119 @ 4' 3 1/2"	0.412	Passed (L/832)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

Member Length : 8' 7"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Factored	
1 - Trimmer - SPF	3.50"	3.50"	1.50"	320	1159	483	1551	None
2 - Trimmer - SPF	3.50"	3.50"	1.50"	320	1159	483	1551	None

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

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 8' 7"	N/A	7.0	--	--	
1 - Uniform (PSF)	0 to 8' 7"	4' 6"	15.0	60.0	25.0	Deck

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

FORTEWEB

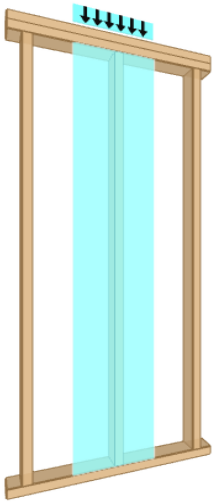
MEMBER REPORT

PASSED

Upper Floor, Upper Wall 1

1 piece(s) 2 x 6 DF No.2 @ 16" OC

Wall Height: 12' Member Height: 11' 7 1/2" O. C. Spacing: 16.00"



Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	25	50	Passed (51%)	--	--
Compression (lbs)	1101	5432	Passed (20%)	1.15	1.0 D + 0.75 L + 0.75 S
Plate Bearing (lbs)	1101	4383	Passed (25%)	--	1.0 D + 0.75 L + 0.75 S
Lateral Reaction (lbs)	112	--	--	1.60	1.0 D + 0.6 W
Lateral Shear (lbs)	103	1584	Passed (7%)	1.60	1.0 D + 0.6 W
Lateral Moment (ft-lbs)	326 @ mid-span	1342	Passed (24%)	1.60	1.0 D + 0.6 W
Total Deflection (in)	0.17 @ mid-span	1.16	Passed (L/836)	--	1.0 D + 0.6 W
Bending/Compression	0.27	1	Passed (27%)	1.60	1.0 D + 0.6 W

- Lateral deflection criteria: Wind (L/120)
- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.
- A bearing area factor of 1.25 has been applied to base plate bearing capacity.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.

Supports	Type	Material
Top	Dbl 2X	Spruce-Pine-Fir
Base	2X	Spruce-Pine-Fir

System : Wall
Member Type : Stud
Building Code : IBC 2018
Design Methodology : ASD

Max Unbraced Length	Comments
1'	

Lateral Connections

Supports	Connector	Type/Model	Quantity	Connector Nailing
Top	Nails	8d (0.113" x 2 1/2") (Toe)	2	N/A
Base	Nails	8d (0.113" x 2 1/2") (Toe)	2	N/A

- Nailed connection at the top of the member is assumed to be nailed through the bottom 2x plate prior to placement of the top 2x of the double top plate assembly.

Vertical Loads	Spacing	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Point (PLF)	16.00"	144.0	-	-	-	Default Load
2 - Point (PLF)	16.00"	92.3	-	134.3	168.0	Linked from: Roof Truss 3, Support 2
3 - Point (PLF)	16.00"	154.5	411.8	-	-	Linked from: Upper Truss 3, Support 2

Lateral Load	Location	Spacing	Wind (1.60)	Comments
1 - Uniform (PSF)	Full Length	16.00"	24.1	

- ASCE/SEI 7 Sec. 30.4: Exposure Category (B), Mean Roof Height (33'), Topographic Factor (1.0), Wind Directionality Factor (0.85), Basic Wind Speed (115), Risk Category(II), Wind Zone (4), GCpi (+/- 0.18), Effective Wind Area determined using full member span and trib. width.
- IBC Table 1604.3, footnote f: Deflection checks are performed using 42% of this lateral wind load.

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ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

NKH Engineering

2/11/2025 7:28:20 PM UTC
ForteWEB v3.8, Engine: V8.4.1.24, Data: V8.1.6.3
File Name: 22-112 3804 House

FORTEWEB

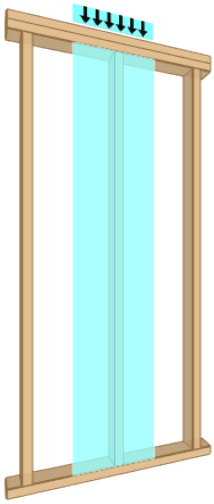
MEMBER REPORT

PASSED

Upper Floor, Upper Wall 2

1 piece(s) 2 x 6 DF No.2 @ 16" OC

Wall Height: 12' Member Height: 11' 7 1/2" O. C. Spacing: 16.00"



Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	25	50	Passed (51%)	--	--
Compression (lbs)	2140	5432	Passed (39%)	1.15	1.0 D + 0.75 L + 0.75 S
Plate Bearing (lbs)	2140	4383	Passed (49%)	--	1.0 D + 0.75 L + 0.75 S
Lateral Reaction (lbs)	112	--	--	1.60	1.0 D + 0.6 W
Lateral Shear (lbs)	103	1584	Passed (7%)	1.60	1.0 D + 0.6 W
Lateral Moment (ft-lbs)	326 @ mid-span	1342	Passed (24%)	1.60	1.0 D + 0.6 W
Total Deflection (in)	0.17 @ mid-span	1.16	Passed (L/836)	--	1.0 D + 0.6 W
Bending/Compression	0.42	1	Passed (42%)	1.60	1.0 D + 0.45 W + 0.75 L + 0.75 S

- Lateral deflection criteria: Wind (L/120)
- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.
- A bearing area factor of 1.25 has been applied to base plate bearing capacity.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.

Supports	Type	Material
Top	Dbl 2X	Spruce-Pine-Fir
Base	2X	Spruce-Pine-Fir

System : Wall
Member Type : Stud
Building Code : IBC 2018
Design Methodology : ASD

Max Unbraced Length	Comments
1'	

Lateral Connections

Supports	Connector	Type/Model	Quantity	Connector Nailing
Top	Nails	8d (0.113" x 2 1/2") (Toe)	2	N/A
Base	Nails	8d (0.113" x 2 1/2") (Toe)	2	N/A

- Nailed connection at the top of the member is assumed to be nailed through the bottom 2x plate prior to placement of the top 2x of the double top plate assembly.

Vertical Loads	Spacing	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Point (PLF)	16.00"	144.0	-	-	-	Default Load
2 - Point (PLF)	16.00"	164.3	-	219.0	273.8	Linked from: Roof Truss 1, Support 1
3 - Point (PLF)	16.00"	162.8	-	216.8	270.8	Linked from: Roof Truss 2, Support 2
4 - Point (PLF)	16.00"	100.5	268.5	-	-	Linked from: Upper Truss 1, Support 1
5 - Point (PLF)	16.00"	141.0	376.5	-	-	Linked from: Upper Truss 2, Support 2

Lateral Load	Location	Spacing	Wind (1.60)	Comments
1 - Uniform (PSF)	Full Length	16.00"	24.1	

- ASCE/SEI 7 Sec. 30.4: Exposure Category (B), Mean Roof Height (33'), Topographic Factor (1.0), Wind Directionality Factor (0.85), Basic Wind Speed (115), Risk Category(II), Wind Zone (4), GCpi (+/- 0.18), Effective Wind Area determined using full member span and trib. width.
- IBC Table 1604.3, footnote f: Deflection checks are performed using 42% of this lateral wind load.

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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
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

NKH Engineering

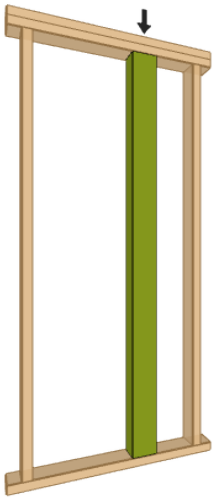
Weyerhaeuser

2/11/2025 7:28:20 PM UTC
ForteWEB v3.8, Engine: V8.4.1.24, Data: V8.1.6.3
File Name: 22-112 3804 House

Upper Floor, Upper Post 1

1 piece(s) 6 x 8 DF No.2

Wall Height: 11' Member Height: 10' 7 1/2" Tributary Width: 1'



Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	17	50	Passed (34%)	--	--
Compression (lbs)	16686	27647	Passed (60%)	1.15	1.0 D + 0.75 L + 0.75 S
Plate Bearing (lbs)	16686	17531	Passed (95%)	--	1.0 D + 0.75 L + 0.75 S
Lateral Reaction (lbs)	0	--	--	--	N/A
Lateral Shear (lbs)	0	N/A	Passed (N/A)	--	N/A
Lateral Moment (ft-lbs)	0 @ mid-span	N/A	Passed (N/A)	--	N/A
Total Deflection (in)	0.00 @ mid-span	N/A	Passed (N/A)	--	N/A
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Lateral deflection criteria: Wind (L/120)
- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.
- Bearing shall be on a metal plate or strap, or on other equivalently durable, rigid, homogeneous material with sufficient stiffness to distribute applied load.

Supports	Type	Material
Top	Dbl 2X	Douglas Fir-Larch
Base	2X	Spruce-Pine-Fir

System : Wall
Member Type : Column
Building Code : IBC 2018
Design Methodology : ASD

Max Unbraced Length	Comments
1'	

Vertical Load	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Point (lb)	N/A	8057	5266	4993	6239	Linked from: Upper Beam 5, Support 1

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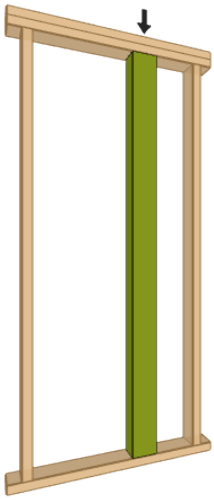
Upper Floor, Upper Post 2

1 piece(s) 4 x 10 DF No.2

Wall Height: 11' Member Height: 10' 7 1/2" Tributary Width: 1'



Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	14	50	Passed (28%)	--	--
Compression (lbs)	31362	41558	Passed (75%)	1.15	1.0 D + 0.75 L + 0.75 S
Plate Bearing (lbs)	31362	20234	Failed (155%)	--	1.0 D + 0.75 L + 0.75 S
Lateral Reaction (lbs)	0	--	--	--	N/A
Lateral Shear (lbs)	0	N/A	Passed (N/A)	--	N/A
Lateral Moment (ft-lbs)	0 @ mid-span	N/A	Passed (N/A)	--	N/A
Total Deflection (in)	0.00 @ mid-span	N/A	Passed (N/A)	--	N/A
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Lateral deflection criteria: Wind (L/120)
- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.
- Special detailing and installation procedures are necessary for large wall construction.

Supports	Type	Material
Top	Dbl 2X	Douglas Fir-Larch
Base	2X	Douglas Fir-Larch

System : Wall
Member Type : Column
Building Code : IBC 2018
Design Methodology : ASD

Max Unbraced Length	Comments
1'	

Vertical Loads	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Point (lb)	N/A	5111	5288	3738	4671	Linked from: Upper Beam 6, Support 1
2 - Point (lb)	N/A	8959	6858	4993	6239	Linked from: Upper Beam 5, Support 2

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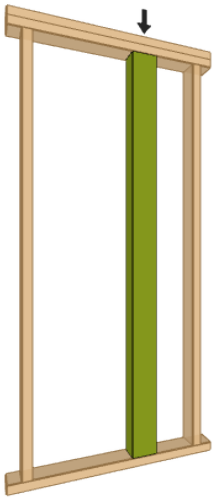
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Upper Floor, Upper Post 3

1 piece(s) 4 x 6 DF No.2

Wall Height: 11' Member Height: 10' 7 1/2" Tributary Width: 1'



Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	23	50	Passed (46%)	--	--
Compression (lbs)	11986	14247	Passed (84%)	1.00	1.0 D + 1.0 L
Plate Bearing (lbs)	11986	12031	Passed (100%)	--	1.0 D + 1.0 L
Lateral Reaction (lbs)	0	--	--	--	N/A
Lateral Shear (lbs)	0	N/A	Passed (N/A)	--	N/A
Lateral Moment (ft-lbs)	0 @ mid-span	N/A	Passed (N/A)	--	N/A
Total Deflection (in)	0.00 @ mid-span	N/A	Passed (N/A)	--	N/A
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Lateral deflection criteria: Wind (L/120)
- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.
- Bearing shall be on a metal plate or strap, or on other equivalently durable, rigid, homogeneous material with sufficient stiffness to distribute applied load.

Supports	Type	Material
Top	Dbl 2X	Douglas Fir-Larch
Base	2X	Douglas Fir-Larch

System : Wall
Member Type : Column
Building Code : IBC 2018
Design Methodology : ASD

Max Unbraced Length	Comments
1'	

Vertical Loads	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Point (lb)	N/A	2566	5288	569	711	Linked from: Upper Beam 6, Support 2
2 - Point (lb)	N/A	1800	2332	1198	1498	Linked from: Upper Beam 7, Support 1

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ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

FORTEWEB

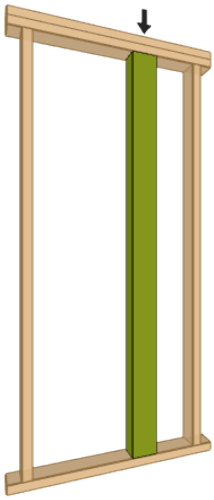
MEMBER REPORT

PASSED

Upper Floor, Upper Post 4

3 piece(s) 2 x 6 DF No.2

Wall Height: 11' Member Height: 10' 7 1/2" Tributary Width: 1'



Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	23	50	Passed (46%)	--	--
Compression (lbs)	10699	18900	Passed (57%)	1.15	1.0 D + 0.75 L + 0.75 S
Plate Bearing (lbs)	10699	15469	Passed (69%)	--	1.0 D + 0.75 L + 0.75 S
Lateral Reaction (lbs)	0	--	--	--	N/A
Lateral Shear (lbs)	0	N/A	Passed (N/A)	--	N/A
Lateral Moment (ft-lbs)	0 @ mid-span	N/A	Passed (N/A)	--	N/A
Total Deflection (in)	0.00 @ mid-span	N/A	Passed (N/A)	--	N/A
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Lateral deflection criteria: Wind (L/120)
- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.
- The column stability factor (Kf = 0.6) applied to this design assumes nailed built-up columns per NDS section 15.3.3. For Weyerhaeuser ELP products refer to the U.S. Wall Guide for multiple-member connection requirements.

Supports	Type	Material
Top	Dbl 2X	Douglas Fir-Larch
Base	2X	Douglas Fir-Larch

System : Wall
Member Type : Column
Building Code : IBC 2018
Design Methodology : ASD

Max Unbraced Length	Comments
1'	

Vertical Load	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Point (lb)	N/A	4364	5808	1286	2638	Linked from: Upper Beam 8, Support 2

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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
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

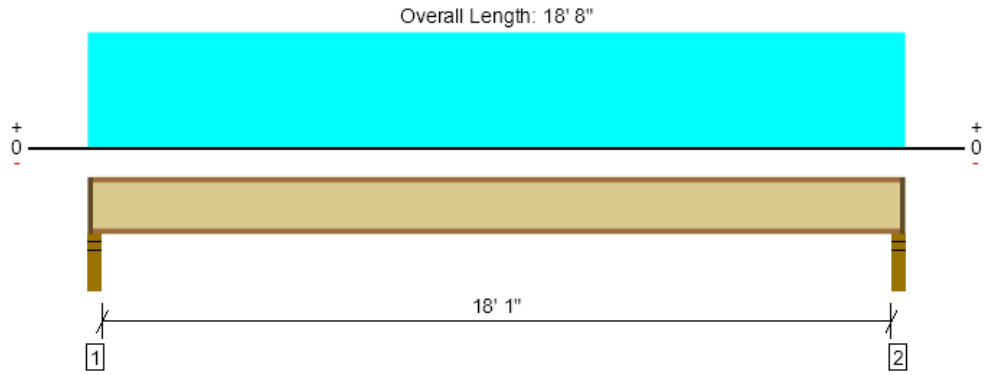
NKH Engineering

Weyerhaeuser

2/11/2025 7:28:20 PM UTC
ForteWEB v3.8, Engine: V8.4.1.24, Data: V8.1.6.3
File Name: 22-112 3804 House

Main, (Loading Only) Main Truss 1

1 piece(s) 11 7/8" TJI® 230 @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	677 @ 2 1/2"	1183 (2.25")	Passed (57%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	663 @ 3 1/2"	1655	Passed (40%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	3053 @ 9' 4"	4215	Passed (72%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.356 @ 9' 4"	0.456	Passed (L/615)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.489 @ 9' 4"	0.913	Passed (L/447)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	40	35	Passed	--	--

Member Length : 18' 5 1/2"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- 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	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.75"	187	498	684	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	2.25"	1.75"	187	498	684	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)	4' 10" o/c	
Bottom Edge (Lu)	18' 6" 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 18' 8"	16"	15.0	40.0	Default Load

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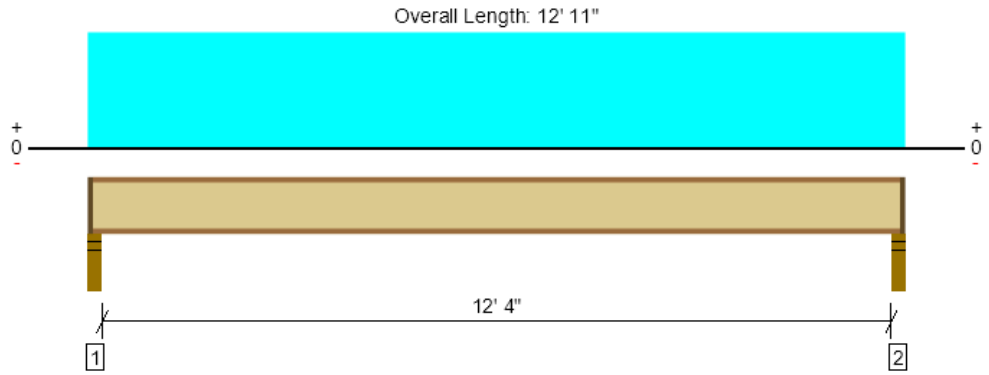
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Main, (Loading Only) Main Truss 2

1 piece(s) 11 7/8" TJI® 230 @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	466 @ 2 1/2"	1183 (2.25")	Passed (39%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	452 @ 3 1/2"	1655	Passed (27%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	1432 @ 6' 5 1/2"	4215	Passed (34%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.088 @ 6' 5 1/2"	0.313	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.121 @ 6' 5 1/2"	0.625	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	57	35	Passed	--	--

Member Length : 12' 8 1/2"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- 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	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.75"	129	344	474	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	2.25"	1.75"	129	344	474	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)	7' 2" o/c	
Bottom Edge (Lu)	12' 9" 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 12' 11"	16"	15.0	40.0	Default Load

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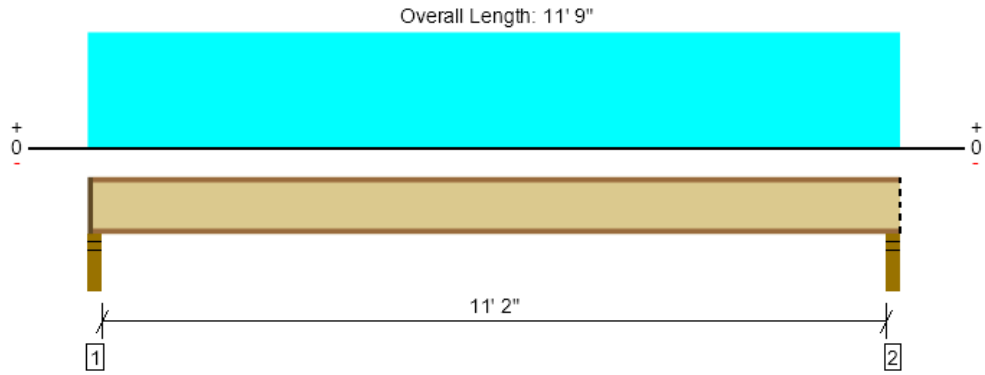
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Main, (Loading Only) Main Truss 3-2

1 piece(s) 11 7/8" TJI® 230 @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	423 @ 2 1/2"	1183 (2.25")	Passed (36%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	409 @ 3 1/2"	1655	Passed (25%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	1177 @ 5' 10 1/2"	4215	Passed (28%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.062 @ 5' 10 1/2"	0.283	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.086 @ 5' 10 1/2"	0.567	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	60	35	Passed	--	--

Member Length : 11' 7 3/4"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- 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	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.75"	118	313	431	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	3.50"	1.75"	117	313	431	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)	8' o/c	
Bottom Edge (Lu)	11' 8" 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 11' 9"	16"	15.0	40.0	Default Load

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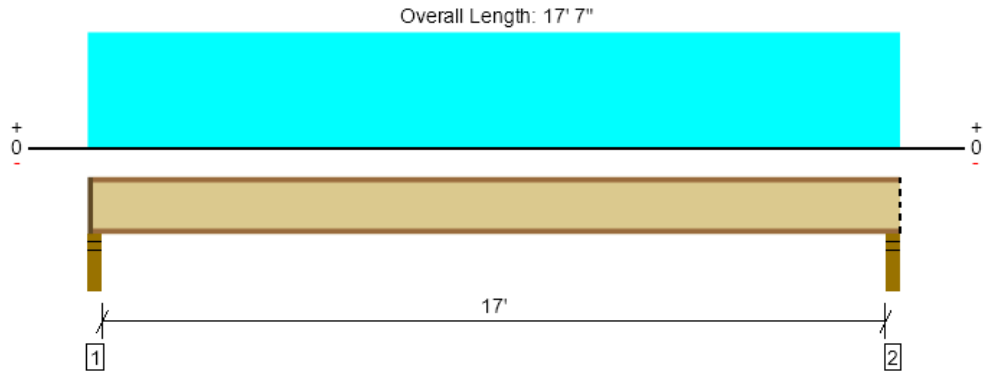
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Main, (Loading Only) Main Truss 4

1 piece(s) 11 7/8" TJI® 230 @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	637 @ 2 1/2"	1183 (2.25")	Passed (54%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	623 @ 3 1/2"	1655	Passed (38%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	2701 @ 8' 9 1/2"	4215	Passed (64%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.283 @ 8' 9 1/2"	0.429	Passed (L/729)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.389 @ 8' 9 1/2"	0.858	Passed (L/530)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	44	35	Passed	--	--

Member Length : 17' 5 3/4"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- 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	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.75"	176	469	645	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	3.50"	1.75"	176	469	645	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)	5' 2" o/c	
Bottom Edge (Lu)	17' 6" 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 17' 7"	16"	15.0	40.0	Default Load

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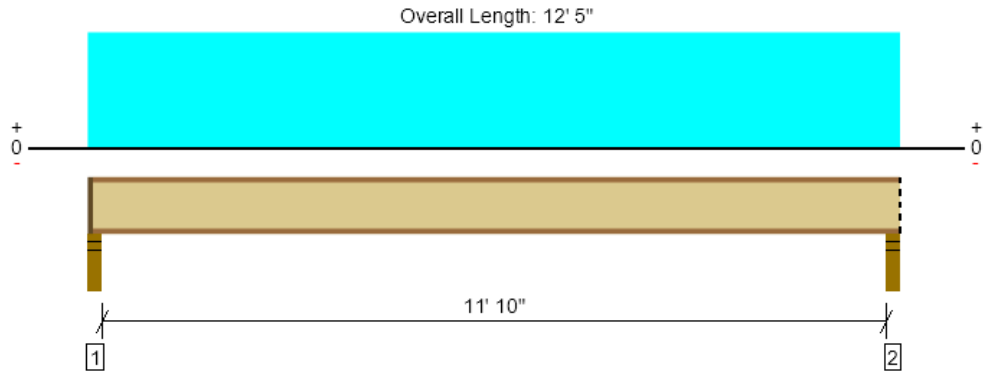
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Main, (Loading Only) Main Truss 5

1 piece(s) 11 7/8" TJI® 230 @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	448 @ 2 1/2"	1183 (2.25")	Passed (38%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	434 @ 3 1/2"	1655	Passed (26%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	1320 @ 6' 2 1/2"	4215	Passed (31%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.076 @ 6' 2 1/2"	0.300	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.105 @ 6' 2 1/2"	0.600	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	59	35	Passed	--	--

Member Length : 12' 3 3/4"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- 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	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.75"	124	331	455	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	3.50"	1.75"	124	331	455	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' 6" o/c	
Bottom Edge (Lu)	12' 4" 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 12' 5"	16"	15.0	40.0	Default Load

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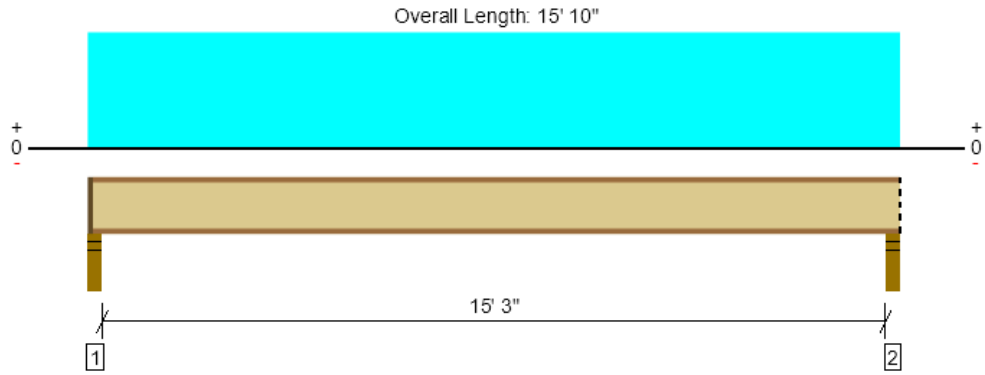
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Main, (Loading Only) Main Truss 6

1 piece(s) 11 7/8" TJI® 230 @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	781 @ 2 1/2"	1183 (2.25")	Passed (66%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	762 @ 3 1/2"	1655	Passed (46%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	2971 @ 7' 11"	4215	Passed (70%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.302 @ 7' 11"	0.385	Passed (L/613)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.373 @ 7' 11"	0.771	Passed (L/496)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
TJ-Pro™ Rating	49	35	Passed	--	--

Member Length : 15' 8 3/4"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- 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	Snow	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.75"	158	633	264	831	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	3.50"	1.75"	158	633	264	831	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)	4' 9" o/c	
Bottom Edge (Lu)	15' 9" 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)	Snow (1.15)	Comments
1 - Uniform (PSF)	0 to 15' 10"	16"	15.0	60.0	25.0	Default Load

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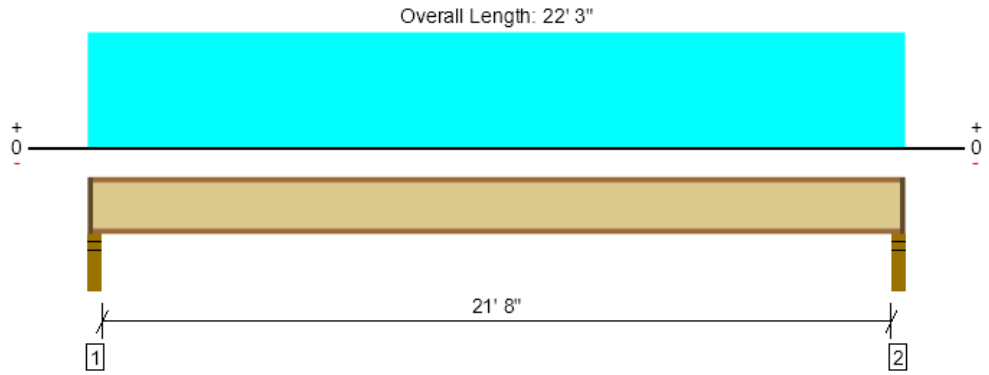
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Main, (Loading Only) Main Truss 7

1 piece(s) 14" TJI® 360 @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	808 @ 2 1/2"	1202 (2.25")	Passed (67%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	794 @ 3 1/2"	1955	Passed (41%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	4370 @ 11' 1 1/2"	7335	Passed (60%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.428 @ 11' 1 1/2"	0.546	Passed (L/613)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.588 @ 11' 1 1/2"	1.092	Passed (L/446)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	37	35	Passed	--	--

Member Length : 22' 1/2"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- 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	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.75"	222	593	816	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	2.25"	1.75"	222	593	816	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)	4' 10" o/c	
Bottom Edge (Lu)	22' 1" 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 22' 3"	16"	15.0	40.0	Default Load

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

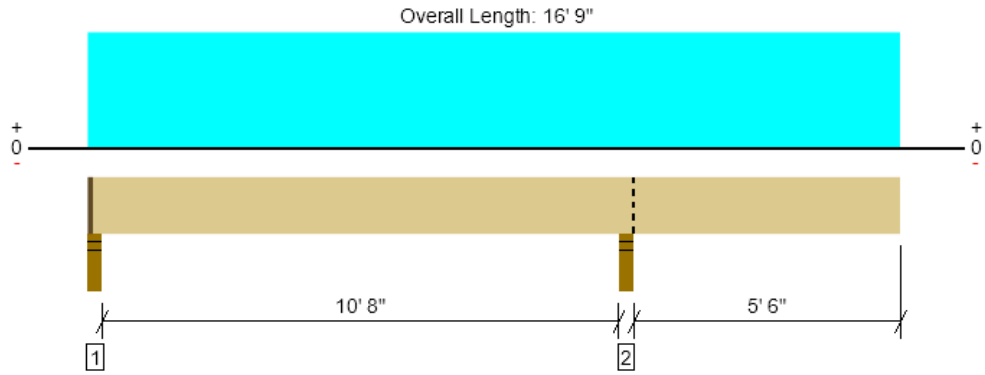
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

MEMBER REPORT

PASSED

Main, Main Deck 1

1 piece(s) 1 3/4" x 9 1/4" 2.0E Microllam® LVL @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1256 @ 11' 1 1/4"	2603 (3.50")	Passed (48%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	599 @ 10' 2 1/4"	3076	Passed (19%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	-1594 @ 11' 1 1/4"	5826	Passed (27%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.248 @ 16' 9"	0.376	Passed (2L/546)	--	1.0 D + 1.0 L (Alt Spans)
Total Load Defl. (in)	0.270 @ 16' 9"	0.565	Passed (2L/502)	--	1.0 D + 1.0 L (Alt Spans)
TJ-Pro™ Rating	60	35	Passed	--	--

Member Length : 16' 7 3/4"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Overhang deflection criteria: LL (2L/360) and TL (2L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A 4% increase in the moment capacity has been added to account for repetitive member usage.
- 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	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.50"	84	453/-109	536/-25	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	3.50"	1.69"	251	1005	1256	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)	16' 8" o/c	
Bottom Edge (Lu)	16' 8" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 16' 9"	16"	15.0	60.0	Default Load

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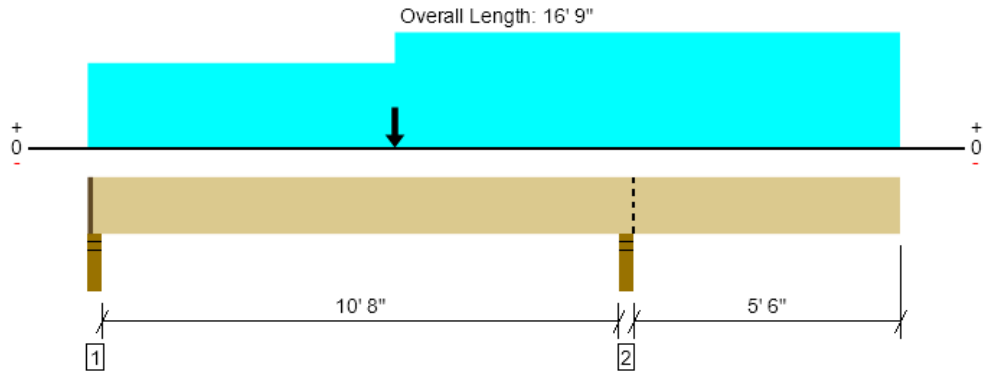
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Main, Main Deck 1 w/ Wall Above

1 piece(s) 1 3/4" x 9 1/4" 2.0E Microllam® LVL @ 16" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1678 @ 11' 1 1/4"	2603 (3.50")	Passed (64%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	1153 @ 10' 2 1/4"	3537	Passed (33%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Moment (Ft-lbs)	4205 @ 6' 4"	6700	Passed (63%)	1.15	1.0 D + 0.75 L + 0.75 S (Alt Spans)
Live Load Defl. (in)	0.248 @ 16' 9"	0.376	Passed (2L/546)	--	1.0 D + 1.0 L (Alt Spans)
Total Load Defl. (in)	0.315 @ 5' 9 1/8"	0.545	Passed (L/416)	--	1.0 D + 0.75 L + 0.75 S (Alt Spans)
TJ-Pro™ Rating	60	35	Passed	--	--

Member Length : 16' 7 3/4"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Overhang deflection criteria: LL (2L/360) and TL (2L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A 4% increase in the moment capacity has been added to account for repetitive member usage.
- Upward deflection on right cantilever exceeds 0.4".
- 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	Snow	Factored	
1 - Stud wall - SPF	3.50"	2.25"	1.50"	294	330/-111	455	883	1 1/4" Rim Board
2 - Stud wall - SPF	3.50"	3.50"	2.26"	521	959	585	1678	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)	8' o/c	
Bottom Edge (Lu)	16' 8" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
1 - Uniform (PSF)	0 to 6' 4"	16"	15.0	40.0	-	Main Floor Load
2 - Uniform (PSF)	6' 4" to 16' 9"	16"	15.0	60.0	-	Deck Load
3 - Point (PLF)	6' 4"	16"	180.0	-	300.0	Roof Load (from bearing wall)
4 - Point (PLF)	6' 4"	16"	180.0	-	480.0	Upper Floor Load (from bearing wall)

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

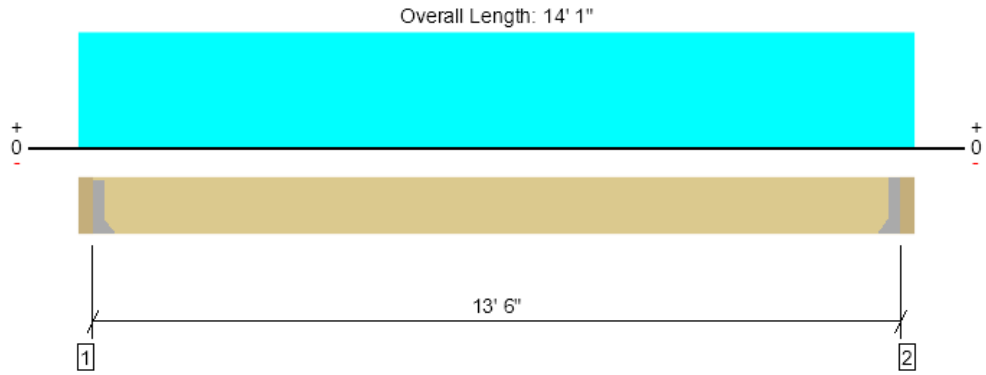
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

MEMBER REPORT

PASSED

Main, Main Deck 2

1 piece(s) 1 3/4" x 7 1/4" 2.0E Microllam® LVL @ 12" OC



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	506 @ 3 1/2"	1969 (1.50")	Passed (26%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	461 @ 10 3/4"	2411	Passed (19%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	1709 @ 7' 1/2"	3700	Passed (46%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.367 @ 7' 1/2"	0.450	Passed (L/441)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.459 @ 7' 1/2"	0.675	Passed (L/353)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	42	35	Passed	--	--

Member Length : 13' 6"
System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A 4% increase in the moment capacity has been added to account for repetitive member usage.
- 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	Factored	
1 - Hanger on 7 1/4" SPF Ledger	3.50"	Hanger[1]	1.50"	106	423	528	See note [1]
2 - Hanger on 7 1/4" SPF Ledger	3.50"	Hanger[1]	1.50"	106	423	528	See note [1]

- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	13' 6" o/c	
Bottom Edge (Lu)	13' 6" o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie

Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	HU1.81/5	2.50"	N/A	12-10dx1.5	4-10dx1.5	
2 - Face Mount Hanger	HU1.81/5	2.50"	N/A	12-10dx1.5	4-10dx1.5	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 14' 1"	12"	15.0	60.0	Default Load

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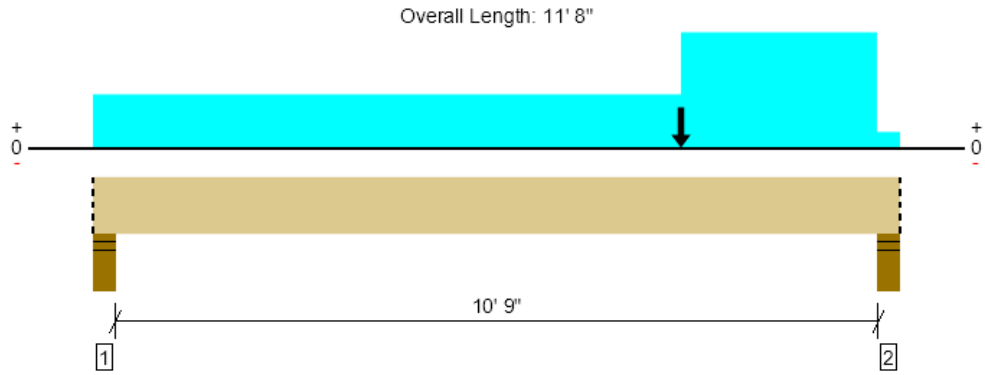
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

2/11/2025 7:28:20 PM UTC
ForteWEB v3.8, Engine: V8.4.1.24, Data: V8.1.6.3
File Name: 22-112 3804 House

Main, Main Beam 1

1 piece(s) 5 1/2" x 12" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	9098 @ 11' 4"	12856 (5.50")	Passed (71%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	7099 @ 10' 2 1/2"	11660	Passed (61%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	20319 @ 6' 9 3/16"	26400	Passed (77%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.152 @ 5' 11 13/16"	0.275	Passed (L/870)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.312 @ 6'	0.550	Passed (L/423)	--	1.0 D + 1.0 L (All Spans)

Member Length : 11' 8"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 11'.
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Snow	Factored	
1 - Stud wall - SPF	5.50"	5.50"	2.84"	3364	3281	333	417	6645	Blocking
2 - Stud wall - SPF	5.50"	5.50"	3.89"	4670	4262	1314	1643	9098	Blocking

- 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)	11' 8" o/c	
Bottom Edge (Lu)	11' 8" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 11' 8"	N/A	16.0	--	--	--	
1 - Uniform (PLF)	0 to 11' 8" (Front)	N/A	288.0	-	-	-	Floor
2 - Uniform (PLF)	8' 6" to 11' 4" (Front)	N/A	187.5	-	249.8	312.0	Linked from: Roof Truss 1, Support 2
3 - Point (lb)	8' 6" (Front)	N/A	732	-	940	1175	Linked from: Roof Header 2, Support 2
4 - Uniform (PLF)	8' 6" to 11' 4" (Front)	N/A	100.5	268.5	-	-	Linked from: Upper Truss 1, Support 2
5 - Point (lb)	8' 6" (Front)	N/A	839	1197	-	-	Linked from: Upper Header 7, Support 2
6 - Uniform (PLF)	0 to 11' 4" (Front)	N/A	96.8	258.0	-	-	Linked from: Main Truss 2, Support 2
7 - Uniform (PLF)	0 to 11' 4" (Front)	N/A	88.5	234.8	-	-	Linked from: Main Truss 3-2, Support 1

- Side loads are assumed to not induce cross-grain tension.

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

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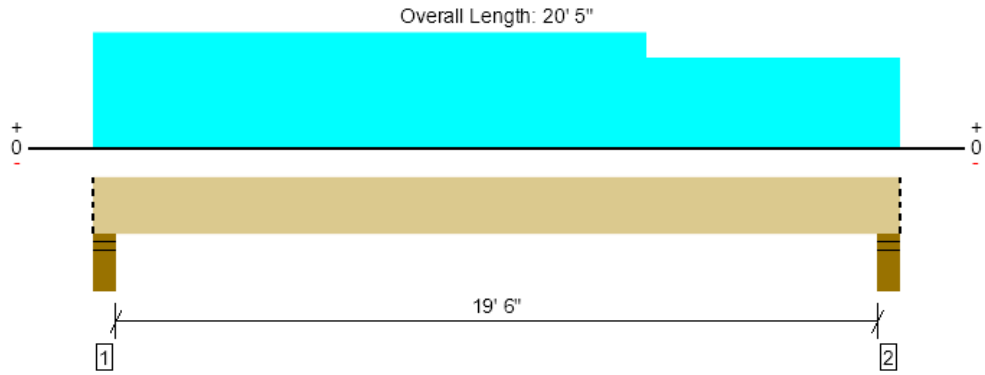
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Main, Main Beam 1 Revised

1 piece(s) 7" x 14" 2.2E Parallam® PSL



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern) [Group]
Member Reaction (lbs)	9719 @ 20' 1"	16363 (5.50")	Passed (59%)	--	1.0 D + 0.75 L + 0.75 S (All Spans) [1]
Shear (lbs)	7784 @ 1' 7 1/2"	18947	Passed (41%)	1.00	1.0 D + 1.0 L (All Spans) [1]
Moment (Ft-lbs)	43996 @ 10' 1 13/16"	54324	Passed (81%)	1.00	1.0 D + 1.0 L (All Spans) [1]
Live Load Defl. (in)	0.591 @ 10' 2 7/8"	0.658	Passed (L/401)	--	1.0 D + 0.75 L + 0.75 S (All Spans) [1]
Total Load Defl. (in)	0.951 @ 10' 2 11/16"	0.988	Passed (L/249)	--	1.0 D + 0.75 L + 0.75 S (All Spans) [1]

Member Length : 20' 5"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Member should be side-loaded from both sides of the member or braced to prevent rotation.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Factored	
1 - Stud wall - SPF	5.50"	5.50"	3.16"	3601	5667	2058	9395	Blocking
2 - Stud wall - SPF	5.50"	5.50"	3.27"	3580	5429	2757	9719	Blocking

- 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)	20' 5" o/c	
Bottom Edge (Lu)	20' 5" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 20' 5"	N/A	30.6	--	--	
1 - Uniform (PSF)	0 to 14' (Front)	7' 6"	15.0	-	25.0	Roof Load
2 - Uniform (PSF)	0 to 14' (Front)	7' 6"	15.0	40.0	-	Upper Floor Load
3 - Uniform (PSF)	0 to 20' 5" (Front)	6' 6"	15.0	40.0	-	Main Floor Load
4 - Uniform (PLF)	14' to 20' 5" (Front)	N/A	220.5	247.5/-83.3	341.3	Linked from: Main Deck 1 w/ Wall Above, Support 1

- Side loads are assumed to not induce cross-grain tension.

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

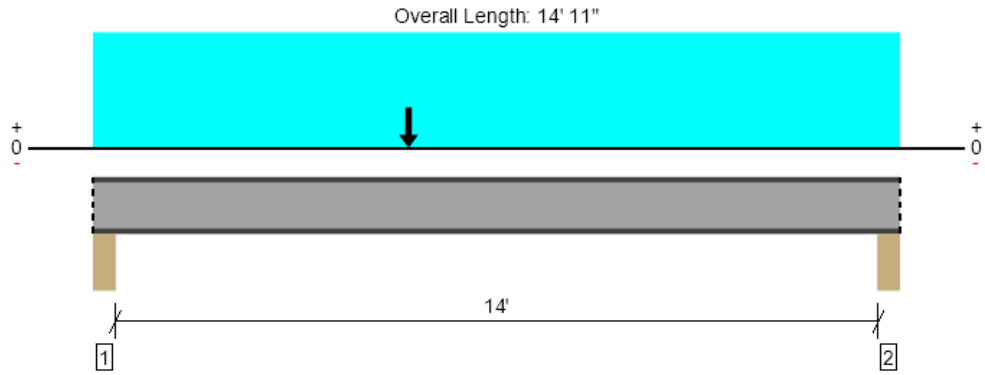
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

MEMBER REPORT

PASSED

Main, Main Beam 2

1 piece(s) W12X45 (A992) ASTM Steel



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Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	26511 @ 4"	34313 (5.50")	Passed (77%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	26069 @ 5 1/2"	81070	Passed (32%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Moment (Ft-lbs)	129441 @ 5' 10"	131988	Passed (98%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Live Load Defl. (in)	0.223 @ 7' 1 9/16"	0.356	Passed (L/768)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.391 @ 7' 1 7/16"	0.712	Passed (L/437)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

Member Length : 14' 11"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Bearing reinforcement may be required for support located at 4".
- Bearing reinforcement may be required for point load located at 5' 10".
- Applicable calculations are based on ANSI/AISC 360-16.
- A lateral-torsional buckling factor (Cb) of 1.0 has been assumed.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Snow	Factored	
1 - Column - DF	5.50"	5.50"	5.50"	11316	13561	5361	6699	26511	Blocking
2 - Column - DF	5.50"	5.50"	5.50"	8088	10791	3370	4211	19339	Blocking

- 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)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 14' 11"	N/A	45.0	--	--	--	
1 - Uniform (PLF)	0 to 14' 11" (Front)	N/A	140.3	373.5	-	-	Linked from: Main Truss 1, Support 2
2 - Uniform (PLF)	0 to 14' 11" (Back)	N/A	166.5	444.8	-	-	Linked from: (Loading Only) Main Truss 7, Support 1
3 - Point (lb)	5' 10" (Top)	N/A	14157	12146	8731	10910	Linked from: Upper Post 2, Support 1

- Side loads are assumed to not induce cross-grain tension.

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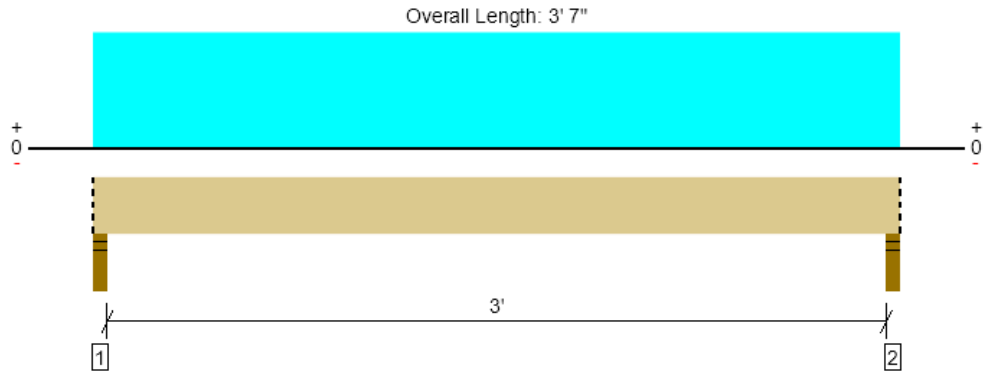
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

2/11/2025 7:28:20 PM UTC
ForteWEB v3.8, Engine: V8.4.1.24, Data: V8.1.6.3
File Name: 22-112 3804 House

Main, Main Beam 3

1 piece(s) 3 1/2" x 7 1/2" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2027 @ 2"	5206 (3.50")	Passed (39%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	990 @ 11"	4638	Passed (21%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	1494 @ 1' 9 1/2"	6563	Passed (23%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.009 @ 1' 9 1/2"	0.081	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.013 @ 1' 9 1/2"	0.162	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)

Member Length : 3' 7"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 3' 3".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - SPF	3.50"	3.50"	1.50"	561	1466	2027	Blocking
2 - Stud wall - SPF	3.50"	3.50"	1.50"	561	1466	2027	Blocking

- 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)	3' 7" o/c	
Bottom Edge (Lu)	3' 7" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 3' 7"	N/A	6.4	--	
1 - Uniform (PLF)	0 to 3' 7" (Front)	N/A	140.3	373.5	Linked from: Main Truss 1, Support 2
2 - Uniform (PLF)	0 to 3' 7" (Back)	N/A	166.5	444.8	Linked from: (Loading Only) Main Truss 7, Support 1

- Side loads are assumed to not induce cross-grain tension.

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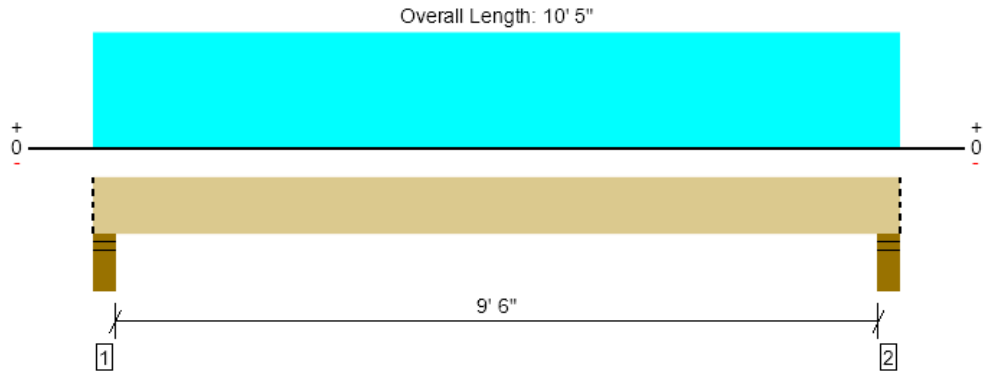
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Main, Main Beam 4

1 piece(s) 5 1/2" x 10 1/2" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	5034 @ 4"	12856 (5.50")	Passed (39%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	3745 @ 1' 4"	10203	Passed (37%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	11485 @ 5' 2 1/2"	20213	Passed (57%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.148 @ 5' 2 1/2"	0.244	Passed (L/793)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.206 @ 5' 2 1/2"	0.488	Passed (L/569)	--	1.0 D + 1.0 L (All Spans)

Member Length : 10' 5"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 9' 9".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - SPF	5.50"	5.50"	2.15"	1425	3609	5034	Blocking
2 - Stud wall - SPF	5.50"	5.50"	2.15"	1425	3609	5034	Blocking

- 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)	10' 5" o/c	
Bottom Edge (Lu)	10' 5" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 10' 5"	N/A	14.0	--	
1 - Uniform (PLF)	0 to 10' 5" (Front)	N/A	93.0	248.3	Linked from: Main Truss 5, Support 1
2 - Uniform (PLF)	0 to 10' 5" (Front)	N/A	166.5	444.8	Linked from: (Loading Only) Main Truss 7, Support 2

- Side loads are assumed to not induce cross-grain tension.

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

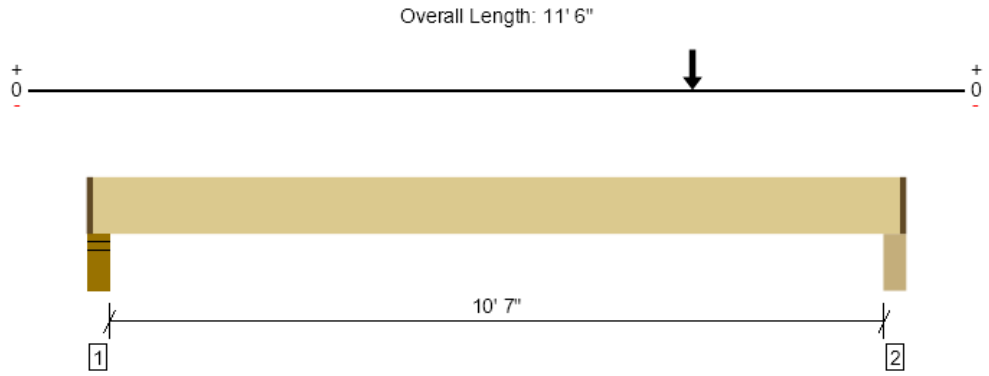
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

MEMBER REPORT

PASSED

Main, Main Beam 5

2 piece(s) 1 3/4" x 14" 2.0E Microllam® LVL



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	4830 @ 11' 2"	10500 (4.00")	Passed (46%)	--	1.0 D + 0.7 E (All Spans)
Shear (lbs)	4808 @ 9' 10 1/2"	14896	Passed (32%)	1.60	1.0 D + 0.7 E (All Spans)
Moment (Ft-lbs)	12820 @ 8' 6"	38813	Passed (33%)	1.60	1.0 D + 0.7 E (All Spans)
Live Load Defl. (in)	0.000 @ 1 1/2"	0.271	Passed (L/999+)	--	1.0 D (All Spans)
Total Load Defl. (in)	0.003 @ 5' 9 1/16"	0.542	Passed (L/999+)	--	1.0 D (All Spans)

Member Length : 11' 3"
System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- An excessive uplift of -1503 lbs detected at support located at 2 1/2".
- An excessive uplift of -4701 lbs detected at support located at 11' 1/2".

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Seismic	Factored	
1 - Stud wall - DF	5.50"	4.00"	1.50"	80	2215/-2215	1631/-1503	1 1/2" Rim Board
2 - Column - DF	5.50"	4.00"	1.84"	80	6785/-6785	4830/-4701	1 1/2" 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)	11' 3" o/c	
Bottom Edge (Lu)	11' 3" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Seismic (1.60)	Comments
0 - Self Weight (PLF)	1 1/2" to 11' 4 1/2"	N/A	14.3	--	
1 - Point (lb)	8' 6" (Top)	N/A	-	9000	HD Forces

- Side loads are assumed to not induce cross-grain tension.

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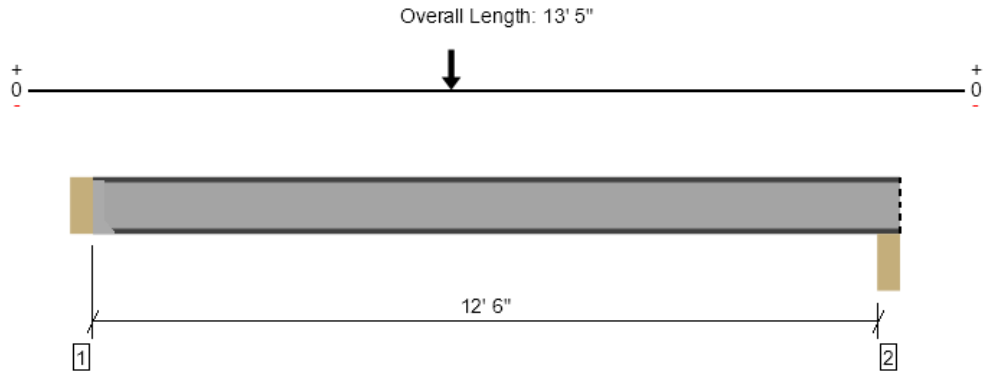
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

MEMBER REPORT

PASSED

Main, Main Beam 6

1 piece(s) W12X35 (A992) ASTM Steel



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	15095 @ 5 1/2"	33038 (1.50")	Passed (46%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	15095 @ 5 1/2"	75000	Passed (20%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Moment (Ft-lbs)	83115 @ 6'	96908	Passed (86%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Live Load Defl. (in)	0.131 @ 6' 6 7/8"	0.316	Passed (L/999+)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.230 @ 6' 6 7/8"	0.631	Passed (L/658)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

Member Length : 12' 11 1/2"
System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Bearing reinforcement may be required for support located at 0".
- Bearing reinforcement may be required for point load located at 5' 6 1/2".
- Applicable calculations are based on ANSI/AISC 360-16.
- A lateral-torsional buckling factor (Cb) of 1.0 has been assumed.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Snow	Factored	
1 - Hanger on 12 1/2" DF beam	5.50"	Hanger[1]	1.50" / - [2]	6570	7608	3008	3759	15095	See note [1]
2 - Column - DF	5.50"	5.50"	5.50"	5200	5953	2353	2940	11869	Blocking

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Connector: Simpson Strong-Tie

Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	5 1/2" to 13' 5"	N/A	35.0	--	--	--	
1 - Point (lb)	6' (Top)	N/A	11316	13561	5361	6699	Linked from: Main Beam 2, Support 1

- Side loads are assumed to not induce cross-grain tension.

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

NKH Engineering

2/11/2025 7:28:20 PM UTC
ForteWEB v3.8, Engine: V8.4.1.24, Data: V8.1.6.3
File Name: 22-112 3804 House

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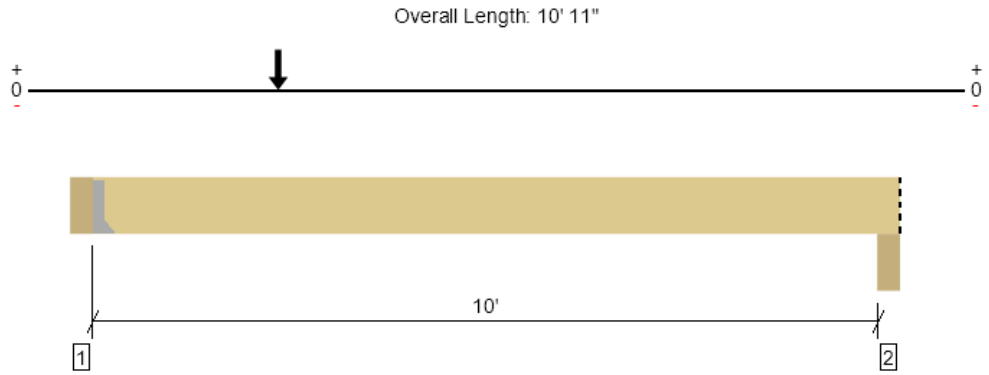
Main, Main Beam 7

1 piece(s) 5 1/2" x 13 1/2" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	11770 @ 5 1/2"	11770 (3.29")	Passed (100%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	11040 @ 1' 7"	13118	Passed (84%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	25299 @ 2' 9"	33413	Passed (76%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.101 @ 4' 11 5/16"	0.253	Passed (L/999+)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.181 @ 4' 11 3/8"	0.506	Passed (L/671)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

Member Length : 10' 5 1/2"
System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 10' 1 1/2".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Snow	Factored	
1 - Hanger on 13 1/2" DF beam	5.50"	Hanger[1]	3.29"	5174	5886	2327	2908	11770	See note [1]
2 - Column - DF	5.50"	5.50"	1.50"	1584	1722	681	851	3514	Blocking

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	10' 6" o/c	
Bottom Edge (Lu)	10' 6" o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	HGUS5.50/12	4.00"	N/A	56-16d	20-16d	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	5 1/2" to 10' 11"	N/A	18.0	--	--	--	
1 - Point (lb)	2' 9" (Front)	N/A	6570	7608	3008	3759	Linked from: Main Beam 6, Support 1

- Side loads are assumed to not induce cross-grain tension.

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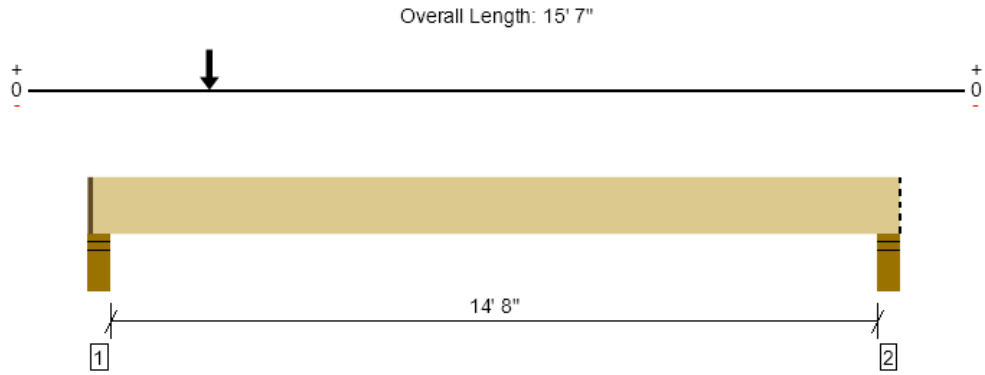
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Main, Main Beam 8

1 piece(s) 5 1/2" x 13 1/2" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	10330 @ 4"	14609 (4.25")	Passed (71%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	9689 @ 1' 7"	13118	Passed (74%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	19387 @ 2' 4"	33413	Passed (58%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.156 @ 6' 9 3/16"	0.373	Passed (L/999+)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.288 @ 6' 9 5/8"	0.746	Passed (L/622)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

Member Length : 15' 5 3/4"
System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 14' 11".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Snow	Factored	
1 - Stud wall - DF	5.50"	4.25"	3.01"	4619	5097	2015	2518	10330	1 1/4" Rim Board
2 - Stud wall - DF	5.50"	5.50"	1.50"	834	789	312	390	1719	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)	15' 6" o/c	
Bottom Edge (Lu)	15' 6" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	1 1/4" to 15' 7"	N/A	18.0	--	--	--	
1 - Point (lb)	2' 4" (Front)	N/A	5174	5886	2327	2908	Linked from: Main Beam 7, Support 1

- Side loads are assumed to not induce cross-grain tension.

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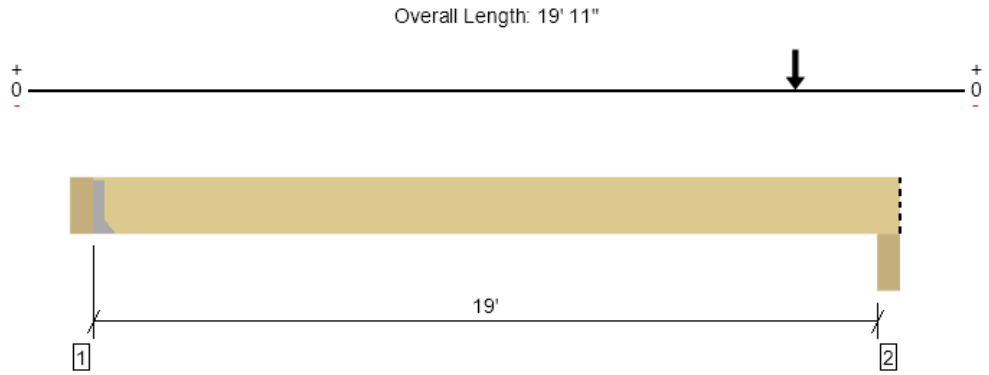
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Main, Main Beam 9

1 piece(s) 5 1/2" x 13 1/2" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	14999 @ 19' 7"	19663 (5.50")	Passed (76%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	14971 @ 18' 4"	15085	Passed (99%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Pos Moment (Ft-lbs)	33689 @ 17' 4"	38062	Passed (89%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Live Load Defl. (in)	0.380 @ 11' 4 13/16"	0.478	Passed (L/604)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.765 @ 11' 4 3/16"	0.956	Passed (L/300)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

Member Length : 19' 5 1/2"
System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 0.99 that was calculated using length L = 19' 1 1/2".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Snow	Factored	
1 - Hanger on 13 1/2" DF beam	5.50"	Hanger[1]	1.50"	1134	620	587	734	2149	See note [1]
2 - Column - DF	5.50"	5.50"	4.20"	7386	4646	4406	5505	14999	Blocking

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	19' 6" o/c	
Bottom Edge (Lu)	19' 6" o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	U610	2.00"	N/A	14-16d	6-10d	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
0 - Self Weight (PLF)	5 1/2" to 19' 11"	N/A	18.0	--	--	--	
1 - Point (lb)	17' 4" (Top)	N/A	8168	5266	4993	6239	Linked from: Upper Post 1, Support 1

- Side loads are assumed to not induce cross-grain tension.

ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

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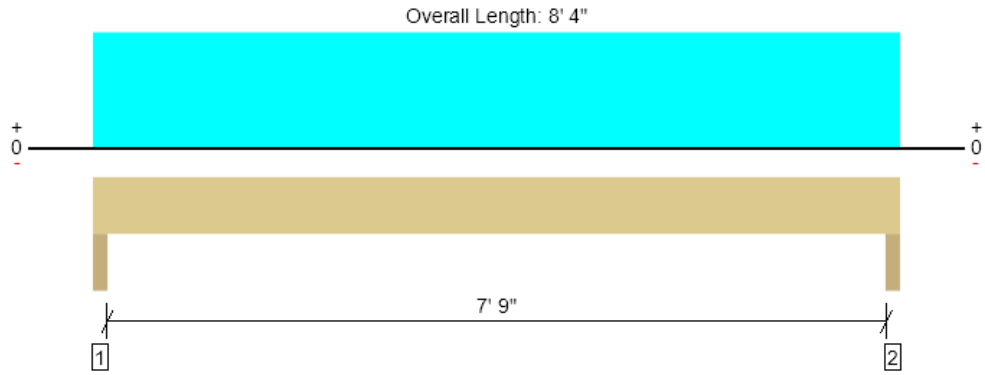
MEMBER REPORT

PASSED

Main, Main Header 1

1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2054 @ 2"	7963 (3.50")	Passed (26%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1540 @ 1' 1/2"	5565	Passed (28%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	3943 @ 4' 2"	9450	Passed (42%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.060 @ 4' 2"	0.200	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.119 @ 4' 2"	0.400	Passed (L/809)	--	1.0 D + 1.0 L (All Spans)

Member Length : 8' 4"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 8'.
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Trimmer - SPF	3.50"	3.50"	1.50"	1019	1034	2054	None
2 - Trimmer - SPF	3.50"	3.50"	1.50"	1019	1034	2054	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	8' 4" o/c	
Bottom Edge (Lu)	8' 4" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 8' 4"	N/A	7.7	--	
1 - Uniform (PLF)	0 to 8' 4"	N/A	144.0	-	Default Load
2 - Uniform (PLF)	0 to 8' 4"	N/A	93.0	248.3	Linked from: Main Truss 5, Support 2

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

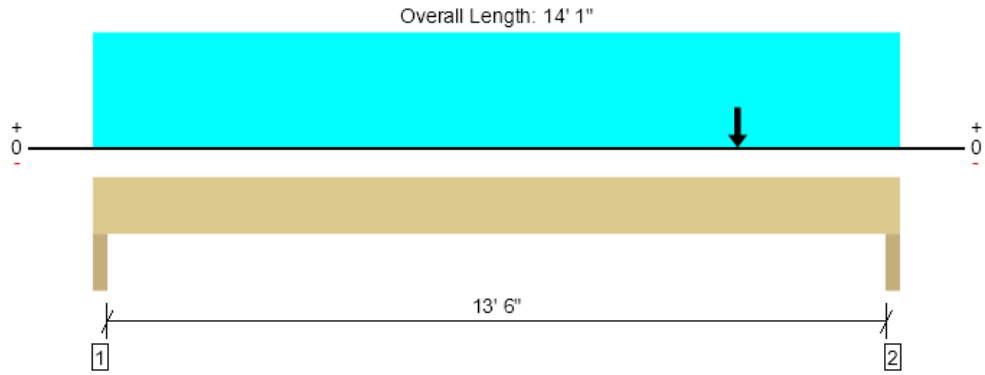
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

MEMBER REPORT

PASSED

Main, Main Header 2

1 piece(s) 5 1/2" x 12" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	3135 @ 13' 11"	12513 (3.50")	Passed (25%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	2928 @ 12' 9 1/2"	11660	Passed (25%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	7833 @ 10' 3/4"	26400	Passed (30%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.072 @ 7' 11 5/16"	0.344	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.182 @ 7' 5 11/16"	0.688	Passed (L/909)	--	1.0 D + 1.0 L (All Spans)

Member Length : 14' 1"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 13' 9".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Trimmer - SPF	3.50"	3.50"	1.50"	1232	378	1610	None
2 - Trimmer - SPF	3.50"	3.50"	1.50"	1564	1571	3135	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	14' 1" o/c	
Bottom Edge (Lu)	14' 1" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 14' 1"	N/A	16.0	--	
1 - Uniform (PLF)	0 to 14' 1"	N/A	144.0	-	Floor
2 - Point (lb)	11' 3"	N/A	542	1949	Linked from: Upper Header 4, Support 1

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

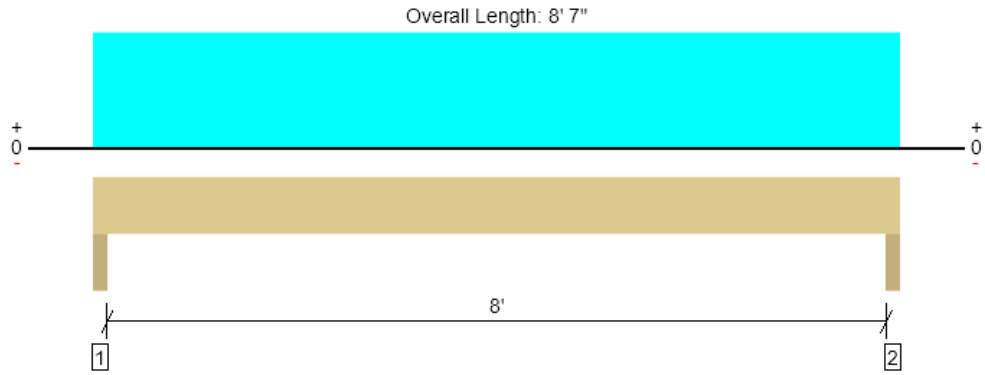
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

MEMBER REPORT

PASSED

Main, Main Header 3

1 piece(s) 5 1/2" x 9" 24F-V4 DF Glulam



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	5330 @ 2"	12513 (3.50")	Passed (43%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	4037 @ 1' 1/2"	8745	Passed (46%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	10567 @ 4' 3 1/2"	14850	Passed (71%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.131 @ 4' 3 1/2"	0.206	Passed (L/758)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.215 @ 4' 3 1/2"	0.412	Passed (L/460)	--	1.0 D + 1.0 L (All Spans)

Member Length : 8' 7"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 8' 3".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Trimmer - SPF	3.50"	3.50"	1.50"	2096	3235	5330	None
2 - Trimmer - SPF	3.50"	3.50"	1.50"	2096	3235	5330	None

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

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 8' 7"	N/A	12.0	--	
1 - Uniform (PLF)	0 to 8' 7"	N/A	288.0	-	Floor
2 - Uniform (PLF)	0 to 8' 7"	N/A	188.3	753.8	Linked from: Main Truss 3, Support 2

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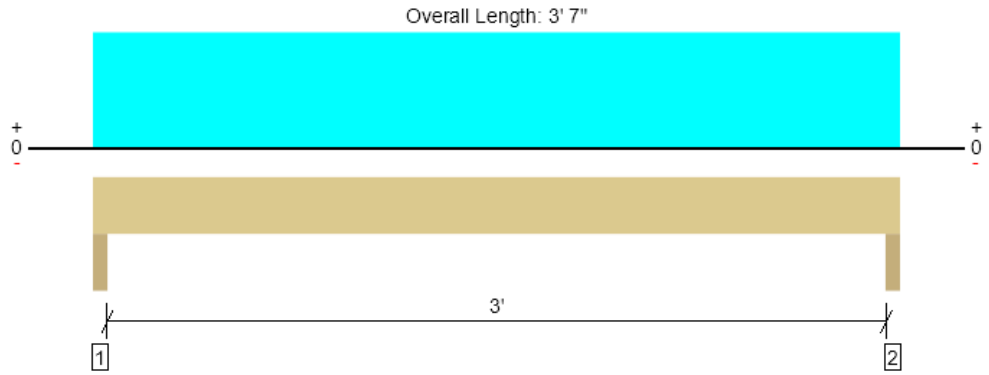
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

MEMBER REPORT

PASSED

Main, Main Header 5

2 piece(s) 2 x 6 DF No.2



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1822 @ 2"	6563 (3.50")	Passed (28%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1059 @ 9"	1980	Passed (53%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	1342 @ 1' 9 1/2"	1475	Passed (91%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.024 @ 1' 9 1/2"	0.081	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.038 @ 1' 9 1/2"	0.162	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)

Member Length : 3' 7"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Trimmer - SPF	3.50"	3.50"	1.50"	690	1131	1822	None
2 - Trimmer - SPF	3.50"	3.50"	1.50"	690	1131	1822	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	3' 7" o/c	
Bottom Edge (Lu)	3' 7" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 3' 7"	N/A	4.2	--	
1 - Uniform (PLF)	0 to 3' 7"	N/A	144.0	-	Floor
2 - Uniform (PLF)	0 to 3' 7"	N/A	140.3	373.5	Linked from: Main Truss 1, Support 2
3 - Uniform (PLF)	0 to 3' 7"	N/A	96.8	258.0	Linked from: Main Truss 2, Support 1

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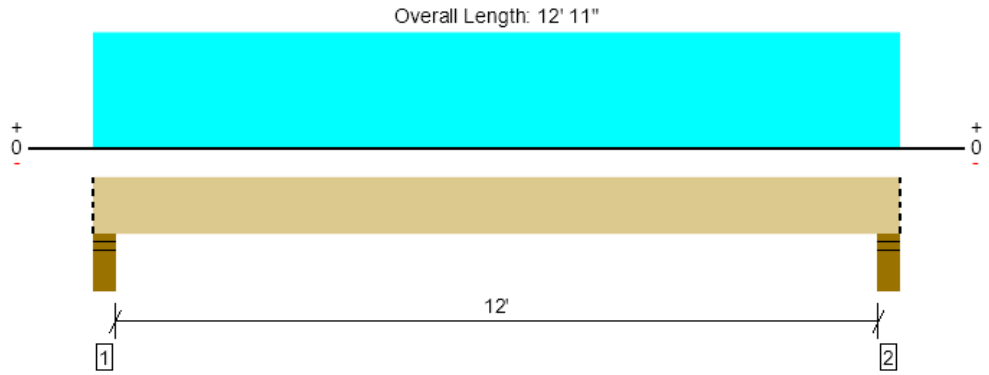
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Main, Main Header 6

1 piece(s) 5 1/4" x 14" 2.2E Parallam® PSL



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

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	7874 @ 4"	12272 (5.50")	Passed (64%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	5893 @ 1' 7 1/2"	14210	Passed (41%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	22870 @ 6' 5 1/2"	40743	Passed (56%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.201 @ 6' 5 1/2"	0.267	Passed (L/730)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.266 @ 6' 5 1/2"	0.267	Passed (L/552)	--	1.0 D + 1.0 L (All Spans)

Member Length : 12' 11"
System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/550) and TL (L/550).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - SPF	5.50"	5.50"	3.53"	1921	5953	7874	Blocking
2 - Stud wall - SPF	5.50"	5.50"	3.53"	1921	5953	7874	Blocking

- 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)	12' 11" o/c	
Bottom Edge (Lu)	12' 11" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 12' 11"	N/A	23.0	--	
1 - Uniform (PSF)	0 to 12' 11" (Back)	9' 6"	15.0	60.0	Deck
2 - Uniform (PLF)	0 to 12' 11" (Front)	N/A	132.0	351.8	Linked from: Main Truss 4, Support 2

- Side loads are assumed to not induce cross-grain tension.

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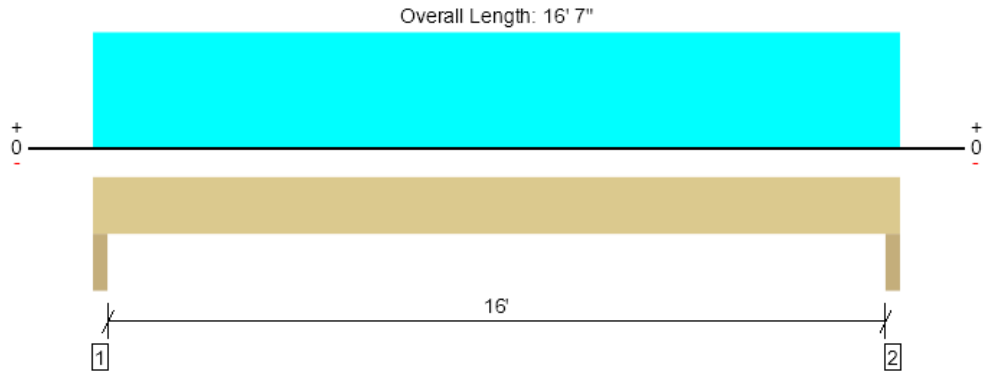
ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Main, Main Header 7

1 piece(s) 5 1/2" x 15" 24F-V4 DF Glulam



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Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	10365 @ 2"	12513 (3.50")	Passed (83%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	8438 @ 1' 6 1/2"	14575	Passed (58%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	41261 @ 8' 3 1/2"	41096	Passed (100%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.425 @ 8' 3 1/2"	0.542	Passed (L/459)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.704 @ 8' 3 1/2"	0.813	Passed (L/277)	--	1.0 D + 1.0 L (All Spans)

Member Length : 16' 7"
System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume/size factor of 1.00 that was calculated using length L = 16' 3".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Trimmer - SPF	3.50"	3.50"	2.90"	4115	6250	10365	None
2 - Trimmer - SPF	3.50"	3.50"	2.90"	4115	6250	10365	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	6" o/c	
Bottom Edge (Lu)	16' 7" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 16' 7"	N/A	20.0	--	
1 - Uniform (PLF)	0 to 16' 7"	N/A	288.0	-	Floor
2 - Uniform (PLF)	0 to 16' 7"	N/A	188.3	753.8	Linked from: Main Truss 3, Support 2

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ForteWEB Software Operator	Job Notes
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

FORTEWEB

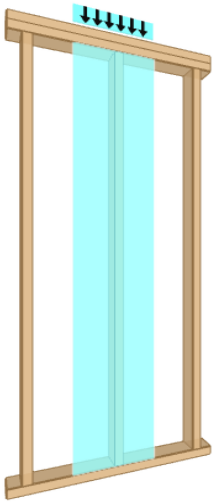
MEMBER REPORT

PASSED

Main, Main Wall 1

1 piece(s) 2 x 6 DF No.2 @ 16" OC

Wall Height: 12' Member Height: 11' 7 1/2" O. C. Spacing: 16.00"



Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	25	50	Passed (51%)	--	--
Compression (lbs)	2645	5304	Passed (50%)	1.00	1.0 D + 1.0 L
Plate Bearing (lbs)	2645	4383	Passed (60%)	--	1.0 D + 1.0 L
Lateral Reaction (lbs)	112	--	--	1.60	1.0 D + 0.6 W
Lateral Shear (lbs)	103	1584	Passed (7%)	1.60	1.0 D + 0.6 W
Lateral Moment (ft-lbs)	326 @ mid-span	1342	Passed (24%)	1.60	1.0 D + 0.6 W
Total Deflection (in)	0.17 @ mid-span	1.16	Passed (L/836)	--	1.0 D + 0.6 W
Bending/Compression	0.52	1	Passed (52%)	1.60	1.0 D + 0.45 W + 0.75 L + 0.75 S

- Lateral deflection criteria: Wind (L/120)
- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.
- A bearing area factor of 1.25 has been applied to base plate bearing capacity.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.

Supports	Type	Material
Top	Dbl 2X	Spruce-Pine-Fir
Base	2X	Spruce-Pine-Fir

System : Wall
Member Type : Stud
Building Code : IBC 2018
Design Methodology : ASD

Max Unbraced Length	Comments
1'	

Lateral Connections

Supports	Connector	Type/Model	Quantity	Connector Nailing
Top	Nails	8d (0.113" x 2 1/2") (Toe)	2	N/A
Base	Nails	8d (0.113" x 2 1/2") (Toe)	2	N/A

- Nailed connection at the top of the member is assumed to be nailed through the bottom 2x plate prior to placement of the top 2x of the double top plate assembly.

Vertical Loads	Spacing	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Point (PLF)	16.00"	288.0	-	-	-	
2 - Point (PLF)	16.00"	187.5	-	249.8	312.0	Linked from: Roof Truss 1, Support 2
3 - Point (PLF)	16.00"	154.5	411.8	-	-	Linked from: Upper Truss 3, Support 2
4 - Point (PLF)	16.00"	188.3	753.8	-	-	Linked from: Main Truss 3, Support 2

Lateral Load	Location	Spacing	Wind (1.60)	Comments
1 - Uniform (PSF)	Full Length	16.00"	24.1	

- ASCE/SEI 7 Sec. 30.4: Exposure Category (B), Mean Roof Height (33'), Topographic Factor (1.0), Wind Directionality Factor (0.85), Basic Wind Speed (115), Risk Category(II), Wind Zone (4), GCpi (+/- 0.18), Effective Wind Area determined using full member span and trib. width.
- IBC Table 1604.3, footnote f: Deflection checks are performed using 42% of this lateral wind load.

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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
Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

NKH Engineering

Weyerhaeuser

2/11/2025 7:28:20 PM UTC
ForteWEB v3.8, Engine: V8.4.1.24, Data: V8.1.6.3
File Name: 22-112 3804 House

FORTEWEB

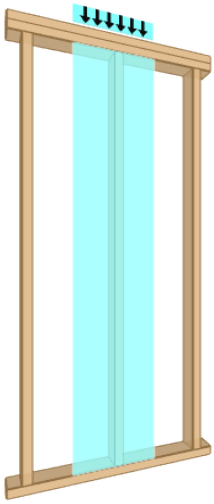
MEMBER REPORT

PASSED

Main, Main Wall 2

1 piece(s) 2 x 6 DF No.2 @ 16" OC

Wall Height: 12' Member Height: 11' 7 1/2" O. C. Spacing: 16.00"



Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	25	50	Passed (51%)	--	--
Compression (lbs)	3066	5304	Passed (58%)	1.00	1.0 D + 1.0 L
Plate Bearing (lbs)	3082	4383	Passed (70%)	--	1.0 D + 0.75 L + 0.75 S
Lateral Reaction (lbs)	112	--	--	1.60	1.0 D + 0.6 W
Lateral Shear (lbs)	103	1584	Passed (7%)	1.60	1.0 D + 0.6 W
Lateral Moment (ft-lbs)	326 @ mid-span	1342	Passed (24%)	1.60	1.0 D + 0.6 W
Total Deflection (in)	0.17 @ mid-span	1.16	Passed (L/836)	--	1.0 D + 0.6 W
Bending/Compression	0.66	1	Passed (66%)	1.60	1.0 D + 0.45 W + 0.75 L + 0.75 S

- Lateral deflection criteria: Wind (L/120)
- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.
- A bearing area factor of 1.25 has been applied to base plate bearing capacity.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.

Supports	Type	Material
Top	Dbl 2X	Spruce-Pine-Fir
Base	2X	Spruce-Pine-Fir

System : Wall
Member Type : Stud
Building Code : IBC 2018
Design Methodology : ASD

Max Unbraced Length	Comments
1'	

Lateral Connections

Supports	Connector	Type/Model	Quantity	Connector Nailing
Top	Nails	8d (0.113" x 2 1/2") (Toe)	2	N/A
Base	Nails	8d (0.113" x 2 1/2") (Toe)	2	N/A

- Nailed connection at the top of the member is assumed to be nailed through the bottom 2x plate prior to placement of the top 2x of the double top plate assembly.

Vertical Loads	Spacing	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Point (PLF)	16.00"	288.0	-	-	-	
2 - Point (PLF)	16.00"	164.3	-	219.0	273.8	Linked from: Roof Truss 1, Support 1
3 - Point (PLF)	16.00"	92.3	-	134.3	168.0	Linked from: Roof Truss 3, Support 2
4 - Point (PLF)	16.00"	100.5	268.5	-	-	Linked from: Upper Truss 1, Support 1
5 - Point (PLF)	16.00"	141.0	376.5	-	-	Linked from: Upper Truss 2, Support 2
6 - Point (PLF)	16.00"	140.3	373.5	-	-	Linked from: Main Truss 1, Support 2
7 - Point (PLF)	16.00"	96.8	258.0	-	-	Linked from: Main Truss 2, Support 1

Lateral Load	Location	Spacing	Wind (1.60)	Comments
1 - Uniform (PSF)	Full Length	16.00"	24.1	

- ASCE/SEI 7 Sec. 30.4: Exposure Category (B), Mean Roof Height (33'), Topographic Factor (1.0), Wind Directionality Factor (0.85), Basic Wind Speed (115), Risk Category(II), Wind Zone (4), GCpi (+/- 0.18), Effective Wind Area determined using full member span and trib. width.
- IBC Table 1604.3, footnote f: Deflection checks are performed using 42% of this lateral wind load.

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Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

NKH Engineering

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File Name: 22-112 3804 House

MEMBER REPORT

PASSED

Main, Main Post 1

1 piece(s) 6 x 6 DF No.2

Post Height: 9'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	20	50	Passed (39%)	--	--
Compression (lbs)	15654	16909	Passed (93%)	1.00	1.0 D + 1.0 L
Base Bearing (lbs)	15857	898425	Passed (2%)	--	1.0 D + 0.75 L + 0.75 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Loads	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Point (lb)	3364	3281	333	417	Linked from: Main Beam 1, Support 1
2 - Point (lb)	3580	5429	-	2757	Linked from: Main Beam 1 Revised, Support 2

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Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

Main, Main Post 2

1 piece(s) 5 1/4" x 5 1/4" 1.8E Parallam® PSL

Post Height: 9'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	21	50	Passed (41%)	--	--
Compression (lbs)	26511	43634	Passed (61%)	1.15	1.0 D + 0.75 L + 0.75 S
Base Bearing (lbs)	26511	818606	Passed (3%)	--	1.0 D + 0.75 L + 0.75 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Point (lb)	11316	13561	5361	6699	Linked from: Main Beam 2, Support 1

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Nabil Kausal-Hayes NKH Engineering (206) 601-9728 nabil@nkhengineering.com	

FORTEWEB

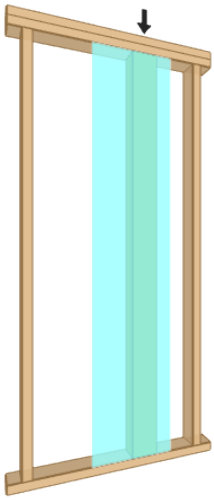
MEMBER REPORT

FAILED

Main, Main Post 3

1 piece(s) 3 1/2" x 7" 1.8E Parallam® PSL

Wall Height: 8' Member Height: 7' 7 1/2" Tributary Width: 1'



Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	11	50	Passed (22%)	--	--
Compression (lbs)	20906	57626	Passed (36%)	1.00	1.0 D + 1.0 L
Plate Bearing (lbs)	21000	15313	Failed (137%)	--	1.0 D + 0.75 L + 0.75 S
Lateral Reaction (lbs)	58	--	--	1.60	1.0 D + 0.6 W
Lateral Shear (lbs)	49	6011	Passed (1%)	1.60	1.0 D + 0.6 W
Lateral Moment (ft-lbs)	111 @ mid-span	10086	Passed (1%)	1.60	1.0 D + 0.6 W
Total Deflection (in)	0.08 @ mid-span	0.76	Passed (L/1192)	--	1.0 D + 0.45 W + 0.75 L + 0.75 S
Bending/Compression	0.52	1	Passed (52%)	1.00	1.0 D + 1.0 L

- Lateral deflection criteria: Wind (L/120)
- Input axial load eccentricity for this design is 16.67% of applicable member side dimension.
- Applicable calculations are based on NDS.
- Bearing shall be on a metal plate or strap, or on other equivalently durable, rigid, homogeneous material with sufficient stiffness to distribute applied load.

Supports	Type	Material
Top	Dbl 2X	Douglas Fir-Larch
Base	2X	Douglas Fir-Larch

System : Wall
Member Type : Column
Building Code : IBC 2018
Design Methodology : ASD

Max Unbraced Length	Comments
1'	

Lateral Connections

Supports	Connector	Type/Model	Quantity	Connector Nailing
Top	Nails	8d (0.113" x 2 1/2") (Toe)	2	N/A
Base	Nails	8d (0.113" x 2 1/2") (Toe)	2	N/A

- Nailed connection at the top of the member is assumed to be nailed through the bottom 2x plate prior to placement of the top 2x of the double top plate assembly.

Vertical Loads	Tributary Width	Dead (0.90)	Floor Live (1.00)	Roof Live (1.25)	Snow (1.15)	Comments
1 - Point (lb)	N/A	561	1466	-	-	Linked from: Main Beam 3, Support 1
2 - Point (lb)	N/A	8088	10791	3370	4211	Linked from: Main Beam 2, Support 2

Lateral Load	Location	Tributary Width	Wind (1.60)	Comments
1 - Uniform (PSF)	Full Length	1'	25.5	

- ASCE/SEI 7 Sec. 30.4: Exposure Category (B), Mean Roof Height (33'), Topographic Factor (1.0), Wind Directionality Factor (0.85), Basic Wind Speed (115), Risk Category(II), Wind Zone (4), GCpi (+/- 0.18), Effective Wind Area determined using full member span and trib. width.
- IBC Table 1604.3, footnote f: Deflection checks are performed using 42% of this lateral wind load.

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File Name: 22-112 3804 House

FOUNDATION DESIGN FOR PROPERTY LOCATED AT 3804 Mercer Way Mercer Island WA 98040

Basis of Design

This document is showing the detail of design and calculations of foundation for gravity loads according to IRC 2018, IBC 2018, ASCE7-16, and ACI 318-14.

The load distribution is as follow:
Floor Dead Load ---------- 15 psf
Roof Dead Load----------15 psf
Floor Live Load----------40 psf
Roof Live Load----------20 psf
Roof Snow Load----------25 psf
Deck Live Load----------60 psf
Deck Dead Load----------15 psf

The maximum bearing pressure on soil was considered at least 1500 psf . Concrete strength is assumed to be at least 2500 psi

Material Properties for Design

$f'_c := 2500psi$ Concrete compressive strength

$f_y := 60 \cdot ksi$ Yield strength of rebar

$f_{soil.bearing} := 1500psf$ Minimum soil bearing capacity

$\gamma_{concrete} := 150pcf$ Concrete unit weight

$\gamma_{steel} := 490pcf$ Steel unit weight

$E_s := 29000ksi$ Young modulus of steel

$E_c := 57000 \cdot \sqrt{\frac{f'_c}{psi}} \cdot psi = 2.85 \times 10^3 \cdot ksi$ Young modulus of concrete (ACI-318-14)

Load Assumptions

$LL_{floor} := 40psf$ Floor live load

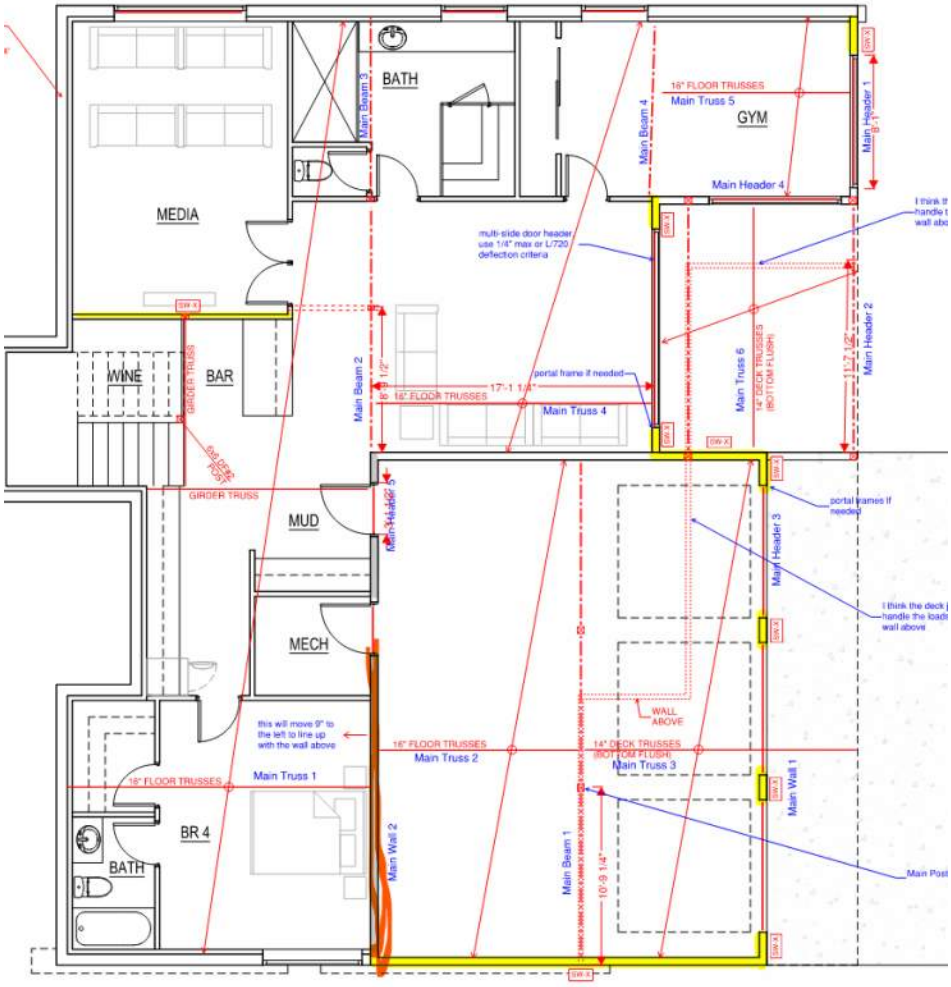
$DL_{floor} := 15psf$ Floor dead load

$DL_{roof} := 15psf$ Roof dead load

$LL_{roof} := 20psf$ Roof live load

$SL_{roof} := 25psf$ Roof snow load

Check Bearing Capacity of Foundation



$F_{wall} := 3048 \frac{lbf}{16in}$ Axial load on wall per stud-from ForteWeb

$W_{found} := 20in$ Foundation size

$d_f := 10in$ Thickness of foundation

$\frac{F_{wall} + W_{found} \cdot d_f \cdot \gamma_{concrete}}{W_{found}} = 1.497 \times 10^3 \cdot psf$ OK less than 1500 psf

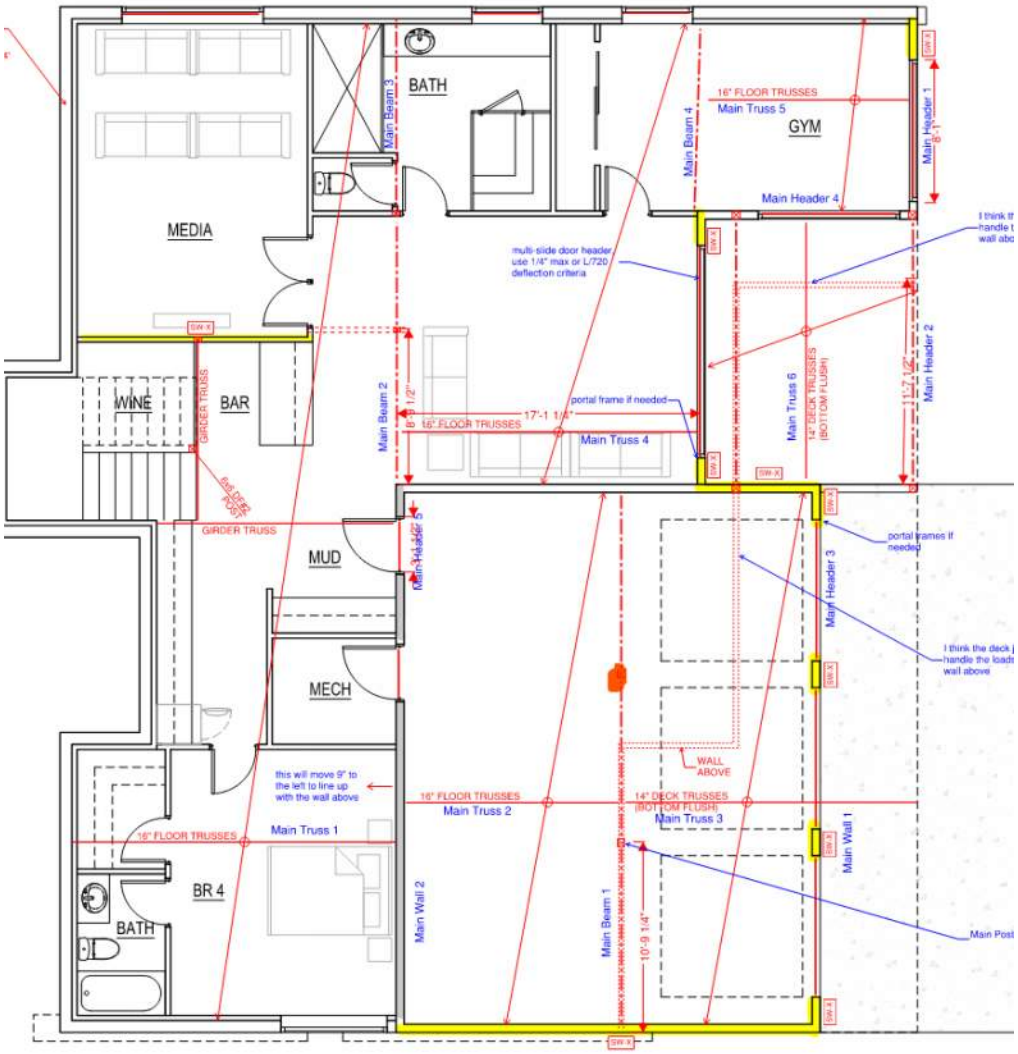
Check the one way shear:

$V_f := 1.6 \cdot \frac{F_{wall}}{W_{found}} \cdot \left(\frac{W_{found}}{2}\right) = 1.829 \times 10^3 \cdot plf$

$\phi V_c := 0.75 \cdot 2 \cdot \sqrt{\frac{f'_c}{psi}} \cdot (d_f - 3in) \cdot psi = 6.3 \times 10^3 \cdot plf$

$\frac{V_f}{\phi V_c} = 0.29$ Less than 1.0 OK

$\frac{0.0018 \cdot W_{found} \cdot d_f}{0.2in^2} = 1.8$ Use 2#4 rebar



$F_f := 15821\text{lbf}$ Load from FortWeb

$W_{found} := 3.5\text{ft}$

$D_{found} := 3.5\text{ft}$ Foundation size

$d_f := 10\text{in}$

$$\frac{F_f + W_{found} \cdot D_{found} \cdot d_f \cdot \gamma_{concrete}}{W_{found} \cdot D_{found}} = 1.417 \times 10^3 \cdot \text{psf}$$

OK less than 1500 psf

Check the Punching Shear:

$$\phi V_c := 0.75 \cdot 4 \cdot \sqrt{\frac{f'_c}{psi}} \cdot \left(5.5in + \frac{d_f - 3in}{2} + 5.5in + \frac{d_f - 3in}{2}\right) \cdot 2 \cdot (d_f - 3in) \cdot psi = 3.78 \times 10^4 \cdot lbf$$

$$\frac{F_f \cdot 1.6}{\phi V_c} = 0.67$$

Less than 1.0 ok to use 10" thick foundation (1.6 here is load factor)

Check the one way shear:

$$V_f := 1.5 \cdot \frac{F_f}{W_{found}} \cdot \left(\frac{D_{found}}{2}\right) = 1.187 \times 10^4 \cdot lbf$$

$$\phi V_c := 0.75 \cdot 2 \cdot \sqrt{\frac{f'_c}{psi}} \cdot W_{found} \cdot (d_f - 3in) \cdot psi = 2.205 \times 10^4 \cdot lbf$$

$$\frac{V_f}{\phi V_c} = 0.538$$

Less than 1.0 OK

$$\frac{0.0018 \cdot W_{found} \cdot d_f}{0.2in^2} = 3.78$$

Use 4#4 rebar

$$M_f := V_f \cdot \frac{D_{found}}{4} = 1.038 \times 10^4 \cdot lbf \cdot ft$$

$$\phi M_n := 4 \cdot 0.2in^2 \cdot f_y \cdot (d_f - 3in) \cdot 0.9 \cdot 0.9 = 2.268 \times 10^4 \cdot lbf \cdot ft$$

$$\frac{M_f}{\phi M_n} = 0.458$$

Design of 10 ft Retaining Wall

$t_{wall} := 8in$ Thickness of wall

$t_{foun} := 10in$ Thickness of foundation

$L_{toe} := 1ft + 10in = 1.833 \cdot ft$ Total foundation length

$h_{key} := 0ft$ Height of key

$t_{key} := 0in$ Thickness of key

$L_{heel} := 1ft + 6in$ Heel length

$t_{gr_slab} := 4in$ Thickness of slab on grade on top of wall foundation

$h_{wall} := 10ft$ Height of the wall

$I := \frac{1}{12} \cdot \left(L_{toe} + L_{heel} + t_{wall}\right)^3 = 5.333 \cdot \frac{ft^4}{ft}$ Moment inertia of wall base

$f'_c := 2500psi$ Concrete compressive strength

$f_y := 60ksi$ Steel yield strength

$E_s := 29000ksi$ Steel young modulus

$\gamma_c := 150pcf$ Concrete unit weight

$p_a := 40pcf$ Active soil pressure

$p_o := 55pcf$ At-rest soil pressure

$\Delta p_{eq} := 8\left(\frac{h_{wall}}{ft}\right) \cdot psf = 80 \cdot psf$ Seismic soil pressure

$p_p := 200pcf$ Passive pressure

$PGA := 0.607$

$\mu := 0.35$ Soil friction factor from IBC 2018

$\phi := \frac{3}{2} \cdot atan(\mu) = 28.935 \cdot deg$ Equivalent friction angle

$K_a := \frac{1 - sin(\phi)}{1 + sin(\phi)} = 0.348$ Active pressure coefficient

$K_o := 1 - sin(\phi) = 0.516$ At-Rest pressure coefficient

$\gamma_{soil} := \frac{p_a}{K_a} = 114.984 \cdot pcf$ Soil unit weight

Vertical weight on wall

$P_{d_wall} := (h_{wall} - t_{foun}) \cdot t_{wall} \cdot \gamma_c = 916.667 \cdot plf$

$P_{d_found} := (L_{toe} + t_{wall} + L_{heel}) \cdot t_{foun} \cdot \gamma_c = 500 \cdot plf$ Concrete weight of foundation

$P_{d_key} := (h_{key} - t_{foun}) \cdot t_{key} \cdot \gamma_c = 0 \cdot plf$ Concrete weight of key

$P_{d_slab} := t_{gr_slab} \cdot (44ft) \cdot \gamma_c + 5psf \cdot 44ft + 0.6\left(3919 \frac{lbf}{16in} + 2092 \frac{lbf}{16in} + 1507 \frac{lbf}{16in}\right) = 5.803 \times 10^3 \cdot p$

Concrete weight of slab and dead load on grade

$P_{slab.on.found} := t_{gr_slab} \cdot \gamma_c \cdot L_{toe} = 91.667 \cdot plf$ Weight of concrete slab on wall foundation

Live load on slab

$P_{ll} := 0psf \cdot (L_{toe}) = 0 \cdot plf$

Surcharge pressure on wall due to slab on grade

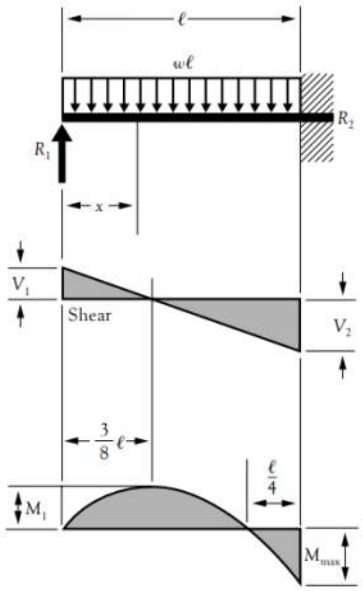
$P_{d_.surch} := 0 \cdot t_{gr_slab} \cdot \gamma_c \cdot K_a = 0 \cdot psf$

Surcharge pressure on wall due to live load on patio

$P_{ll_.surch} := 60psf \cdot K_a = 20.872 \cdot psf$

Check Sliding Capacity for Dead Load

Lateral earth force from active pressure



$$R_1 = V_1 \quad \ldots\ldots\ldots\ldots\ldots \quad = \frac{3w\ell}{8}$$

$$R_2 = V_2 \quad \ldots\ldots\ldots\ldots\ldots \quad = \frac{5w\ell}{8}$$

$$V_x \quad \ldots\ldots\ldots\ldots\ldots \quad = R_1 - wx$$

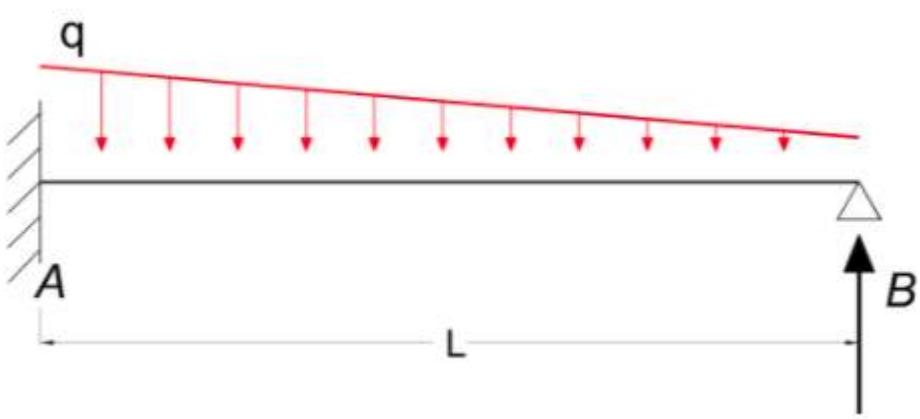
$$M_{max} \quad \ldots\ldots\ldots\ldots\ldots \quad = \frac{w\ell^2}{8}$$

$$M_1 \left(\text{at } x = \frac{3}{8}\ \ell\right) \quad \ldots\ldots\ldots\ldots \quad = \frac{9}{128} w\ell^2$$

$$M_x \quad \ldots\ldots\ldots\ldots\ldots \quad = R_1 x - \frac{wx^2}{2}$$

$$\Delta_{max} \left(\text{at } x = \frac{\ell}{16}(1 + \sqrt{33}) = .4215\,\ell\right) \quad . \quad = \frac{w\ell^4}{185EI}$$

$$\Delta_x \quad \ldots\ldots\ldots\ldots\ldots \quad = \frac{wx}{48EI}(\ell^3 - 3\ell x^2 + 2x^3)$$



Bending Moment

$M_A = - q\ L^2 / 15$ (3a)

where

M_A = *moment at the fixed end (Nm, lb_f ft)*

q = *continuous declining load (N/m, lb_f/ft)*

$M_1 = q\ L^2 / 33.6$ (3b)

where

M_1 = *maximum moment at x = 0.553 L (Nm, lb_f ft)*

Deflection

$\delta_{max} = q\ L^4 / (419\ E\ I)$ (3c)

where

δ_{max} = *max deflection at x = 0.553 L (m, ft)*

$\delta_{1/2} = q\ L^4 / (427\ E\ I)$ (3d)

where

$\delta_{1/2}$ = *deflection at x = L / 2 (m, ft)*

Support Reactions

$R_A = 2\ q\ L / 5$ (3e)

$R_B = q\ L / 10$ (3f)

$$F_d := \frac{2}{5} \cdot p_o \cdot \left(h_{wall} - t_{gr_slab}\right)^2 + 5 \cdot \frac{P_{d_.surch} \cdot \left(h_{wall} - t_{gr_slab}\right)}{8} = 2.056 \times 10^3 \cdot plf$$

Resisting force

$$F_{res} := P_{d_wall} + P_{d_found} + P_{d_key} + P_{d_slab} \ldots + L_{heel} \cdot \gamma_{soil} \cdot \left(h_{wall} - t_{gr_slab} - t_{foun}\right) = 8.743 \times 10^3 \cdot plf$$

$$\frac{F_{res} \cdot \mu}{F_d} = 1.5$$

It is more than or equal 1.5

Check Sliding Capacity for Seismic Load

Lateral earth force from active pressure

$$F_d := \frac{2}{5} \cdot p_a \cdot \left(h_{wall} - t_{gr_slab}\right)^2 + \frac{5}{8} \cdot P_{d_.surch} \cdot \left(h_{wall} - t_{gr_slab}\right) \ldots + \frac{\frac{5}{8} \cdot \Delta p_{eq} \cdot \left(h_{wall} - t_{gr_slab}\right) + \left(\frac{P_{d_wall}}{2} + P_{d_found} + P_{d_key}\right) \cdot PGA \cdot \frac{1}{2}}{1.4} = 2.048 \times 10^3 \cdot plf$$

Resisting Force

$$F_{res} := P_{d_wall} + P_{d_found} + P_{d_key} + P_{d_slab} \ldots + L_{heel} \cdot \gamma_{soil} \cdot \left(h_{wall} - t_{gr_slab} - t_{foun}\right) = 8.743 \times 10^3 \cdot plf$$

$$\frac{0.9 F_{res} \cdot \mu + \frac{1}{2} p_p \cdot \left(h_{key}\right)^2}{F_d} = 1.345$$

It is more than 1.0

Check Overturning Capacity for Dead Load

Lateral moment about toe due to soil pressure

$$M_d := \frac{1}{15}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab}\right)^3 + \frac{2}{5}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab}\right)^2\cdot\left(h_{key}\right) \cdots + \frac{P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8} + \frac{5}{8}\cdot P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab}\right)\cdot h_{key} = 3.312\cdot\frac{kip\cdot ft}{ft}$$

Resisting moment

$$M_{res} := P_{d_wall}\cdot\left(L_{toe} + \frac{t_{wall}}{2}\right) + P_{d_found}\cdot\left(\frac{L_{toe} + t_{wall} + L_{heel}}{2}\right) \cdots + P_{d_key}\cdot\frac{t_{key}}{2} + P_{slab.on.found}\cdot\frac{L_{toe}}{2} \cdots + L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)\cdot\left(\frac{L_{heel}}{2} + t_{wall} + L_{toe}\right) = 8.022\cdot\frac{kip\cdot ft}{ft}$$

$$\frac{M_{res}}{M_d} = 2.422$$

It is more than 1.5

Check Overturning Capacity for Seismic Load

Lateral moment about toe due to soil pressure

$$M_d := \frac{1}{15}\cdot p_a\cdot\left(h_{wall} - t_{gr_slab}\right)^3 + \frac{2}{5}\cdot p_a\cdot\left(h_{wall} - t_{gr_slab}\right)^2\cdot\left(h_{key}\right) \cdots + \frac{P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8} + \frac{5}{8}\cdot P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab}\right)\cdot h_{key} \cdots \frac{\Delta p_{eq}\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8} + \frac{5}{8}\cdot\Delta p_{eq}\cdot\left(h_{wall} - t_{gr_slab}\right)\cdot h_{key} \cdots + \frac{\left[\frac{P_{d_wall}}{2}\cdot\left(\frac{h_{wall}}{2} - t_{foun}\right) + P_{d_found}\cdot\frac{t_{foun}}{2} + P_{d_key}\cdot\frac{h_{key}}{2}\right]\cdot PGA\cdot\frac{1}{2}}{1.4}$$

$$M_d = 3.535\cdot\frac{kip\cdot ft}{ft}$$

Resisting moment

$$M_{res} := P_{d_wall}\cdot\left(L_{toe} + \frac{t_{wall}}{2}\right) + P_{d_found}\cdot\left(\frac{L_{toe} + t_{wall} + L_{heel}}{2}\right) \ldots \quad = 8.022\cdot\frac{kip\cdot ft}{ft}$$
$$+ P_{d_key}\cdot\frac{t_{key}}{2} + P_{slab.on.found}\cdot\frac{L_{toe}}{2} \ldots$$
$$+ L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)\cdot\left(\frac{L_{heel}}{2} + t_{wall} + L_{toe}\right)$$

$$\frac{0.9\cdot M_{res}}{M_d} = 2.042$$

It is more than 1.1

Check Overturning Capacity for Dead and Live Load

Lateral moment about toe due to soil pressure

$$M_d := \frac{1}{15}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab}\right)^3 + \frac{2}{5}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab}\right)^2\cdot\left(h_{key}\right) \ldots$$
$$+ \frac{\left(P_{d_.surch} + P_{ll_.surch}\right)\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8} \ldots$$
$$+ \frac{5}{8}\cdot\left(P_{d_.surch} + P_{ll_.surch}\right)\cdot\left(h_{wall} - t_{gr_slab}\right)\cdot h_{key}$$

$$M_d = 3.556\cdot\frac{kip\cdot ft}{ft}$$

Resisting moment

$$M_{res} := P_{d_wall}\cdot\left(L_{toe} + \frac{t_{wall}}{2}\right) + P_{d_found}\cdot\left(\frac{L_{toe} + t_{wall} + L_{heel}}{2}\right) \ldots \quad = 8.022\cdot\frac{kip\cdot ft}{ft}$$
$$+ P_{d_key}\cdot\frac{t_{key}}{2} + P_{slab.on.found}\cdot\frac{L_{toe}}{2} \ldots$$
$$+ L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)\cdot\left(\frac{L_{heel}}{2} + t_{wall} + L_{toe}\right)$$

$$\frac{M_{res} + \frac{1}{4}p_p\cdot\left(h_{key} + t_{foun} - 4in\right)^3}{M_d} = 2.258$$

It is more than 1.0

Check Soil Bearing Pressure for DL+LL

$$M_d := \frac{1}{15}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab}\right)^3 \ldots + \frac{\left(P_{d_.surch} + P_{ll_.surch}\right)\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8}$$

$$M_{res} := P_{d_wall}\cdot\left(L_{toe} + \frac{t_{wall}}{2}\right) + P_{d_found}\cdot\left(\frac{L_{toe} + t_{wall} + L_{heel}}{2}\right) \ldots + P_{d_key}\cdot\frac{t_{key}}{2} + P_{slab.on.found}\cdot\frac{L_{toe}}{2} \ldots + L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)\cdot\left(\frac{L_{heel}}{2} + t_{wall} + L_{toe}\right) = 8.022\cdot\frac{kip\cdot ft}{ft}$$

$$L_{base} := L_{toe} + t_{wall} + L_{heel}$$

$$P := P_{d_wall} + P_{d_found} + P_{d_key} + L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)$$

$$\left|\frac{M_{res} - M_d}{P} - \frac{\left(L_{toe} + t_{wall} + L_{heel}\right)}{2}\right| = 0.481\cdot ft$$

Eccentricity

$$\frac{L_{base}}{6} = 0.667\cdot ft$$

Eccentricity is within 1/3 of base so base is always in compression

$$\sigma_{toe} := \frac{P_{d_wall} + P_{d_found} + P_{d_key} + L_{heel} \cdot \gamma_{soil} \cdot (h_{wall} - t_{gr_slab} - t_{foun})}{L_{toe} + t_{wall} + L_{heel}} \ldots$$
$$+ \frac{M_d \cdot 0.5 \cdot L_{base}}{I} - \frac{P_{d_wall} \cdot \left(\frac{L_{base}}{2} - t_{wall} - L_{heel}\right) \cdot 0.5 L_{base}}{I} \ldots$$
$$+ \frac{P_{d_key} \cdot \left(\frac{L_{base}}{2} - \frac{t_{key}}{2}\right) \cdot (0.5 L_{base})}{I} + \frac{P_{slab.on.found} \cdot \left(\frac{L_{base}}{2} - \frac{L_{toe}}{2}\right) \cdot (0.5 L_{base})}{I} \ldots$$
$$+ \frac{-L_{heel} \cdot \gamma_{soil} \cdot (h_{wall} - t_{gr_slab} - t_{foun}) \cdot \left(\frac{L_{base}}{2} - \frac{L_{heel}}{2}\right) \cdot .5 L_{base}}{I}$$

$\sigma_{toe} = 1.449 \times 10^3 \cdot psf$ Less than 1500 psf OK

$$\sigma_{heel} := \frac{P_{d_wall} + P_{d_found} + P_{d_key} + L_{heel} \cdot \gamma_{soil} \cdot (h_{wall} - t_{gr_slab} - t_{foun})}{L_{toe} + t_{wall} + L_{heel}} \ldots$$
$$+ \frac{-M_d \cdot 0.5 \cdot L_{base}}{I} - \frac{-P_{d_wall} \cdot \left(\frac{L_{base}}{2} - t_{wall} - L_{heel}\right) \cdot 0.5 L_{base}}{I} \ldots$$
$$+ \frac{-P_{d_key} \cdot \left(\frac{L_{base}}{2} - \frac{t_{key}}{2}\right) \cdot (0.5 L_{base})}{I} - \frac{P_{slab.on.found} \cdot \left(\frac{L_{base}}{2} - \frac{L_{toe}}{2}\right) \cdot (0.5 L_{base})}{I} ..$$
$$+ \frac{L_{heel} \cdot \gamma_{soil} \cdot (h_{wall} - t_{gr_slab} - t_{foun}) \cdot \left(\frac{L_{base}}{2} - \frac{L_{heel}}{2}\right) \cdot .5 L_{base}}{I}$$

$\sigma_{heel} = 21.222 \cdot psf$ Less than 1500 psf OK

Check Soil Bearing Pressure for Seismic

$$M_d := \frac{1}{15}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab}\right)^3 + \frac{2}{5}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab}\right)^2\cdot\left(h_{key}\right) \cdots$$
$$+ \frac{P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8} + \frac{5}{8}\cdot P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab}\right)\cdot h_{key} \cdots$$
$$\frac{\Delta p_{eq}\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8} + \frac{5}{8}\cdot\Delta p_{eq}\cdot\left(h_{wall} - t_{gr_slab}\right)\cdot h_{key} \cdots$$
$$+ \frac{+\left[\frac{P_{d_wall}}{2}\cdot\left(\frac{h_{wall}}{2} - t_{foun}\right) + P_{d_found}\cdot\frac{t_{foun}}{2} + P_{d_key}\cdot\frac{h_{key}}{2}\right]\cdot PGA\cdot\frac{1}{2}}{1.4}$$

$$M_d = 4.439\cdot\frac{kip\cdot ft}{ft}$$

Resisting moment

$$M_{res} := P_{d_wall}\cdot\left(L_{toe} + \frac{t_{wall}}{2}\right) + P_{d_found}\cdot\left(\frac{L_{toe} + t_{wall} + L_{heel}}{2}\right) \cdots \quad = 8.022\cdot\frac{kip\cdot ft}{ft}$$
$$+ P_{d_key}\cdot\frac{t_{key}}{2} + P_{slab.on.found}\cdot\frac{L_{toe}}{2} \cdots$$
$$+ L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)\cdot\left(\frac{L_{heel}}{2} + t_{wall} + L_{toe}\right)$$

$$P := P_{d_wall} + P_{d_found} + P_{d_key} + P_{d_slab} + L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)$$

$$e_{cc} := \left|\frac{0.9\cdot M_{res} + \frac{1}{4}p_p\cdot\left(h_{key} + t_{foun} - 1ft\right)^3 - M_d}{P} - \frac{L_{base}}{2}\right| = 1.682\cdot ft$$ Eccentricity

$$\frac{L_{base}}{2} = 2\cdot ft$$ The resultant is within base

Moment about centroid of foundation

$$M_{center} := M_d - P_{d_wall}\cdot\left(\frac{L_{base}}{2} - t_{wall} - L_{heel}\right) + P_{d_key}\cdot\left(\frac{L_{base}}{2} - \frac{t_{key}}{2}\right) \ldots$$
$$+ P_{slab.on.found}\cdot\left(\frac{L_{base}}{2} - \frac{L_{toe}}{2}\right) - L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)\cdot\left(\frac{L_{base}}{2} - \frac{L_{heel}}{2}\right)$$

$$M_{center} = 2.786\cdot\frac{kip\cdot ft}{ft}$$

Axial load on center of foundation

$$P_{center} := P_{d_wall} + P_{d_found} + P_{d_key} + P_{slab.on.found} + L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)$$

$$P_{center} = 3.032\cdot\frac{kip}{ft}$$

$\sigma_{toe} = 1.87 \times 10^3\cdot psf$

Maximum bearing pressure on soil due to seismic is less than 1.3x1500= 1950 psf per IBC OK

Check for Shear and Moment Capacity

Wall Shear and Moment Capacity

$A_{s.min.wall} := 0.0018 \cdot t_{wall} \cdot 12in = 0.173 \cdot in^2$ Provide at least #4@12

Shear Capacity ACI-318

$\phi V_c := 0.75 \cdot 2 \cdot \sqrt{\frac{|f'_c|}{psi}} \cdot psi \cdot (t_{wall} - 3in) = 4.5 \cdot \frac{kip}{ft}$ Shear Capacity

$\phi M_{cap_base} := 0.9 \cdot f_y \cdot 0.2 \frac{in^2}{ft} \cdot \frac{12}{8} \cdot \left(0.9 \cdot \frac{t_{wall}}{2}\right) = 4.86 \cdot \frac{kip \cdot ft}{ft}$ Moment capacity of wall at the base #4@8"

$\phi M_{cap_mid} := 0.9 \cdot f_y \cdot 0.2 \frac{in^2}{ft} \cdot \frac{12}{8} \cdot \left(0.9 \cdot \frac{t_{wall}}{2}\right) = 4.86 \cdot \frac{kip \cdot ft}{ft}$ Moment capacity of wall at the middle #4@12"

$\phi V_c = 4.5 \cdot \frac{kip}{ft}$ Shear capacity of wall

Calculate Demand on Base of Wall (1.4DL+1.6LL+1.6EH)

$$M := 1.6 \frac{1}{15} \cdot p_o \cdot (h_{wall} - t_{gr_slab} - t_{foun})^3 \ldots + \frac{(1.2 \cdot P_{d_.surch} + 1.6 \cdot P_{ll_.surch}) \cdot (h_{wall} - t_{gr_slab} - t_{foun})^2}{8} = 4.369 \cdot kip \cdot \frac{ft}{ft}$$

$M = 4.369 \cdot kip$

$\frac{M}{\phi M_{cap_base}} = 89.903 \cdot \%$ Moment capacity is more than demand moment on wall-OK

$$V := 1.6\frac{2}{5}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab} - t_{foun} - t_{wall}\right)^2 \ldots$$
$$+\frac{5}{8}\cdot\left(1.2\cdot P_{d_.surch} + 1.6\cdot P_{ll_.surch}\right)\cdot\left(h_{wall} - t_{gr_slab} - t_{foun} - t_{wall}\right)$$

$$V = 2.518\cdot\frac{kip}{ft}$$

$$\frac{V}{\phi V_c} = 55.958\cdot\%$$

Shear capacity is more than demand moment on wall-OK

Calculate Demand on Base Wall (1.2DL+1.0LL+1.6EH+1.0EQ)

$$M := 1.6\frac{1}{15}\cdot p_a\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)^3 \ldots$$
$$+\frac{1.2\cdot P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)^2}{8} \ldots$$
$$+\frac{\Delta p_{eq}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)^2}{8} \ldots$$
$$+\left[\frac{1.2P_{d_wall}}{2}\cdot\left(\frac{h_{wall}}{2} - t_{foun}\right)\right]\cdot\frac{PGA}{2}$$

$$M = 4.417\cdot kip$$

$$\frac{M}{\phi M_{cap_base}} = 90.876\cdot\%$$

OK

$$V := 1.6\frac{2}{5}\cdot p_a\cdot\left(h_{wall} - t_{gr_slab} - t_{foun} - t_{wall}\right)^2 + 1.2\frac{5}{8}\cdot P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun} - t_{wall}\right) ..$$
$$+\frac{5}{8}\cdot\Delta p_{eq}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun} - t_{wall}\right) + \left(\frac{1.2P_{d_wall}}{2}\right)\cdot\frac{PGA}{2}$$

$$V = 2.283\cdot\frac{kip}{ft}$$

$$\frac{V}{\phi V_c} = 50.725\cdot\%$$

Shear capacity is more than demand moment on wall-OK

$$A_{smin.wall} := 0.0018\cdot t_{wall}\cdot 12in = 0.173\cdot in^2$$

Ok use #4@8" vertical and horizontal

Toe Foundation Shear and Moment Capacity

Toe Foundation Shear and Moment Capacity

$$A_{smin.found.L} := \frac{0.0018 \cdot t_{foun} \cdot L_{base}}{0.2in^2} = 4.32$$

Provide 5-#4 rebar longitudinal

$$A_{smin.found.T} := \frac{0.0018 \cdot t_{foun} \cdot 10in}{0.2in^2} = 0.9$$

Provide- #4@10" rebar transverse

Shear Capacity ACI-318

$$\phi V_c := 0.75 \cdot 2 \cdot \sqrt{\frac{|f'_c|}{psi}} \cdot psi \cdot (t_{foun} - 3in) = 6.3 \cdot \frac{kip}{ft}$$

Shear Capacity

Moment capacity of wall

$$\phi M_{cap} := 0.9 \cdot f_y \cdot \left(0.2 \frac{in^2}{ft} \cdot \frac{12}{10}\right) \cdot \left(0.9 \cdot \frac{t_{foun}}{2}\right) = 4.86 \cdot \frac{kip \cdot ft}{ft}$$

$$\phi V_c = 6.3 \cdot \frac{kip}{ft}$$

Shear capacity of wall

Calculate demand on toe under soil pressure (1.2DL+1.6LL+1.6EH)

Moment about centroid of foundation

$$M_d := 1.6\frac{1}{15}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab}\right)^3 \cdots + \frac{\left(1.2\cdot P_{d_.surch} + 1.6\cdot P_{ll_.surch}\right)\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8}$$

$$M_{center} := M_d - 1.2P_{d_wall}\cdot\left(\frac{L_{base}}{2} - t_{wall} - L_{heel}\right) + 1.2P_{d_key}\cdot\left(\frac{L_{base}}{2} - \frac{t_{key}}{2}\right) \cdots + 1.2\cdot P_{slab.on.found}\cdot\left(\frac{L_{base}}{2} - \frac{L_{toe}}{2}\right) \cdots + -1.2L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)\cdot\left(\frac{L_{base}}{2} - \frac{L_{heel}}{2}\right)$$

$$M_{center} = 3.707\cdot kip$$

Axial load on center of foundation

$$P_{center} := 1.2P_{d_wall} + 1.2P_{d_found} + 1.2P_{d_key} + 1.2\cdot P_{slab.on.found} \cdots + 1.6L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)$$

$$P_{center} = 4.248\cdot\frac{kip}{ft}$$

$$\frac{\max\left(\left|M_{toe}\right|, \left|M_{heel}\right|\right)}{\phi M_{cap}} = 71.163\cdot\%$$

$$\frac{\max\left(\left|V_{toe}\right|, \left|V_{heel}\right|\right)}{\phi V_c} = 33.976\cdot\%$$

Calculate demand on toe under soil pressure (1.2DL+1.0LL+1.6EH+1.0EQ)

Moment about centroid of foundation

$$M_d := 1.6\frac{1}{15}\cdot p_a\cdot\left(h_{wall} - t_{gr_slab}\right)^3 \ldots + \frac{1.2\cdot P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8} \ldots + \frac{\Delta p_{eq}\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8} \ldots + \left[\frac{1.2P_{d_wall}}{2}\cdot\left(\frac{h_{wall}}{2}\right)\right]\cdot PGA$$

$$M_{center} := M_d - 1.2P_{d_wall}\cdot\left(\frac{L_{base}}{2} - t_{wall} - L_{heel}\right) + 1.2P_{d_key}\cdot\left(\frac{L_{base}}{2} - \frac{t_{key}}{2}\right) \ldots + 1.2\cdot P_{slab.on.found}\cdot\left(\frac{L_{base}}{2} - \frac{L_{toe}}{2}\right) \ldots + -1.0L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)\cdot\left(\frac{L_{base}}{2} - \frac{L_{heel}}{}\right)$$

$$M_{center} = 4.856\cdot kip$$

Axial load on center of foundation

$$P_{center} := 1.2P_{d_wall} + 1.2P_{d_found} + 1.2P_{d_key} + 1.2\cdot P_{slab.on.found} \cdots + 1.6L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)$$

$$P_{center} = 4.248\cdot\frac{kip}{ft}$$

$$\frac{\max\left(\left|M_{toe}\right|, \left|M_{heel}\right|\right)}{\phi M_{cap}} = 87.114\cdot\% \qquad \frac{\max\left(\left|V_{toe}\right|, \left|V_{heel}\right|\right)}{\phi V_c} = 42.256\cdot\%$$

OK

It is less than 5% Over EOR is OK

Design of 7 ft Retaining Wall

Thickness of wall

$t_{wall} := 8in$

$t_{foun} := 10in$ Thickness of foundation

$L_{toe} := 1ft + 4in = 1.333 \cdot ft$ Total foundation length

$h_{key} := 0ft$ Height of key

$t_{key} := 0in$ Thickness of key

$L_{heel} := 1ft$ Heel length

$t_{gr_slab} := 4in$ Thickness of slab on grade on top of wall foundation

$h_{wall} := 7ft$ Height of the wall

$I := \frac{1}{12} \cdot \left(L_{toe} + L_{heel} + t_{wall}\right)^3 = 2.25 \cdot \frac{ft^4}{ft}$ Moment inertia of wall base

$f'_c := 2500psi$ Concrete compressive strength

$f_y := 60ksi$ Steel yield strength

$E_s := 29000ksi$ Steel young modulus

$\gamma_c := 150pcf$ Concrete unit weight

$p_a := 40pcf$ Active soil pressure

$p_o := 55pcf$ At-rest soil pressure

$\Delta p_{eq} := 8\left(\frac{h_{wall}}{ft}\right) \cdot psf = 56 \cdot psf$ Seismic soil pressure

$p_p := 200pcf$ Passive pressure

$PGA := 0.607$

$\mu := 0.35$ Soil friction factor from IBC 2018

$\phi := \frac{3}{2} \cdot atan(\mu) = 28.935 \cdot deg$ Equivalent friction angle

$K_a := \frac{1 - \sin(\phi)}{1 + \sin(\phi)} = 0.348$ Active pressure coefficient

$K_o := 1 - \sin(\phi) = 0.516$ At-Rest pressure coefficient

$\gamma_{soil} := \frac{p_a}{K_a} = 114.984 \cdot pcf$ Soil unit weight

Vertical weight on wall

$P_{d_wall} := (h_{wall} - t_{foun}) \cdot t_{wall} \cdot \gamma_c = 616.667 \cdot plf$

$P_{d_found} := (L_{toe} + t_{wall} + L_{heel}) \cdot t_{foun} \cdot \gamma_c = 375 \cdot plf$ Concrete weight of foundation

$P_{d_key} := (h_{key} - t_{foun}) \cdot t_{key} \cdot \gamma_c = 0 \cdot plf$ Concrete weight of key

$P_{d_slab} := t_{gr_slab} \cdot (44ft) \cdot \gamma_c + 5psf \cdot 44ft = 2.42 \times 10^3 \cdot plf$

Concrete weight of slab and dead load on grade

$P_{slab.on.found} := t_{gr_slab} \cdot \gamma_c \cdot L_{toe} = 66.667 \cdot plf$ Weight of concrete slab on wall foundation

Live load on slab

$P_{ll} := 0psf \cdot (L_{toe}) = 0 \cdot plf$

Surcharge pressure on wall due to slab on grade

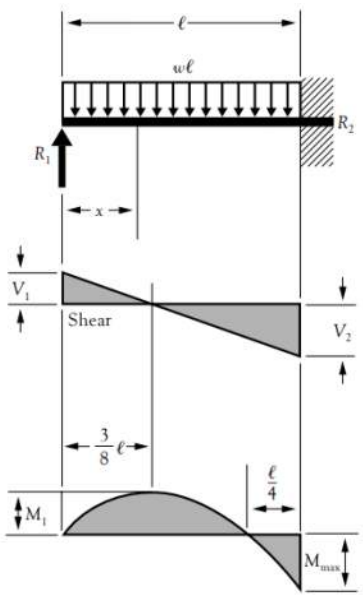
$P_{d_.surch} := 0 \cdot t_{gr_slab} \cdot \gamma_c \cdot K_a = 0 \cdot psf$

Surcharge pressure on wall due to live load on patio

$P_{ll_.surch} := 60psf \cdot K_a = 20.872 \cdot psf$

Check Sliding Capacity for Dead Load

Lateral earth force from active pressure



$$R_1 = V_1 \quad \ldots\ldots\ldots\ldots\ldots \quad = \frac{3w\ell}{8}$$

$$R_2 = V_2 \quad \ldots\ldots\ldots\ldots\ldots \quad = \frac{5w\ell}{8}$$

$$V_x \quad \ldots\ldots\ldots\ldots\ldots \quad = R_1 - wx$$

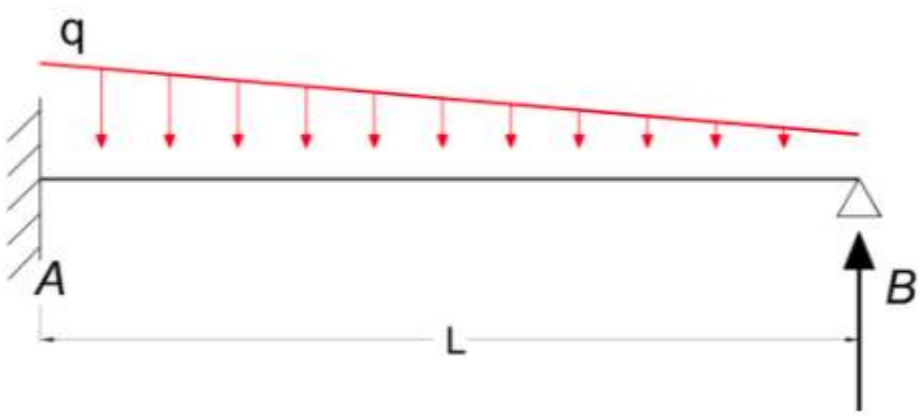
$$M_{max} \quad \ldots\ldots\ldots\ldots\ldots \quad = \frac{w\ell^2}{8}$$

$$M_1 \left(\text{at } x = \frac{3}{8}\ell\right) \quad \ldots\ldots\ldots\ldots \quad = \frac{9}{128} w\ell^2$$

$$M_x \quad \ldots\ldots\ldots\ldots\ldots \quad = R_1 x - \frac{wx^2}{2}$$

$$\Delta_{max} \left(\text{at } x = \frac{\ell}{16}(1+\sqrt{33}) = .4215\,\ell\right) \quad . \quad = \frac{w\ell^4}{185EI}$$

$$\Delta_x \quad \ldots\ldots\ldots\ldots\ldots \quad = \frac{wx}{48EI}(\ell^3 - 3\ell x^2 + 2x^3)$$



Bending Moment

$M_A = - q L^2 / 15$ (3a)

where

M_A = moment at the fixed end (Nm, lb_f ft)

q = continuous declining load (N/m, lb_f/ft)

$M_1 = q L^2 / 33.6$ (3b)

where

M_1 = maximum moment at x = 0.553 L (Nm, lb_f ft)

Deflection

$\delta_{max} = q L^4 / (419 E I)$ (3c)

where

δ_{max} = max deflection at x = 0.553 L (m, ft)

$\delta_{1/2} = q L^4 / (427 E I)$ (3d)

where

$\delta_{1/2}$ = deflection at x = L / 2 (m, ft)

Support Reactions

$R_A = 2 q L / 5$ (3e)

$R_B = q L / 10$ (3f)

$$F_d := \frac{2}{5} \cdot p_o \cdot \left(h_{wall} - t_{gr_slab}\right)^2 + 5 \cdot \frac{P_{d_.surch} \cdot \left(h_{wall} - t_{gr_slab}\right)}{8} = 977.778 \cdot plf$$

Resisting force

$$F_{res} := P_{d_wall} + P_{d_found} + P_{d_key} + P_{d_slab} \cdots + L_{heel} \cdot \gamma_{soil} \cdot \left(h_{wall} - t_{gr_slab} - t_{foun}\right) = 4.082 \times 10^3 \cdot plf$$

$$\frac{F_{res} \cdot \mu}{F_d} = 1.5$$

It is more than or equal 1.5

Check Sliding Capacity for Seismic Load

Lateral earth force from active pressure

$$F_d := \frac{2}{5} \cdot p_a \cdot \left(h_{wall} - t_{gr_slab}\right)^2 + \frac{5}{8} \cdot P_{d_.surch} \cdot \left(h_{wall} - t_{gr_slab}\right) \cdots + \frac{\frac{5}{8} \cdot \Delta p_{eq} \cdot \left(h_{wall} - t_{gr_slab}\right) + \left(\frac{P_{d_wall}}{2} + P_{d_found} + P_{d_key}\right) \cdot PGA \cdot \frac{1}{2}}{1.4} = 1.026 \times 10^3 \cdot plf$$

Resisting Force

$$F_{res} := P_{d_wall} + P_{d_found} + P_{d_key} + P_{d_slab} \cdots + L_{heel} \cdot \gamma_{soil} \cdot \left(h_{wall} - t_{gr_slab} - t_{foun}\right) = 4.082 \times 10^3 \cdot plf$$

$$\frac{0.9 F_{res} \cdot \mu + \frac{1}{2} p_p \cdot \left(h_{key}\right)^2}{F_d} = 1.253$$

It is more than 1.0

Check Overturning Capacity for Dead Load

Lateral moment about toe due to soil pressure

$$M_d := \frac{1}{15}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab}\right)^3 + \frac{2}{5}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab}\right)^2\cdot\left(h_{key}\right) \ldots + \frac{P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8} + \frac{5}{8}\cdot P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab}\right)\cdot h_{key} = 1.086\cdot\frac{kip\cdot ft}{ft}$$

Resisting moment

$$M_{res} := P_{d_wall}\cdot\left(L_{toe} + \frac{t_{wall}}{2}\right) + P_{d_found}\cdot\left(\frac{L_{toe} + t_{wall} + L_{heel}}{2}\right) \ldots + P_{d_key}\cdot\frac{t_{key}}{2} + P_{slab.on.found}\cdot\frac{L_{toe}}{2} \ldots + L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)\cdot\left(\frac{L_{heel}}{2} + t_{wall} + L_{toe}\right) = 3.312\cdot\frac{kip\cdot ft}{ft}$$

$$\frac{M_{res}}{M_d} = 3.048$$

It is more than 1.5

Check Overturning Capacity for Seismic Load

Lateral moment about toe due to soil pressure

$$M_d := \frac{1}{15}\cdot p_a\cdot\left(h_{wall} - t_{gr_slab}\right)^3 + \frac{2}{5}\cdot p_a\cdot\left(h_{wall} - t_{gr_slab}\right)^2\cdot\left(h_{key}\right) \ldots + \frac{P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8} + \frac{5}{8}\cdot P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab}\right)\cdot h_{key} \ldots + \frac{\Delta p_{eq}\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8} + \frac{5}{8}\cdot\Delta p_{eq}\cdot\left(h_{wall} - t_{gr_slab}\right)\cdot h_{key} \ldots + \frac{\left[\frac{P_{d_wall}}{2}\cdot\left(\frac{h_{wall}}{2} - t_{foun}\right) + P_{d_found}\cdot\frac{t_{foun}}{2} + P_{d_key}\cdot\frac{h_{key}}{2}\right]\cdot PGA\cdot\frac{1}{2}}{1.4}$$

$$M_d = 1.224\cdot\frac{kip\cdot ft}{ft}$$

Resisting moment

$$M_{res} := P_{d_wall}\cdot\left(L_{toe} + \frac{t_{wall}}{2}\right) + P_{d_found}\cdot\left(\frac{L_{toe} + t_{wall} + L_{heel}}{2}\right) \ldots \quad = 3.312\cdot\frac{kip\cdot ft}{ft}$$
$$+ P_{d_key}\cdot\frac{t_{key}}{2} + P_{slab.on.found}\cdot\frac{L_{toe}}{2} \ldots$$
$$+ L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)\cdot\left(\frac{L_{heel}}{2} + t_{wall} + L_{toe}\right)$$

$$\frac{0.9\cdot M_{res}}{M_d} = 2.434$$

It is more than 1.1

Check Overturning Capacity for Dead and Live Load

Lateral moment about toe due to soil pressure

$$M_d := \frac{1}{15}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab}\right)^3 + \frac{2}{5}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab}\right)^2\cdot\left(h_{key}\right) \ldots$$
$$+ \frac{\left(P_{d_.surch} + P_{ll_.surch}\right)\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8} \ldots$$
$$+ \frac{5}{8}\cdot\left(P_{d_.surch} + P_{ll_.surch}\right)\cdot\left(h_{wall} - t_{gr_slab}\right)\cdot h_{key}$$

$$M_d = 1.202\cdot\frac{kip\cdot ft}{ft}$$

Resisting moment

$$M_{res} := P_{d_wall}\cdot\left(L_{toe} + \frac{t_{wall}}{2}\right) + P_{d_found}\cdot\left(\frac{L_{toe} + t_{wall} + L_{heel}}{2}\right) \ldots \quad = 3.312\cdot\frac{kip\cdot ft}{ft}$$
$$+ P_{d_key}\cdot\frac{t_{key}}{2} + P_{slab.on.found}\cdot\frac{L_{toe}}{2} \ldots$$
$$+ L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)\cdot\left(\frac{L_{heel}}{2} + t_{wall} + L_{toe}\right)$$

$$\frac{M_{res} + \frac{1}{4}p_p\cdot\left(h_{key} + t_{foun} - 4in\right)^3}{M_d} = 2.759$$

It is more than 1.0

Check Soil Bearing Pressure for DL+LL

$$M_d := \frac{1}{15}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab}\right)^3 \ldots + \frac{\left(P_{d_.surch} + P_{ll_.surch}\right)\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8}$$

$$M_{res} := P_{d_wall}\cdot\left(L_{toe} + \frac{t_{wall}}{2}\right) + P_{d_found}\cdot\left(\frac{L_{toe} + t_{wall} + L_{heel}}{2}\right) \ldots + P_{d_key}\cdot\frac{t_{key}}{2} + P_{slab.on.found}\cdot\frac{L_{toe}}{2} \ldots + L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)\cdot\left(\frac{L_{heel}}{2} + t_{wall} + L_{toe}\right) = 3.312\cdot\frac{kip\cdot ft}{ft}$$

$$L_{base} := L_{toe} + t_{wall} + L_{heel}$$

$$P := P_{d_wall} + P_{d_found} + P_{d_key} + L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)$$

$$\left|\frac{M_{res} - M_d}{P} - \frac{\left(L_{toe} + t_{wall} + L_{heel}\right)}{2}\right| = 0.231\cdot ft$$

Eccentricity

$$\frac{L_{base}}{6} = 0.5\cdot ft$$

Eccentricity is within 1/3 of base so base is always in compression

$$\sigma_{toe} := \frac{P_{d_wall} + P_{d_found} + P_{d_key} + L_{heel} \cdot \gamma_{soil} \cdot (h_{wall} - t_{gr_slab} - t_{foun})}{L_{toe} + t_{wall} + L_{heel}} \ldots$$
$$+ \frac{M_d \cdot 0.5 \cdot L_{base}}{I} - \frac{P_{d_wall} \cdot \left(\frac{L_{base}}{2} - t_{wall} - L_{heel}\right) \cdot 0.5 L_{base}}{I} \ldots$$
$$+ \frac{P_{d_key} \cdot \left(\frac{L_{base}}{2} - \frac{t_{key}}{2}\right) \cdot (0.5 L_{base})}{I} + \frac{P_{slab.on.found} \cdot \left(\frac{L_{base}}{2} - \frac{L_{toe}}{2}\right) \cdot (0.5 L_{base})}{I} \ldots$$
$$+ \frac{-L_{heel} \cdot \gamma_{soil} \cdot (h_{wall} - t_{gr_slab} - t_{foun}) \cdot \left(\frac{L_{base}}{2} - \frac{L_{heel}}{2}\right) \cdot .5 L_{base}}{I}$$

$\sigma_{toe} = 1.014 \times 10^3 \cdot psf$ Less than 2500 psf OK

$$\sigma_{heel} := \frac{P_{d_wall} + P_{d_found} + P_{d_key} + L_{heel} \cdot \gamma_{soil} \cdot (h_{wall} - t_{gr_slab} - t_{foun})}{L_{toe} + t_{wall} + L_{heel}} \ldots$$
$$+ \frac{-M_d \cdot 0.5 \cdot L_{base}}{I} - \frac{-P_{d_wall} \cdot \left(\frac{L_{base}}{2} - t_{wall} - L_{heel}\right) \cdot 0.5 L_{base}}{I} \ldots$$
$$+ \frac{-P_{d_key} \cdot \left(\frac{L_{base}}{2} - \frac{t_{key}}{2}\right) \cdot (0.5 L_{base})}{I} - \frac{P_{slab.on.found} \cdot \left(\frac{L_{base}}{2} - \frac{L_{toe}}{2}\right) \cdot (0.5 L_{base})}{I} \ldots$$
$$+ \frac{L_{heel} \cdot \gamma_{soil} \cdot (h_{wall} - t_{gr_slab} - t_{foun}) \cdot \left(\frac{L_{base}}{2} - \frac{L_{heel}}{2}\right) \cdot .5 L_{base}}{I}$$

$\sigma_{heel} = 94.156 \cdot psf$ Less than 2000 psf OK

Check Soil Bearing Pressure for Seismic

$$M_d := \frac{1}{15}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab}\right)^3 + \frac{2}{5}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab}\right)^2\cdot\left(h_{key}\right) \cdots$$
$$+ \frac{P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8} + \frac{5}{8}\cdot P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab}\right)\cdot h_{key} \cdots$$
$$\frac{\Delta p_{eq}\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8} + \frac{5}{8}\cdot\Delta p_{eq}\cdot\left(h_{wall} - t_{gr_slab}\right)\cdot h_{key} \cdots$$
$$+ \frac{+\left[\frac{P_{d_wall}}{2}\cdot\left(\frac{h_{wall}}{2} - t_{foun}\right) + P_{d_found}\cdot\frac{t_{foun}}{2} + P_{d_key}\cdot\frac{h_{key}}{2}\right]\cdot PGA\cdot\frac{1}{2}}{1.4}$$

$$M_d = 1.521\cdot\frac{kip\cdot ft}{ft}$$

Resisting moment

$$M_{res} := P_{d_wall}\cdot\left(L_{toe} + \frac{t_{wall}}{2}\right) + P_{d_found}\cdot\left(\frac{L_{toe} + t_{wall} + L_{heel}}{2}\right) \cdots \quad = 3.312\cdot\frac{kip\cdot ft}{ft}$$
$$+ P_{d_key}\cdot\frac{t_{key}}{2} + P_{slab.on.found}\cdot\frac{L_{toe}}{2} \cdots$$
$$+ L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)\cdot\left(\frac{L_{heel}}{2} + t_{wall} + L_{toe}\right)$$

$$P := P_{d_wall} + P_{d_found} + P_{d_key} + P_{d_slab} + L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)$$

$$e_{cc} := \left|\frac{0.9\cdot M_{res} + \frac{1}{4}p_p\cdot\left(h_{key} + t_{foun} - 1ft\right)^3 - M_d}{P} - \frac{L_{base}}{2}\right| = 1.143\cdot ft$$ Eccentricity

$$\frac{L_{base}}{2} = 1.5\cdot ft$$ The resultant is within base

Moment about centroid of foundation

$$M_{center} := M_d - P_{d_wall} \cdot \left(\frac{L_{base}}{2} - t_{wall} - L_{heel} \right) + P_{d_key} \cdot \left(\frac{L_{base}}{2} - \frac{t_{key}}{2} \right) \ldots$$
$$+ P_{slab.on.found} \cdot \left(\frac{L_{base}}{2} - \frac{L_{toe}}{2} \right) - L_{heel} \cdot \gamma_{soil} \cdot \left(h_{wall} - t_{gr_slab} - t_{foun} \right) \cdot \left(\frac{L_{base}}{2} - \frac{L_{heel}}{2} \right)$$

$$M_{center} = 1.008 \cdot \frac{kip \cdot ft}{ft}$$

Axial load on center of foundation

$$P_{center} := P_{d_wall} + P_{d_found} + P_{d_key} + P_{slab.on.found} + L_{heel} \cdot \gamma_{soil} \cdot \left(h_{wall} - t_{gr_slab} - t_{foun} \right)$$

$$P_{center} = 1.729 \cdot \frac{kip}{ft}$$

$$\sigma_{toe} = 1.257 \times 10^3 \cdot psf$$

Maximum bearing pressure on soil due to seismic is less than 1.3x1500=1950 psf per IBC OK

Check for Shear and Moment Capacity

Wall Shear and Moment Capacity

$A_{s.min.wall} := 0.0018 \cdot t_{wall} \cdot 12in = 0.173 \cdot in^2$ Provide at least #4@12

Shear Capacity ACI-318

$\phi V_c := 0.75 \cdot 2 \cdot \sqrt{\frac{|f'_c|}{psi}} \cdot psi \cdot (t_{wall} - 3in) = 4.5 \cdot \frac{kip}{ft}$ Shear Capacity

$\phi M_{cap_base} := 0.9 \cdot f_y \cdot 0.2 \frac{in^2}{ft} \cdot \frac{12}{12} \cdot \left(0.9 \cdot \frac{t_{wall}}{2}\right) = 3.24 \cdot \frac{kip \cdot ft}{ft}$ Moment capacity of wall at the base #4@12"

$\phi M_{cap_mid} := 0.9 \cdot f_y \cdot 0.2 \frac{in^2}{ft} \cdot \frac{12}{12} \cdot \left(0.9 \cdot \frac{t_{wall}}{2}\right) = 3.24 \cdot \frac{kip \cdot ft}{ft}$ Moment capacity of wall at the middle #4@12"

$\phi V_c = 4.5 \cdot \frac{kip}{ft}$ Shear capacity of wall

Calculate Demand on Base of Wall (1.4DL+1.6LL+1.6EH)

$$M := 1.6 \frac{1}{15} \cdot p_o \cdot (h_{wall} - t_{gr_slab} - t_{foun})^3 \ldots + \frac{(1.2 \cdot P_{d_.surch} + 1.6 \cdot P_{ll_.surch}) \cdot (h_{wall} - t_{gr_slab} - t_{foun})^2}{8} = 1.307 \cdot kip \cdot \frac{ft}{ft}$$

$$M = 1.307 \cdot kip$$

$\frac{M}{\phi M_{cap_base}} = 40.326 \cdot \%$ Moment capacity is more than demand moment on wall-OK

$$V := 1.6\frac{2}{5}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab} - t_{foun} - t_{wall}\right)^2 \ldots$$
$$+\frac{5}{8}\cdot\left(1.2\cdot P_{d_.surch} + 1.6\cdot P_{ll_.surch}\right)\cdot\left(h_{wall} - t_{gr_slab} - t_{foun} - t_{wall}\right)$$

$$V = 1.047\cdot\frac{kip}{ft}$$

$$\frac{V}{\phi V_c} = 23.277\cdot\%$$

Shear capacity is more than demand moment on wall-OK

Calculate Demand on Base Wall (1.2DL+1.0LL+1.6EH+1.0EQ)

$$M := 1.6\frac{1}{15}\cdot p_a\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)^3 \ldots$$
$$+\frac{1.2\cdot P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)^2}{8} \ldots$$
$$+\frac{\Delta p_{eq}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)^2}{8} \ldots$$
$$+\left[\frac{1.2P_{d_wall}}{2}\cdot\left(\frac{h_{wall}}{2} - t_{foun}\right)\right]\cdot\frac{PGA}{2}$$

$$M = 1.385\cdot kip$$

$$\frac{M}{\phi M_{cap_base}} = 42.733\cdot\%$$

OK

$$V := 1.6\frac{2}{5}\cdot p_a\cdot\left(h_{wall} - t_{gr_slab} - t_{foun} - t_{wall}\right)^2 + 1.2\frac{5}{8}\cdot P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun} - t_{wall}\right) ..$$
$$+\frac{5}{8}\cdot\Delta p_{eq}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun} - t_{wall}\right) + \left(\frac{1.2P_{d_wall}}{2}\right)\cdot\frac{PGA}{2}$$

$$V = 0.977\cdot\frac{kip}{ft}$$

$$\frac{V}{\phi V_c} = 21.7\cdot\%$$

Shear capacity is more than demand moment on wall-OK

$$A_{smin.wall} := 0.0018\cdot t_{wall}\cdot 12in = 0.173\cdot in^2$$

Ok use #4@12" vertical and horizontal

Toe Foundation Shear and Moment Capacity

Toe Foundation Shear and Moment Capacity

$$A_{smin.found.L} := \frac{0.0018 \cdot t_{foun} \cdot L_{base}}{0.2in^2} = 3.24$$

Provide 4-#4 rebar longitudinal

$$A_{smin.found.T} := \frac{0.0018 \cdot t_{foun} \cdot 10in}{0.2in^2} = 0.9$$

Provide- #4@10" rebar transverse

Shear Capacity ACI-318

$$\phi V_c := 0.75 \cdot 2 \cdot \sqrt{\frac{|f'_c|}{psi}} \cdot psi \cdot \left(t_{foun} - 3in\right) = 6.3 \cdot \frac{kip}{ft}$$

Shear Capacity

Moment capacity of wall

$$\phi M_{cap} := 0.9 \cdot f_y \cdot \left(0.2 \frac{in^2}{ft} \cdot \frac{12}{10}\right) \cdot \left(0.9 \cdot \frac{t_{foun}}{2}\right) = 4.86 \cdot \frac{kip \cdot ft}{ft}$$

$$\phi V_c = 6.3 \cdot \frac{kip}{ft}$$

Shear capacity of wall

Calculate demand on toe under soil pressure (1.2DL+1.6LL+1.6EH)

Moment about centroid of foundation

$$M_d := 1.6\frac{1}{15}\cdot p_o\cdot\left(h_{wall} - t_{gr_slab}\right)^3 \cdots + \frac{\left(1.2\cdot P_{d_.surch} + 1.6\cdot P_{ll_.surch}\right)\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8}$$

$$M_{center} := M_d - 1.2P_{d_wall}\cdot\left(\frac{L_{base}}{2} - t_{wall} - L_{heel}\right) + 1.2P_{d_key}\cdot\left(\frac{L_{base}}{2} - \frac{t_{key}}{2}\right) \cdots + 1.2\cdot P_{slab.on.found}\cdot\left(\frac{L_{base}}{2} - \frac{L_{toe}}{2}\right) \cdots + -1.2L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)\cdot\left(\frac{L_{base}}{2} - \frac{L_{heel}}{2}\right)$$

$$M_{center} = 1.309\cdot kip$$

Axial load on center of foundation

$$P_{center} := 1.2P_{d_wall} + 1.2P_{d_found} + 1.2P_{d_key} + 1.2\cdot P_{slab.on.found} \cdots + 1.6L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)$$

$$P_{center} = 2.343\cdot\frac{kip}{ft}$$

$$\frac{\max\left(\left|M_{toe}\right|, \left|M_{heel}\right|\right)}{\phi M_{cap}} = 25.573\cdot\%$$

$$\frac{\max\left(\left|V_{toe}\right|, \left|V_{heel}\right|\right)}{\phi V_c} = 12.004\cdot\%$$

Calculate demand on toe under soil pressure (1.2DL+1.0LL+1.6EH+1.0EQ)

Moment about centroid of foundation

$$M_d := 1.6\frac{1}{15}\cdot p_a\cdot\left(h_{wall} - t_{gr_slab}\right)^3 \ldots + \frac{1.2\cdot P_{d_.surch}\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8} \ldots + \frac{\Delta p_{eq}\cdot\left(h_{wall} - t_{gr_slab}\right)^2}{8} \ldots + \left[\frac{1.2P_{d_wall}}{2}\cdot\left(\frac{h_{wall}}{2}\right)\right]\cdot PGA$$

$$M_{center} := M_d - 1.2P_{d_wall}\cdot\left(\frac{L_{base}}{2} - t_{wall} - L_{heel}\right) + 1.2P_{d_key}\cdot\left(\frac{L_{base}}{2} - \frac{t_{key}}{2}\right) \ldots + 1.2\cdot P_{slab.on.found}\cdot\left(\frac{L_{base}}{2} - \frac{L_{toe}}{2}\right) \ldots + -1.0L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)\cdot\left(\frac{L_{base}}{2} - \frac{L_{heel}}{}\right)$$

$$M_{center} = 1.881\cdot kip$$

Axial load on center of foundation

$$P_{center} := 1.2P_{d_wall} + 1.2P_{d_found} + 1.2P_{d_key} + 1.2\cdot P_{slab.on.found} \cdots + 1.6L_{heel}\cdot\gamma_{soil}\cdot\left(h_{wall} - t_{gr_slab} - t_{foun}\right)$$

$$P_{center} = 2.343\cdot\frac{kip}{ft}$$

$$\frac{\max\left(\left|M_{toe}\right|, \left|M_{heel}\right|\right)}{\phi M_{cap}} = 32.265\cdot\%$$

$$\frac{\max\left(\left|V_{toe}\right|, \left|V_{heel}\right|\right)}{\phi V_c} = 15.653\cdot\%$$

OK

Project Information

Project File: Foundations.ec6

LIC# : KW-06013860, Build:20.23.08.30 NKH Engineering (c) ENERCALC INC 1983-2023

Project Title : 3804 House

Description :

I.D. : 22-112

Address : , Mercer Island, WA

Project Leader : NKH

Phone : Fax : eMail :

Project Notes

General Footing

Project File: Foundations.ec6

LIC# : KW-06013860, Build:20.24.12.02 NKH Engineering (c) ENERCALC, LLC 1982-2025

DESCRIPTION: Footing @ Main Post 1

Code References

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

General Information

Material Properties

f'c : Concrete 28 day strength	=	2.50	ksi
fy : Rebar Yield	=	60.0	ksi
Ec : Concrete Elastic Modulus	=	3,122.0	ksi
Concrete Density	=	145.0	pcf
φ Values Flexure	=	0.90	
Shear	=	0.750	

Analysis Settings

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

Soil Design Values

Allowable Soil Bearing	=	1.50	ksf
Soil Density	=	110.0	pcf
Increase Bearing By Footing Weight	=	Yes	
Soil Passive Resistance (for Sliding)	=	250.0	pcf
Soil/Concrete Friction Coeff.	=	0.30	

Increases based on footing Depth

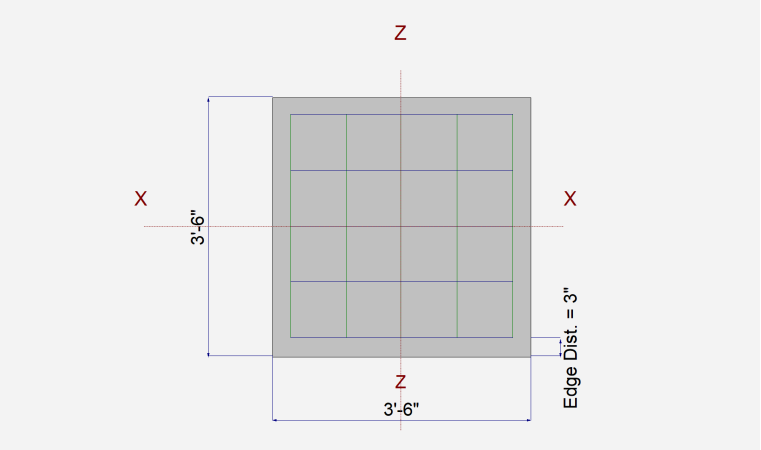
Footing base depth below soil surface	=	ft
Allow press. increase per foot of depth	=	ksf
when footing base is below	=	ft

Increases based on footing plan dimension

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

Dimensions

Width parallel to X-X Axis	=	3.50	ft
Length parallel to Z-Z Axis	=	3.50	ft
Footing Thickness	=	12.0	in



Pedestal dimensions...

px : parallel to X-X Axis	=		in
pz : parallel to Z-Z Axis	=		in
Height	=		in

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	3.0	in

Reinforcing

Bars parallel to X-X Axis			
Number of Bars	=		5.0
Reinforcing Bar Size	=	#	4
Bars parallel to Z-Z Axis			
Number of Bars	=		5.0
Reinforcing Bar Size	=	#	4

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation n/a

# Bars required within zone	n/a
# Bars required on each side of zone	n/a

Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	6.944	0.0	8.710	3.174				k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=								k-ft
V-x	=								k
V-z	=								k

General Footing

Project File: Foundations.ec6

LIC# : KW-06013860, Build:20.24.12.02 NKH Engineering (c) ENERCALC, LLC 1982-2025

DESCRIPTION: Footing @ Main Post 1

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.8748	Soil Bearing	1.439 ksf	1.645 ksf	+D+0.750L+0.750S about Z-Z axis
PASS	n/a	Overturning - X-X	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.2677	Z Flexure (+X)	2.982 k-ft/ft	11.139 k-ft/ft	+1.20D+1.60L+0.50S
PASS	0.2677	Z Flexure (-X)	2.982 k-ft/ft	11.139 k-ft/ft	+1.20D+1.60L+0.50S
PASS	0.2677	X Flexure (+Z)	2.982 k-ft/ft	11.139 k-ft/ft	+1.20D+1.60L+0.50S
PASS	0.2677	X Flexure (-Z)	2.982 k-ft/ft	11.139 k-ft/ft	+1.20D+1.60L+0.50S
PASS	0.2440	1-way Shear (+X)	18.302 psi	75.0 psi	+1.20D+1.60L+0.50S
PASS	0.2440	1-way Shear (-X)	18.302 psi	75.0 psi	+1.20D+1.60L+0.50S
PASS	0.2440	1-way Shear (+Z)	18.302 psi	75.0 psi	+1.20D+1.60L+0.50S
PASS	0.2440	1-way Shear (-Z)	18.302 psi	75.0 psi	+1.20D+1.60L+0.50S
PASS	0.4671	2-way Punching	70.065 psi	150.0 psi	+1.20D+1.60L+0.50S

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, D Only	1.645	n/a	0.0	0.7119	0.7119	n/a	n/a	0.433
X-X, +D+L	1.645	n/a	0.0	1.423	1.423	n/a	n/a	0.865
X-X, +D+S	1.645	n/a	0.0	0.9710	0.9710	n/a	n/a	0.590
X-X, +D+0.750L	1.645	n/a	0.0	1.245	1.245	n/a	n/a	0.757
X-X, +D+0.750L+0.750S	1.645	n/a	0.0	1.439	1.439	n/a	n/a	0.875
X-X, +0.60D	1.645	n/a	0.0	0.4271	0.4271	n/a	n/a	0.260
Z-Z, D Only	1.645	0.0	n/a	n/a	n/a	0.7119	0.7119	0.433
Z-Z, +D+L	1.645	0.0	n/a	n/a	n/a	1.423	1.423	0.865
Z-Z, +D+S	1.645	0.0	n/a	n/a	n/a	0.9710	0.9710	0.590
Z-Z, +D+0.750L	1.645	0.0	n/a	n/a	n/a	1.245	1.245	0.757
Z-Z, +D+0.750L+0.750S	1.645	0.0	n/a	n/a	n/a	1.439	1.439	0.875
Z-Z, +0.60D	1.645	0.0	n/a	n/a	n/a	0.4271	0.4271	0.260

Overturning Stability

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

All units k

Sliding Stability

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

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	1.215	+Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +1.40D	1.215	-Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +1.20D+1.60L	2.784	+Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +1.20D+1.60L	2.784	-Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +1.20D+1.60L+0.50S	2.982	+Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +1.20D+1.60L+0.50S	2.982	-Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +1.20D+L	2.130	+Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +1.20D+L	2.130	-Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +1.20D	1.042	+Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +1.20D	1.042	-Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +1.20D+L+1.60S	2.765	+Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +1.20D+L+1.60S	2.765	-Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +1.20D+1.60S	1.676	+Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK

General Footing

Project File: Foundations.ec6

LIC# : KW-06013860, Build:20.24.12.02 NKH Engineering (c) ENERCALC, LLC 1982-2025

DESCRIPTION: Footing @ Main Post 1

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.20D+1.60S	1.676	-Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +1.20D+L+0.50S	2.329	+Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +1.20D+L+0.50S	2.329	-Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +0.90D	0.7812	+Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +0.90D	0.7812	-Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +1.20D+L+0.20S	2.210	+Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
X-X, +1.20D+L+0.20S	2.210	-Z	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.40D	1.215	-X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.40D	1.215	+X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.20D+1.60L	2.784	-X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.20D+1.60L	2.784	+X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.20D+1.60L+0.50S	2.982	-X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.20D+1.60L+0.50S	2.982	+X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.20D+L	2.130	-X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.20D+L	2.130	+X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.20D	1.042	-X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.20D	1.042	+X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.20D+L+1.60S	2.765	-X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.20D+L+1.60S	2.765	+X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.20D+1.60S	1.676	-X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.20D+1.60S	1.676	+X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.20D+L+0.50S	2.329	-X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.20D+L+0.50S	2.329	+X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +0.90D	0.7812	-X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +0.90D	0.7812	+X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.20D+L+0.20S	2.210	-X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK
Z-Z, +1.20D+L+0.20S	2.210	+X	Bottom	0.2592	ACI 7.6.1.1	0.2857	11.139	OK

One Way Shear X

Load Combination...	Vu @ -X	Vu @ +X	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	7.46 psi	7.46 psi	7.46 psi	75.00 psi	0.10	OK
+1.20D+1.60L	17.09 psi	17.09 psi	17.09 psi	75.00 psi	0.23	OK
+1.20D+1.60L+0.50S	18.30 psi	18.30 psi	18.30 psi	75.00 psi	0.24	OK
+1.20D+L	13.08 psi	13.08 psi	13.08 psi	75.00 psi	0.17	OK
+1.20D	6.39 psi	6.39 psi	6.39 psi	75.00 psi	0.09	OK
+1.20D+L+1.60S	16.97 psi	16.97 psi	16.97 psi	75.00 psi	0.23	OK
+1.20D+1.60S	10.29 psi	10.29 psi	10.29 psi	75.00 psi	0.14	OK
+1.20D+L+0.50S	14.29 psi	14.29 psi	14.29 psi	75.00 psi	0.19	OK
+0.90D	4.80 psi	4.80 psi	4.80 psi	75.00 psi	0.06	OK
+1.20D+L+0.20S	13.56 psi	13.56 psi	13.56 psi	75.00 psi	0.18	OK

One Way Shear Z

Load Combination...	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	7.46 psi	7.46 psi	7.46 psi	75.00 psi	0.10	OK
+1.20D+1.60L	17.09 psi	17.09 psi	17.09 psi	75.00 psi	0.23	OK
+1.20D+1.60L+0.50S	18.30 psi	18.30 psi	18.30 psi	75.00 psi	0.24	OK
+1.20D+L	13.08 psi	13.08 psi	13.08 psi	75.00 psi	0.17	OK
+1.20D	6.39 psi	6.39 psi	6.39 psi	75.00 psi	0.09	OK
+1.20D+L+1.60S	16.97 psi	16.97 psi	16.97 psi	75.00 psi	0.23	OK
+1.20D+1.60S	10.29 psi	10.29 psi	10.29 psi	75.00 psi	0.14	OK
+1.20D+L+0.50S	14.29 psi	14.29 psi	14.29 psi	75.00 psi	0.19	OK
+0.90D	4.80 psi	4.80 psi	4.80 psi	75.00 psi	0.06	OK
+1.20D+L+0.20S	13.56 psi	13.56 psi	13.56 psi	75.00 psi	0.18	OK

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	28.55 psi	150.00psi	0.1904	OK
+1.20D+1.60L	65.40 psi	150.00psi	0.436	OK
+1.20D+1.60L+0.50S	70.07 psi	150.00psi	0.4671	OK
+1.20D+L	50.06 psi	150.00psi	0.3337	OK
+1.20D	24.47 psi	150.00psi	0.1632	OK
+1.20D+L+1.60S	64.97 psi	150.00psi	0.4331	OK
+1.20D+1.60S	39.39 psi	150.00psi	0.2626	OK

General Footing

Project File: Foundations.ec6

LIC# : KW-06013860, Build:20.24.12.02 NKH Engineering (c) ENERCALC, LLC 1982-2025

DESCRIPTION: Footing @ Main Post 1

Two-Way "Punching" Shear All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.20D+L+0.50S	54.72 psi	150.00 psi	0.3648	OK
+0.90D	18.36 psi	150.00 psi	0.1224	OK
+1.20D+L+0.20S	51.92 psi	150.00 psi	0.3461	OK

General Footing

Project File: Foundations.ec6

LIC# : KW-06013860, Build:20.23.08.30 NKH Engineering (c) ENERCALC INC 1983-2023

DESCRIPTION: Footing @ Main Post 2

Code References

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

General Information

Material Properties

f'c : Concrete 28 day strength	=	2.50	ksi
fy : Rebar Yield	=	60.0	ksi
Ec : Concrete Elastic Modulus	=	3,122.0	ksi
Concrete Density	=	145.0	pcf
φ Values Flexure	=	0.90	
Shear	=	0.750	

Analysis Settings

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

Soil Design Values

Allowable Soil Bearing	=	1.50	ksf
Soil Density	=	110.0	pcf
Increase Bearing By Footing Weight	=	Yes	
Soil Passive Resistance (for Sliding)	=	250.0	pcf
Soil/Concrete Friction Coeff.	=	0.30	

Increases based on footing Depth

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

Increases based on footing plan dimension

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

Dimensions

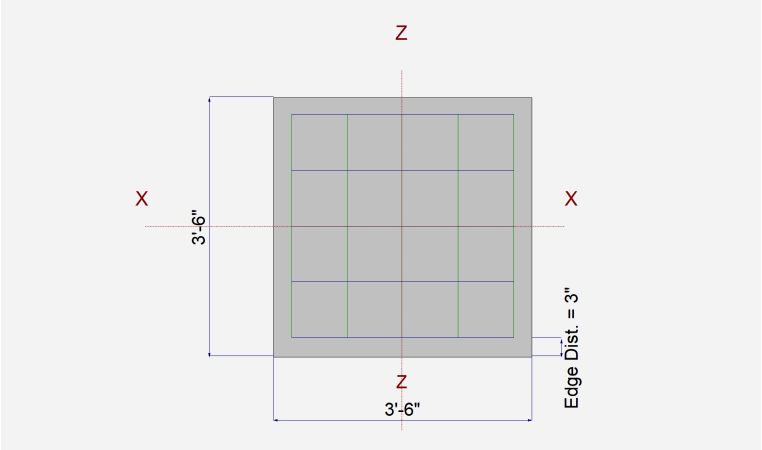
Width parallel to X-X Axis	=	3.50	ft
Length parallel to Z-Z Axis	=	3.50	ft
Footing Thickness	=	12.0	in

Pedestal dimensions...

px : parallel to X-X Axis	=		in
pz : parallel to Z-Z Axis	=		in
Height	=		in

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	3.0	in



Reinforcing

Bars parallel to X-X Axis			
Number of Bars	=		5
Reinforcing Bar Size	=	#	4
Bars parallel to Z-Z Axis			
Number of Bars	=		5
Reinforcing Bar Size	=	#	4

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation	n/a
# Bars required within zone	n/a
# Bars required on each side of zone	n/a

Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	7.814	3.161	10.111	3.948				k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=								k-ft
V-x	=								k
V-z	=								k

General Footing

Project File: Foundations.ec6

LIC# : KW-06013860, Build:20.23.08.30 NKH Engineering (c) ENERCALC INC 1983-2023

DESCRIPTION: Footing @ Main Post 2

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.9994	Soil Bearing	1.644 ksf	1.645 ksf	+D+0.750L+0.750S about Z-Z axis
PASS	n/a	Overturning - X-X	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.3089	Z Flexure (+X)	3.441 k-ft/ft	11.139 k-ft/ft	+1.20D+1.60L+0.50S
PASS	0.3089	Z Flexure (-X)	3.441 k-ft/ft	11.139 k-ft/ft	+1.20D+1.60L+0.50S
PASS	0.3089	X Flexure (+Z)	3.441 k-ft/ft	11.139 k-ft/ft	+1.20D+1.60L+0.50S
PASS	0.3089	X Flexure (-Z)	3.441 k-ft/ft	11.139 k-ft/ft	+1.20D+1.60L+0.50S
PASS	0.2816	1-way Shear (+X)	21.120 psi	75.0 psi	+1.20D+1.60L+0.50S
PASS	0.2816	1-way Shear (-X)	21.120 psi	75.0 psi	+1.20D+1.60L+0.50S
PASS	0.2816	1-way Shear (+Z)	21.120 psi	75.0 psi	+1.20D+1.60L+0.50S
PASS	0.2816	1-way Shear (-Z)	21.120 psi	75.0 psi	+1.20D+1.60L+0.50S
PASS	0.5390	2-way Punching	80.852 psi	150.0 psi	+1.20D+1.60L+0.50S

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, D Only	1.645	n/a	0.0	0.7829	0.7829	n/a	n/a	0.476
X-X, +D+L	1.645	n/a	0.0	1.608	1.608	n/a	n/a	0.978
X-X, +D+Lr	1.645	n/a	0.0	1.041	1.041	n/a	n/a	0.633
X-X, +D+S	1.645	n/a	0.0	1.105	1.105	n/a	n/a	0.672
X-X, +D+0.750Lr+0.750L	1.645	n/a	0.0	1.595	1.595	n/a	n/a	0.970
X-X, +D+0.750L+0.750S	1.645	n/a	0.0	1.644	1.644	n/a	n/a	0.999
X-X, +0.60D	1.645	n/a	0.0	0.4697	0.4697	n/a	n/a	0.286
Z-Z, D Only	1.645	0.0	n/a	n/a	n/a	0.7829	0.7829	0.476
Z-Z, +D+L	1.645	0.0	n/a	n/a	n/a	1.608	1.608	0.978
Z-Z, +D+Lr	1.645	0.0	n/a	n/a	n/a	1.041	1.041	0.633
Z-Z, +D+S	1.645	0.0	n/a	n/a	n/a	1.105	1.105	0.672
Z-Z, +D+0.750Lr+0.750L	1.645	0.0	n/a	n/a	n/a	1.595	1.595	0.970
Z-Z, +D+0.750L+0.750S	1.645	0.0	n/a	n/a	n/a	1.644	1.644	0.999
Z-Z, +0.60D	1.645	0.0	n/a	n/a	n/a	0.4697	0.4697	0.286

Overturning Stability

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

All units k

Sliding Stability

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

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	1.367	+Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.40D	1.367	-Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+0.50Lr+1.60L	3.392	+Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+0.50Lr+1.60L	3.392	-Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+1.60L+0.50S	3.441	+Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+1.60L+0.50S	3.441	-Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+1.60Lr+L	3.068	+Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+1.60Lr+L	3.068	-Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+1.60Lr	1.804	+Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+1.60Lr	1.804	-Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+L+1.60S	3.226	+Z	Bottom	0.2592	AsMin	0.2857	11.139	OK

General Footing

Project File: Foundations.ec6

LIC# : KW-06013860, Build:20.23.08.30 NKH Engineering (c) ENERCALC INC 1983-2023

DESCRIPTION: Footing @ Main Post 2

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.20D+L+1.60S	3.226	-Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+1.60S	1.962	+Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+1.60S	1.962	-Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+0.50Lr+L	2.634	+Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+0.50Lr+L	2.634	-Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+L+0.50S	2.683	+Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+L+0.50S	2.683	-Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +0.90D	0.8791	+Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +0.90D	0.8791	-Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+L+0.20S	2.535	+Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
X-X, +1.20D+L+0.20S	2.535	-Z	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.40D	1.367	-X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.40D	1.367	+X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+0.50Lr+1.60L	3.392	-X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+0.50Lr+1.60L	3.392	+X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+1.60L+0.50S	3.441	-X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+1.60L+0.50S	3.441	+X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+1.60Lr+L	3.068	-X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+1.60Lr+L	3.068	+X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+1.60Lr	1.804	-X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+1.60Lr	1.804	+X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+L+1.60S	3.226	-X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+L+1.60S	3.226	+X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+1.60S	1.962	-X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+1.60S	1.962	+X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+0.50Lr+L	2.634	-X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+0.50Lr+L	2.634	+X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+L+0.50S	2.683	-X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+L+0.50S	2.683	+X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +0.90D	0.8791	-X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +0.90D	0.8791	+X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+L+0.20S	2.535	-X	Bottom	0.2592	AsMin	0.2857	11.139	OK
Z-Z, +1.20D+L+0.20S	2.535	+X	Bottom	0.2592	AsMin	0.2857	11.139	OK

One Way Shear

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	8.39 psi	8.39 psi	8.39 psi	8.39 psi	8.39 psi	75.00 psi	0.11	OK
+1.20D+0.50Lr+1.60L	20.82 psi	20.82 psi	20.82 psi	20.82 psi	20.82 psi	75.00 psi	0.28	OK
+1.20D+1.60L+0.50S	21.12 psi	21.12 psi	21.12 psi	21.12 psi	21.12 psi	75.00 psi	0.28	OK
+1.20D+1.60Lr+L	18.83 psi	18.83 psi	18.83 psi	18.83 psi	18.83 psi	75.00 psi	0.25	OK
+1.20D+1.60Lr	11.07 psi	11.07 psi	11.07 psi	11.07 psi	11.07 psi	75.00 psi	0.15	OK
+1.20D+L+1.60S	19.80 psi	19.80 psi	19.80 psi	19.80 psi	19.80 psi	75.00 psi	0.26	OK
+1.20D+1.60S	12.04 psi	12.04 psi	12.04 psi	12.04 psi	12.04 psi	75.00 psi	0.16	OK
+1.20D+0.50Lr+L	16.16 psi	16.16 psi	16.16 psi	16.16 psi	16.16 psi	75.00 psi	0.22	OK
+1.20D+L+0.50S	16.47 psi	16.47 psi	16.47 psi	16.47 psi	16.47 psi	75.00 psi	0.22	OK
+0.90D	5.40 psi	5.40 psi	5.40 psi	5.40 psi	5.40 psi	75.00 psi	0.07	OK
+1.20D+L+0.20S	15.56 psi	15.56 psi	15.56 psi	15.56 psi	15.56 psi	75.00 psi	0.21	OK

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	32.13 psi	150.00 psi	0.2142	OK
+1.20D+0.50Lr+1.60L	79.70 psi	150.00 psi	0.5313	OK
+1.20D+1.60L+0.50S	80.85 psi	150.00 psi	0.539	OK
+1.20D+1.60Lr+L	72.09 psi	150.00 psi	0.4806	OK
+1.20D+1.60Lr	42.39 psi	150.00 psi	0.2826	OK
+1.20D+L+1.60S	75.79 psi	150.00 psi	0.5053	OK
+1.20D+1.60S	46.09 psi	150.00 psi	0.3073	OK
+1.20D+0.50Lr+L	61.88 psi	150.00 psi	0.4125	OK
+1.20D+L+0.50S	63.03 psi	150.00 psi	0.4202	OK
+0.90D	20.66 psi	150.00 psi	0.1377	OK
+1.20D+L+0.20S	59.56 psi	150.00 psi	0.397	OK

General Footing

Project File: Foundations.ec6

LIC# : KW-06013860, Build:20.23.08.30 NKH Engineering (c) ENERCALC INC 1983-2023

DESCRIPTION: Footing @ Main Post 3

Code References

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

General Information

Material Properties

f'c : Concrete 28 day strength	=	2.50	ksi
fy : Rebar Yield	=	60.0	ksi
Ec : Concrete Elastic Modulus	=	3,122.0	ksi
Concrete Density	=	145.0	pcf
φ Values Flexure	=	0.90	
Shear	=	0.750	

Analysis Settings

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

Soil Design Values

Allowable Soil Bearing	=	1.50	ksf
Soil Density	=	110.0	pcf
Increase Bearing By Footing Weight	=	No	
Soil Passive Resistance (for Sliding)	=	250.0	pcf
Soil/Concrete Friction Coeff.	=	0.30	

Increases based on footing Depth

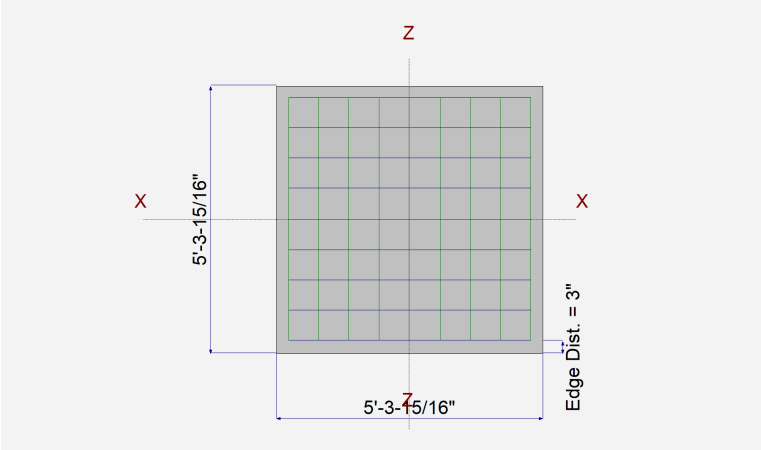
Footing base depth below soil surface	=	ft
Allow press. increase per foot of depth	=	ksf
when footing base is below	=	ft

Increases based on footing plan dimension

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

Dimensions

Width parallel to X-X Axis	=	5.330	ft
Length parallel to Z-Z Axis	=	5.330	ft
Footing Thickness	=	14.0	in



Pedestal dimensions...

px : parallel to X-X Axis	=		in
pz : parallel to Z-Z Axis	=		in
Height	=		in

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	3.0	in

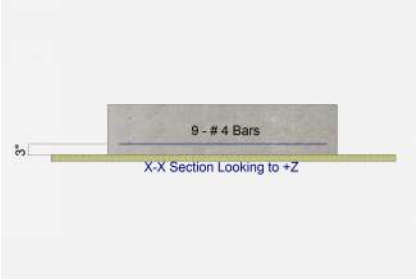
Reinforcing

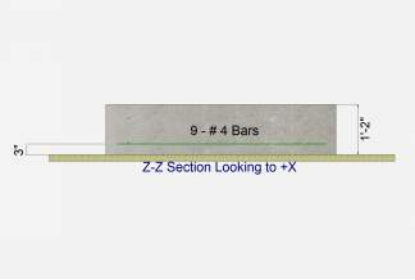
Bars parallel to X-X Axis			
Number of Bars	=		9.0
Reinforcing Bar Size	=	#	4
Bars parallel to Z-Z Axis			
Number of Bars	=		9.0
Reinforcing Bar Size	=	#	4

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation n/a

# Bars required within zone	n/a
# Bars required on each side of zone	n/a





Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	14.50	5.10	22.30	6.40				k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=								k-ft
V-x	=								k
V-z	=								k

General Footing

Project File: Foundations.ec6

LIC# : KW-06013860, Build:20.23.08.30 NKH Engineering (c) ENERCALC INC 1983-2023

DESCRIPTION: Footing @ Main Post 3

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.9767	Soil Bearing	1.465 ksf	1.50 ksf	+D+L about Z-Z axis
PASS	n/a	Overturning - X-X	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.4366	Z Flexure (+X)	7.035 k-ft/ft	16.113 k-ft/ft	+1.20D+1.60L+0.50S
PASS	0.4366	Z Flexure (-X)	7.035 k-ft/ft	16.113 k-ft/ft	+1.20D+1.60L+0.50S
PASS	0.4366	X Flexure (+Z)	7.035 k-ft/ft	16.113 k-ft/ft	+1.20D+1.60L+0.50S
PASS	0.4366	X Flexure (-Z)	7.035 k-ft/ft	16.113 k-ft/ft	+1.20D+1.60L+0.50S
PASS	0.3520	1-way Shear (+X)	26.398 psi	75.0 psi	+1.20D+1.60L+0.50S
PASS	0.3520	1-way Shear (-X)	26.398 psi	75.0 psi	+1.20D+1.60L+0.50S
PASS	0.3520	1-way Shear (+Z)	26.398 psi	75.0 psi	+1.20D+1.60L+0.50S
PASS	0.3520	1-way Shear (-Z)	26.398 psi	75.0 psi	+1.20D+1.60L+0.50S
PASS	0.7501	2-way Punching	112.513 psi	150.0 psi	+1.20D+1.60L+0.50S

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, D Only	1.50	n/a	0.0	0.6796	0.6796	n/a	n/a	0.453
X-X, +D+L	1.50	n/a	0.0	1.465	1.465	n/a	n/a	0.977
X-X, +D+Lr	1.50	n/a	0.0	0.8591	0.8591	n/a	n/a	0.573
X-X, +D+S	1.50	n/a	0.0	0.9049	0.9049	n/a	n/a	0.603
X-X, +D+0.750Lr+0.750L	1.50	n/a	0.0	1.403	1.403	n/a	n/a	0.935
X-X, +D+0.750L+0.750S	1.50	n/a	0.0	1.437	1.437	n/a	n/a	0.958
X-X, +0.60D	1.50	n/a	0.0	0.4077	0.4077	n/a	n/a	0.272
Z-Z, D Only	1.50	0.0	n/a	n/a	n/a	0.6796	0.6796	0.453
Z-Z, +D+L	1.50	0.0	n/a	n/a	n/a	1.465	1.465	0.977
Z-Z, +D+Lr	1.50	0.0	n/a	n/a	n/a	0.8591	0.8591	0.573
Z-Z, +D+S	1.50	0.0	n/a	n/a	n/a	0.9049	0.9049	0.603
Z-Z, +D+0.750Lr+0.750L	1.50	0.0	n/a	n/a	n/a	1.403	1.403	0.935
Z-Z, +D+0.750L+0.750S	1.50	0.0	n/a	n/a	n/a	1.437	1.437	0.958
Z-Z, +0.60D	1.50	0.0	n/a	n/a	n/a	0.4077	0.4077	0.272

Overturning Stability

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

All units k

Sliding Stability

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

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	2.538	+Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.40D	2.538	-Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+0.50Lr+1.60L	6.954	+Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+0.50Lr+1.60L	6.954	-Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+1.60L+0.50S	7.035	+Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+1.60L+0.50S	7.035	-Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+1.60Lr+L	5.983	+Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+1.60Lr+L	5.983	-Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+1.60Lr	3.195	+Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+1.60Lr	3.195	-Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+L+1.60S	6.243	+Z	Bottom	0.3024	AsMin	0.3377	16.113	OK

General Footing

Project File: Foundations.ec6

LIC# : KW-06013860, Build:20.23.08.30 NKH Engineering (c) ENERCALC INC 1983-2023

DESCRIPTION: Footing @ Main Post 3

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.20D+L+1.60S	6.243	-Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+1.60S	3.455	+Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+1.60S	3.455	-Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+0.50Lr+L	5.281	+Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+0.50Lr+L	5.281	-Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+L+0.50S	5.363	+Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+L+0.50S	5.363	-Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +0.90D	1.631	+Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +0.90D	1.631	-Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+L+0.20S	5.123	+Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
X-X, +1.20D+L+0.20S	5.123	-Z	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.40D	2.538	-X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.40D	2.538	+X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+0.50Lr+1.60L	6.954	-X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+0.50Lr+1.60L	6.954	+X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+1.60L+0.50S	7.035	-X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+1.60L+0.50S	7.035	+X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+1.60Lr+L	5.983	-X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+1.60Lr+L	5.983	+X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+1.60Lr	3.195	-X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+1.60Lr	3.195	+X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+L+1.60S	6.243	-X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+L+1.60S	6.243	+X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+1.60S	3.455	-X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+1.60S	3.455	+X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+0.50Lr+L	5.281	-X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+0.50Lr+L	5.281	+X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+L+0.50S	5.363	-X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+L+0.50S	5.363	+X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +0.90D	1.631	-X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +0.90D	1.631	+X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+L+0.20S	5.123	-X	Bottom	0.3024	AsMin	0.3377	16.113	OK
Z-Z, +1.20D+L+0.20S	5.123	+X	Bottom	0.3024	AsMin	0.3377	16.113	OK

One Way Shear

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	9.52 psi	9.52 psi	9.52 psi	9.52 psi	9.52 psi	75.00 psi	0.13	OK
+1.20D+0.50Lr+1.60L	26.09 psi	26.09 psi	26.09 psi	26.09 psi	26.09 psi	75.00 psi	0.35	OK
+1.20D+1.60L+0.50S	26.40 psi	26.40 psi	26.40 psi	26.40 psi	26.40 psi	75.00 psi	0.35	OK
+1.20D+1.60Lr+L	22.45 psi	22.45 psi	22.45 psi	22.45 psi	22.45 psi	75.00 psi	0.30	OK
+1.20D+1.60Lr	11.99 psi	11.99 psi	11.99 psi	11.99 psi	11.99 psi	75.00 psi	0.16	OK
+1.20D+L+1.60S	23.42 psi	23.42 psi	23.42 psi	23.42 psi	23.42 psi	75.00 psi	0.31	OK
+1.20D+1.60S	12.96 psi	12.96 psi	12.96 psi	12.96 psi	12.96 psi	75.00 psi	0.17	OK
+1.20D+0.50Lr+L	19.82 psi	19.82 psi	19.82 psi	19.82 psi	19.82 psi	75.00 psi	0.26	OK
+1.20D+L+0.50S	20.12 psi	20.12 psi	20.12 psi	20.12 psi	20.12 psi	75.00 psi	0.27	OK
+0.90D	6.12 psi	6.12 psi	6.12 psi	6.12 psi	6.12 psi	75.00 psi	0.08	OK
+1.20D+L+0.20S	19.22 psi	19.22 psi	19.22 psi	19.22 psi	19.22 psi	75.00 psi	0.26	OK

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	40.58 psi	150.00 psi	0.2706	OK
+1.20D+0.50Lr+1.60L	111.21 psi	150.00 psi	0.7414	OK
+1.20D+1.60L+0.50S	112.51 psi	150.00 psi	0.7501	OK
+1.20D+1.60Lr+L	95.68 psi	150.00 psi	0.6379	OK
+1.20D+1.60Lr	51.10 psi	150.00 psi	0.3407	OK
+1.20D+L+1.60S	99.84 psi	150.00 psi	0.6656	OK
+1.20D+1.60S	55.26 psi	150.00 psi	0.3684	OK
+1.20D+0.50Lr+L	84.47 psi	150.00 psi	0.5631	OK
+1.20D+L+0.50S	85.77 psi	150.00 psi	0.5718	OK
+0.90D	26.09 psi	150.00 psi	0.1739	OK
+1.20D+L+0.20S	81.93 psi	150.00 psi	0.5462	OK

Steel Beam

Project File: Foundations.ec6

LIC# : KW-06013860, Build:20.24.09.03 NKH Engineering (c) ENERCALC, LLC 1982-2025

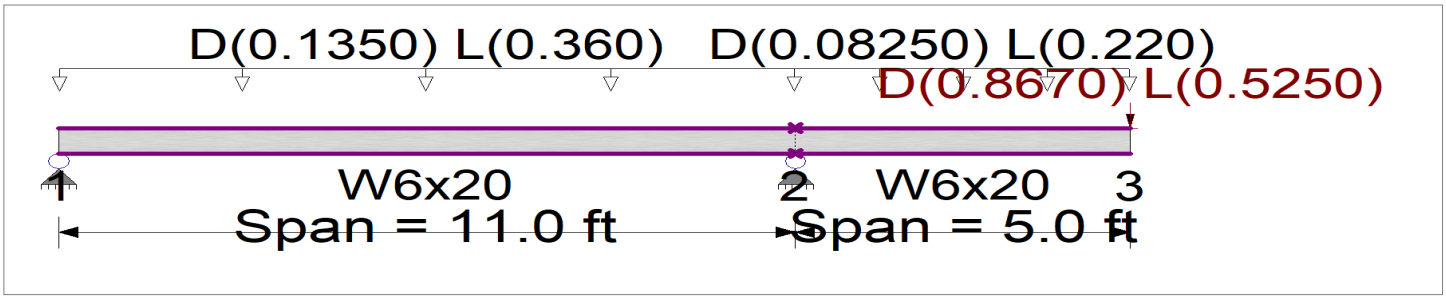
DESCRIPTION: Upper Beam 11

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : ASCE 7-22 / IBC 2024 (L<=100psf)

Material Properties

Analysis Method :	Allowable Strength 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 = 0.0150, L = 0.040 ksf, Tributary Width = 9.0 ft, (Floor)
Load for Span Number 2
Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 5.50 ft, (Floor)
Point Load : D = 0.8670, L = 0.5250 k @ 5.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.296 : 1	Maximum Shear Stress Ratio =	0.119 : 1
Section used for this span	W6x20	Section used for this span	W6x20
Ma : Applied	10.991 k-ft	Va : Applied	3.832 k
Mn / Omega : Allowable	37.176 k-ft	Vn/Omega : Allowable	32.240 k
Load Combination	+D+L	Load Combination	+D+L
		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	0.054 in	Ratio =	2,213	>=360	Span: 2 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0	<360	n/a
Max Downward Total Deflection	0.204 in	Ratio =	589	>=180	Span: 2 : +D+L
Max Upward Total Deflection	-0.024 in	Ratio =	5577	>=180	Span: 2 : D Only

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values						Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	VnxVnx/Omega
D Only												
Dsgn. L = 11.00 ft	1	0.151	0.043	0.38	-5.62	5.62	62.08	37.18	1.00	1.00	1.38	48.36 32.24
Dsgn. L = 5.00 ft	2	0.151	0.043		-5.62	5.62	62.08	37.18	1.00	1.00	1.38	48.36 32.24
+D+L												
Dsgn. L = 11.00 ft	1	0.296	0.119	3.26	-10.99	10.99	62.08	37.18	1.00	1.00	3.83	48.36 32.24
Dsgn. L = 5.00 ft	2	0.296	0.093		-10.99	10.99	62.08	37.18	1.00	1.00	3.00	48.36 32.24
+D+0.750L												
Dsgn. L = 11.00 ft	1	0.260	0.100	2.51	-9.65	9.65	62.08	37.18	1.00	1.00	3.21	48.36 32.24
Dsgn. L = 5.00 ft	2	0.260	0.081		-9.65	9.65	62.08	37.18	1.00	1.00	2.60	48.36 32.24
+0.60D												
Dsgn. L = 11.00 ft	1	0.091	0.026	0.23	-3.37	3.37	62.08	37.18	1.00	1.00	0.83	48.36 32.24
Dsgn. L = 5.00 ft	2	0.091	0.026		-3.37	3.37	62.08	37.18	1.00	1.00	0.83	48.36 32.24

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
L Only	1	0.0421	4.664	D Only	-0.0236	7.876
+D+L	2	0.2039	5.000		0.0000	7.876

Steel Beam

Project File: Foundations.ec6

LIC# : KW-06013860, Build:20.24.09.03 NKH Engineering (c) ENERCALC, LLC 1982-2025

DESCRIPTION: Upper Beam 11

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Max Upward from all Load Conditions	1.833	6.836	
Max Upward from Load Combinations	1.833	6.836	
Max Upward from Load Cases	1.491	4.094	
D Only	0.342	2.743	
+D+L	1.833	6.836	
+D+0.750L	1.460	5.813	
+0.60D	0.205	1.646	
L Only	1.491	4.094	