Plan Check Comments

Douglas County
Community Development
1594 Esmeralda Ave
Minden, NV 89423

Permit Type: Commercial Permit

Project Description: Genoa Church Foundation Repair, structural only

Document Name: Structural Calcs SUB 2

Report Date: 03-29-2023

Application Number: DB23-0477

Site Address:
182 NIXON ST
Genoa, NV 89411

Reviewer Contact Information:

Reviewer Name	Reviewer Email	Reviewer Phone No.:
Tim Davis	tdavis@douglasnv.us	775-782-6224
Rebecca Spates	rspates@douglasnv.us	775-782-6226

General Comments

Corrections in the following table need to be applied before a permit can be issued

Prepared for: Town of Genoa

GENOA CHURCH FOUNDATION REPAIR

Calculation Package

February 28, 2023

PROFESSIONAL ENGINEER - STATE OF NEVADA
CORY A. WILDER
Exp: 6/30/24
CIVIL
No. 30653

moffatt & nichol

DB23-0477

Document Verification

Client	Town of Genoa
Project name	Genoa Church Foundation Repair
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Revision	Description	Issued by	Date	Checked
1	Add PE Seal	CW	3/17/23	GN

Produced by:

Moffatt & Nichol
111 West Telegraph Street
Suite 204
Carson City, NV, 89703
775-305-1466
www.moffattnichol.com

Project Description

History
The 40 ft x 20 ft church chapel was rebuilt in 1910 after a fire. In 1979-1980 the bell tower, porch, new roof, new doors and a natural gas heating system were installed. In 1991-1992 the church was expanded with reception area, dressing rooms, restrooms and a wheelchair ramp.

Structural Issue
The chapel's 40 ft x 20 ft wood frame structure is founded on wood posts and stone footings. The crawl space exterior has wood siding, or skirting, which is exposed to soil and standing water due to drainage issues. The exterior skirting is deteriorating. Additionally, there is differential settlement across the structural foundation elements causing unlevel flooring. The settlement and impacts to the structure are most pronounced on the west wall of the chapel where deformation from the bottom of the wall to the top of wall.

Proposed Solutions
- analyze the existing structure for seismic, wind, snow, live and dead loads
- design replacement foundation including exterior concrete footer with concrete block; and interior posts with concrete footers

References

- International Building Code (IBC) 2021
- ASCE 7-22 Minimum Design Loads and Associated Criteria for Buildings and Other Structures
- ASCE 7 Online Hazard Tool
- American Concrete Institute (ACI) 318, Building Code Requirements for Structural Concrete
- National Design Specification for Wood (NDS) 2018

Assumptions

- Scope is limited to analysis and upgrade of the chapel foundation system only.

Calculation Notes

- Hand calculations are done in Mathcad and Excel, where input and results are carried from one application to the other. Notes are included in these Mathcad calculations where to go in the Excel calculations.
- The hand calculations are based on a rigid building frame and an equivalent lateral force procedure. For simplicity these are only applied to the chapel structure.
- The computer program Woodworks was used to original chapel and building addition. Woodworks was used to analyze for dead, wind and seismic loads and allows for both rigid and flexible analyses.
- The goal of using Woodworks was to derive foundation reactions only. The capacity of the existing walls, and roof structure was not part of the scope of work.

Seismic - Equivalent Lateral Force Procedure per ASCE 7

The equivalent lateral force procedure is used as an approximate way to evaluate impacts of seismic events on structures. Base Shear, V, is the product of Cs and W, where Cs is the seismic response coefficient. Ta is the approximate fundamental period of the structure, which is used to select Sa, the 5% damped design response acceleration from MCE_R spectra.

Approximate Fundamental Period, Ta

ASCE 7 12.8.2

$C_t := 0.02$ $x := 0.75$

from Table 12.8-2. Values of Approximate Period Parameters Ct and x, for "All Other Structural Systems". Note that back of chapel is adjoined by addition which makes it more rigid.

$h_n := 14.22$ ft

h_n = structural height from top of foundation to roof system center of mass, including bell tower. See graphic in load spreadsheet.

$T_a := C_t \cdot h_n^{\ x}$ $T_a = 0.146$ seconds

Design Spectral Acceleration Parameter, Sa

ASCE 7 11.4.5.1

Sa =Design spectral response acceleration parameter defined in Section 11.4.5.1 and determined for the period T defined in Section 12.8.2

Per ASCE 7 11.4.5.1, (1) Sa, shall be taken as 2/3 of the multi-period 5%-damped MCE_R (risk-targeted maximum considered earthquake) response spectrum from the USGS Seismic Design Geodatabase for the applicable site class; and (2) At each response period, T, less than 10 s and not equal to one of the discrete values of period, T, listed in Item 1 above, Sa, shall be determined by linear interpolation between values of Sa

$$S_a := \frac{2}{3} \cdot \left[2.21 - \left(0.15 - T_a\right) \cdot \frac{(2.21 - 1.85)}{(0.15 - 0.10)} \right]$$

Interpolation of Multi-Period MCE_R Spectrum-2022
Source: ASCE 7 Hazards Report

$S_a = 1.456$ g

Per 12.8.1.1, Method 1, where Equation(12.8-2) is used to calculate the siesmic response coefficient, and the period T is less than the period at which Sa is maximum, the maximum value of Sa shall be used.

For the Multi-Period MCE_R spectrum the maximum Sa of 2.48g occurs at a period of 0.30 seconds which is greater than Ta calculated above. Therefore 2/3 of 2.48 g shall be used.

$S_a := \frac{2(2.48)}{3}$ $\quad S_a = 1.653 \quad g$

Seismic Response Coefficient, Cs ASCE 7 12.8-2

R =Response modification factor in Table 12.2-1; and Ie = Importance Factor determined in accordance with Section 11.5.1.

$I_e := 1.00$ per Table 1.5-2 for Risk Category II as defined in Table 1.5-1

$R := 6.5$ per Table 12.2-1, A.16. Light framed (wood) walls sheathed with wood structural panels rated for shear resistance.

$C_s := \frac{S_a}{\left(\frac{R}{I_e}\right)}$ $\quad C_s = 0.254 \quad g$

Effective Seismic Weight, W ASCE 7 12.7.2

$W_d := 34223 \cdot lbf$ W = effictive seismic weight of structure. Dead load + 15% of uniform snow load for flat roofs, Pf. From load spreadsheet.

$W_s := 6251 \cdot lbf$ Snow load assumed 15% of 45.1 psf, on flat projection of 42 x 22 feet. From load spreadsheet.

$W := W_d + W_s$ $\quad W = 40474 \cdot lbf$

Base Shear, V ASCE 7 12.8-1

$V := C_s \cdot W$ $\quad V = 10295 \cdot lbf$

Seismic Overturning Moment, M_{OE}

$M_{OE} := 95472 ft \cdot lbf$ See Loading Spreadsheet

Dead + 15% Snow Righting Moment, Mr

$M_r := 404742 ft \cdot lbf$

$FS := \frac{M_r}{M_{OE}}$ $\quad FS = 4.2$ Δ - Globally OK for seismic overturning.

Shear Wall Reactions

Assume end walls have capacity to gather shear load from overturning forces. This is conservative considering the claboard siding on exterior and interior surfaces.
Calculate reactions at corners assuming moment couple across width of end wall.

$$R_E := \frac{\frac{M_{OE}}{2}}{20ft} \qquad R_E = 2387 \cdot lbf$$

Reaction force does not account for countering dead load, which is conservative.

Snow Loads

Snow load of 45.1 psf. 20-year MRI Value from ASCE 7. See BOD. Flat projection of 42 x 22 feet to account for eves.

$$W_s := 45.1 \cdot psf \cdot 42ft \cdot 22ft \qquad W_s = 41672 \cdot lbf$$

$$L_p := (20ft + 40ft) \cdot 2 \qquad L_p = 120 \cdot ft$$

$$W_{sp} := \frac{W_s}{L_p} \qquad W_{sp} = 347.27 \cdot \frac{lbf}{ft}$$

Assume vertical snow load distributed evenly around perimeter of structure. This is feasible given the heavy timber floor frame.

Wind Loads

Wind Speed: Minimum 120 MPH V ult' – Exposure C, Risk Category II per Douglas County
Wind analysis per ASCE 7 - 22, Chapters 26 and 27 (Directional Procedure)

$V_{ult} := 120$ — From Douglas County. This is a conservative wind speed given the setting of the church which is surrounded by trees and other buildings. However it's location does not meet the criteria for Exposure B.

$K_{zt} := 1.0$ — No additional topographic effect due to hills, ridges, etc. Per ASCE 26.8

$K_e := 0.86 - (.03 \cdot .825)$ — Elevation of church is 4825 feet. Value interpolated from Table 26.9-1 using delta between Ke values and 82.5% of elevation range

$K_e = 0.835$

$K_z := 0.85$ — For vertical wall segments less than 15 ft high. From Table 26.10-1

$K_h := 0.85$ — For vertical roof projections at mean roof height of approximately 14.2 feet. See load calc spreadsheet. From Table 26.10-1

$K_{hbell} := 0.96$ — For bell tower which is appromately 27 feet high. From Table 26.10-1

$q_{zwall} := 0.00256 \cdot K_z \cdot K_{zt} \cdot K_e \cdot V_{ult}^2$ $q_{zwall} = 26.172 \frac{lbf}{ft^2}$ per equation 26.10-1

$q_{hroof} := 0.00256 \cdot K_h \cdot K_{zt} \cdot K_e \cdot V_{ult}^2$ $q_{hroof} = 26.172$ per equation 26.10-1

$q_{hbell} := 0.00256 \cdot K_{hbell} \cdot K_{zt} \cdot K_e \cdot V_{ult}^2$ $q_{hbell} = 29.559$

Wind Loads on Buildings: Main Force Resisting System (Directional Procedure)

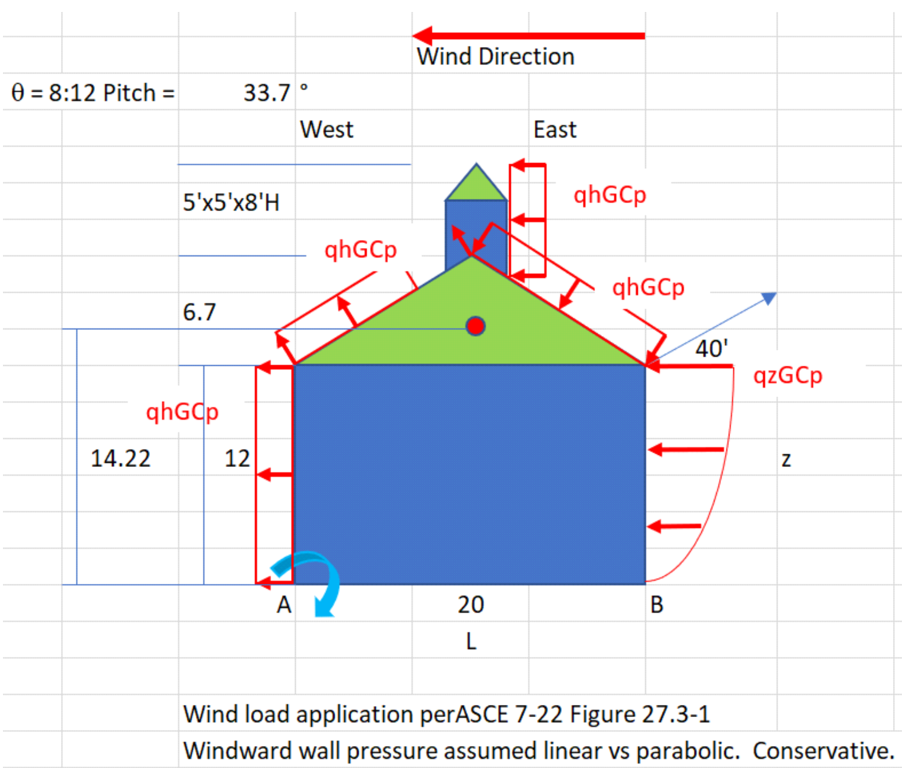
$G_f := 0.85$ Gust effect factor for rigid buildings per 26.11.1

$K_d := 0.85$ Wind Directionality Factor for main building per Table 26.6-1

$K_{dbell} := 0.90$ Wind Directionality Factor for square bell tower per Table 26.6-1

$GC_{pi} := 0.18$ +/- Internal pressure coefficient for partially open buildings per Table 26.13-1. Value can be positive or negative, whichever produces the more conservative result when combined with external wind loads.

External pressure coefficients, Cp, for the windward and leeward sides of the building account for positive and negative pressures. The figure below assumes wind from the right which puts positive pressure against the wall, roof and bell tower; and negative pressures on the opposite side of the building. Figure is copied from the loading spreadsheet.



Wind load application perASCE 7-22 Figure 27.3-1
Windward wall pressure assumed linear vs parabolic. Conservative.

External pressure coefficients, Cp, for partially open building. See Table 27.3-1.

Roof pitch = 8:12, or θ = 33.7 deg

$C_{pww} := 0.8$ — Cp for the windward vertical wall. Assume rectangular vs parabolic distribution.

$C_{pwr} := 0.3$ — Cp for the windward roof

$C_{plr} := -0.6$ — Cp for the leeward roof

$C_{plw} := -0.3$ — Cp for the leeward wall

$C_{pbell} := 0.8$ — Cp for the windward bell tower

Section 27.3 provides wind load formula for partially open buildings.

$p_{ww} := q_{zwall} \cdot K_d \cdot G_f \cdot C_{pww} + q_{zwall} \cdot K_d \cdot GC_{pi}$ $\quad p_{ww} = 19.13 \dfrac{lbf}{ft^2}$ Windward wall

$p_{wr} := q_{hroof} \cdot K_d \cdot G_f \cdot C_{pwr} + q_{hroof} \cdot K_d \cdot GC_{pi}$ $\quad p_{wr} = 9.68$ Windward roof

$p_{lr} := q_{hroof} \cdot K_d \cdot G_f \cdot C_{plr} - q_{hroof} \cdot K_d \cdot GC_{pi}$ $\quad p_{lr} = -15.35$ Leeward roof

$p_{lw} := q_{zwall} \cdot K_d \cdot G_f \cdot C_{plw} - q_{zwall} \cdot K_d \cdot GC_{pi}$ $\quad p_{lw} = -9.68$ Leeward wall

$p_{bell} := q_{hbell} \cdot K_{dbell} \cdot G_f \cdot C_{pbell}$ $\quad p_{bell} = 18.09$ Windward wall of bell tower. Internal or leeward pressure not applied to mostly open bell tower.

Calculated wind loads exceed minimum design wind loads of 16 lb/sf and 8 lb/sf for wall and roof elements, respectively. Per section 27.1.5.

Break roof pressures into vertical and horizontal components using roof pitch, 8:12, or 33.7 degree angle.

$$p_{wrx} := p_{wr} \cdot \sin\left(33.7 \cdot \frac{3.14}{180}\right) \qquad p_{wrx} = 5.37 \qquad \frac{lbf}{ft^2}$$

$$p_{wry} := p_{wr} \cdot \cos\left(33.7 \cdot \frac{3.14}{180}\right) \qquad p_{wry} = 8.05$$

$$p_{lrx} := p_{lr} \cdot \sin\left(33.7 \cdot \frac{3.14}{180}\right) \qquad p_{lrx} = -8.51$$

$$p_{lry} := p_{lr} \cdot \cos\left(33.7 \cdot \frac{3.14}{180}\right) \qquad p_{lry} = -12.77$$

Go to load spreadsheet for application of wind loads to structure and overturning moment, shear, and reactions.

Live Loads

Live load for Assembly Area with Moveable Seats, Per ASCE7-22 Table 4.3-1

Live Load = 100 psf

Application Areas

Exterior Foundation

Assuming a 0.5 x L for exterior tributary area around perimeter. Where L is the length of floor joist from interior support and exterior foundation wall, or 5 feet. See AISC beam diagram for four equal spans with first and third spans loaded. Max shear at beam ends is 0.446 x L.

Lext = 100 psf * 0.5 * 5 ft = 250 lb/ft of exterior foundation

Interior Foundation

The interior floor frame is supported by posts on a 5' by 5', or 25 SF tributary area.

Lint = 100 psf * 25 sf = 2,500 lb

Go to load spreadsheet for application of live loads to structure.

Load Combinations

Exterior
Foundation

Load combinations for strength design are provided in ASCE7-22, Chapter 2.

2.3 LOAD COMBINATIONS FOR STRENGTH DESIGN

2.3.1 Basic Combinations

1a. 1.4D
2a. 1.2D + 1.6L + (0.5Lr or 0.3S or 0.5R)
3a. 1.2D + (1.6Lr or 1.0S or 1.6R) + (L or 0.5W)
4a. 1.2D + 1.0(W or WT)+ L + (0.5Lr or 0.3S or 0.5R)
5a. 0.9D + 1.0(W or WT)

2.3.6 BasicCombinationswithSeismicLoadEffects

6. 1.2D + Ev + Eh + L + 0.15S
7. 0.9D − Ev + Eh

The following loads were evaluated for the chapel structure.

Load	Calculation Source	Note
Dead Load, D	see Dead-Seismic-Snow tab	
Snow Load, S	see Dead-Seismic-Snow tab	
Seismic Load, E	see Dead-Seismic-Snow tab	+/- (with 15% snow load)
Wind Load, W	see Wind tab	+/-
Live Load, L	see Interior Dead-Live tab	

Load were derived for exterior wall foundations as distributed loads, and combined using the factors provided above.

Go load spreadsheet for individual wall loads and load combinations. Results are presented below.

	Load Factors and Distributed Loads					Load Combinations and Load						
	Dead	Live	Snow	Wind	Siesmic							
	285	250	347	235	119	Dead	Live	Snow	Wind	Siesmic	Total	
Combination	D	L	S	W	E	D	L	S	W	E	(PLF)	
1a	1.4					399	0	0	0	0	399	
2a	1.2	1.6	0.3			342	400	104	0	0	846	
3a-1	1.2	1	1			342	250	347	0	0	939	
3a-2	1.2		1	0.5		342	0	347	117	0	807	
4a	1.2	1	0.3			342	250	104	0	0	696	
5a-1	0.9			1		257	0	0	235	0	491	
5a-2	0.9			-1		257	0	0	-235	0	22	*
6	1.2	1	0.15		1	342	250	52	0	119	764	
7-1	0.9				-1	257	0	0	0	-119	137	
										** Max	939	
										Min	22	

* Close to minimum. Add anchors along perimeter of chapel footing. Dead load does not include stem wall or footing, so anchors will provide higher factor of safety.

** Add stem wall and footing for check of max soil pressure.

Interior Footing

Assuming that wind, siesmic and snow loads are carried by the exterior stem wall and footing. Interior posts and footings will carry live and tributary dead loads from floor and framing. Results for interior foundations are provide below from the Load spreadsheet.

	Load Factors and Distributed Loads						Load Combinations and Load					
	Dead	Live	Snow	Wind	Siesmic							
	734	2500	0	0	0	(lb)	Dead	Live	Snow	Wind	Siesmic	Total
Combination	D	L	S	W	E		D	L	S	W	E	(lb)
1a	1.4						1028	0	0	0	0	1028
2a	1.2	1.6	0.3				881	4000	0	0	0	4881
3a-1	1.2	1	1				881	2500	0	0	0	3381
3a-2	1.2		1	0.5			881	0	0	0	0	881
4a	1.2	1	0.3				881	2500	0	0	0	3381
5a-1	0.9			1			661	0	0	0	0	661
5a-2	0.9			-1			661	0	0	0	0	661
6	1.2	1	0.15		1		881	2500	0	0	0	3381
7-1	0.9				-1		661	0	0	0	0	661
											Max	4881
											Min	661

Footing Sizing

Interior Post Footing

Interior post footings will carry 2,500 lb of live load and 516 lb of dead load from combined flooring, framing and post materials. Assuming the post footing is 24"x24"x10". See Loading spreadsheet for details about loads.

$p_{postmax} := 4881 lbf$

$A_{postfoot} := 2ft \cdot 2ft$ $\quad A_{postfoot} = 4 \cdot ft^2$

$p_{postfoot} := \frac{p_{postmax}}{A_{postfoot}}$ $\quad p_{postfoot} = 1220 \cdot psf$ $\quad$ < 1,500. OK

Two Way Punching Shear Check

Reference ACI 318-19, Section 22.6.5 for two way shear strength without shear reinforcement.

$\lambda = 1$ for normal wieght concrete per 19.2.4.
$\lambda s = 1$ per 22.5.5.1.3

$f'_c := 2500 psi$

$fc_{check} := \left(\frac{f'_c}{psi}\right)^{.5} \cdot psi$ $\quad fc_{check} = 50\, psi$ $\quad$ per 22.6.3.1 (f'c)^.5 cannot exceed 100 psi - OK

$v_{c2} := 4 \cdot \left(\frac{f'_c}{psi}\right)^{.5} \cdot psi$ $\quad v_{c2} = 200\, psi$

$b := 6 in$ $\quad$ Existing foundation posts are square rough cut 6"x6" timbers.

$d := 10 in - 3 in$ $\quad d = 7\, in$ $\quad$ Assuming 3" min cover on footing rebar

$b_o := 4 \cdot \left(b + \frac{d}{2}\right)$ $\quad b_o = 38\, in$ $\quad$ 22.6.4.1(a)

$V_{c2} := v_{c2} \cdot b_o \cdot d$ $\quad V_{c2} = 53200 \cdot lbf$ $\quad$ >> 4881 lb maximum factored load - OK

One Way Direct Shear

$Q_u := \frac{p_{postmax}}{24in \cdot 24in}$ $Q_u = 8.474\ psi$ Footing pressure from max factored load

$b_w := 24in$

$b_p := \frac{(b_w - 6in)}{2} - d$ $b_p = 2\ in$ Width of footing outside failure surface at d away from face of column

$V_{c1} := \frac{(Q_u \cdot b_p \cdot b_w)}{d \cdot 24in}$ $V_{c1} = 2.421\ psi$ Shear stress resulting from footing pressure

$v_{c1} := 2 \cdot \left(\frac{f'_c}{psi}\right)^{.5} \cdot psi$ $v_{c1} = 100\ psi$ Shear capacity. Simplified form of 22.5.5.1 (a)

vc1 >> Vc1 - OK

Exterior Footing

The exterior footing will support an 8-inch reinforced CMU stem wall. The dead loads for foundation materials must be added to the maximum distributed load.

Assume footing width of 18 inches and depth of 10 inches.

Assume maximum number of CMU block courses = 5 to ensure bottom of footing is below design frost depth.

$$w_{max} := 939$$

$$w_{cmu} := \frac{5 \cdot 8 \cdot 8}{144} \cdot 150 \qquad w_{cmu} = 333.3$$

$$w_{foot} := \frac{10 \cdot 18}{144} \cdot 150 \qquad w_{foot} = 187.5$$

$$w_{footdes} := w_{max} + w_{cmu} + w_{foot} \qquad w_{footdes} = 1459.8 \ \frac{lbf}{ft}$$

Maximum allowable soil bearing pressure = 1,500 psf per Douglas County, unless site specific evaluations are completed. No geotechnical information is available therefore the Douglas County criteria will be used.

$$p_{soil} := \frac{w_{footdes}}{\frac{18}{12}} \qquad p_{soil} = 973.2$$ psf < 1,500. OK

Exterior Spread Footing Shear Check

$$b_w := 18in$$

$$b_p := \frac{(b_w - 6in)}{2} - d \qquad b_p = -1\ in$$

Width of footing outside failure surface at d away from face of column.

No portion of footing is outside failure plane.

Check shear capacity of 1 foot length of footing versus maximum factored distributed load.

$$V_{cspread} := v_{c1} \cdot d \qquad V_{cspread} = 8400\ plf$$ >> 939 plf factored load - OK

$kip := 1000 \cdot lbf$

$pcf := \frac{lbf}{ft^3}$

$ksi := \frac{kip}{in^2}$

$plf := \frac{lbf}{ft}$

$klf := \frac{kip}{ft}$

$psf := \frac{lbf}{ft^2}$

$ksf := \frac{kip}{ft^2}$

Reinforcing Bar diameter and area

$$d_{bar} := \begin{pmatrix} 0.375 \\ 0.500 \\ 0.625 \\ 0.750 \\ 0.875 \\ 1.00 \\ 1.128 \\ 1.270 \\ 1.410 \end{pmatrix} \cdot in \qquad A_{bar} := \begin{pmatrix} 0.11 \\ 0.20 \\ 0.31 \\ 0.44 \\ 0.60 \\ 0.79 \\ 1.00 \\ 1.27 \\ 1.56 \end{pmatrix} \cdot in^2$$

Multi-Period MCER Spectrum-2022
Source: ASCE 7 Hazards Report

T(s)	Sa(g)
0	0.97
0.01	0.97
0.02	0.98
0.03	1.05
0.05	1.31
0.075	1.62
0.1	1.85
0.15	2.21
0.2	2.38
0.25	2.44
0.3	2.48
0.4	2.37
0.5	2.29
0.75	1.94
1	1.66
1.5	1.17
2	0.89
3	0.57
4	0.38
5	0.27
7.5	0.13
10	0.081

DB23-0477

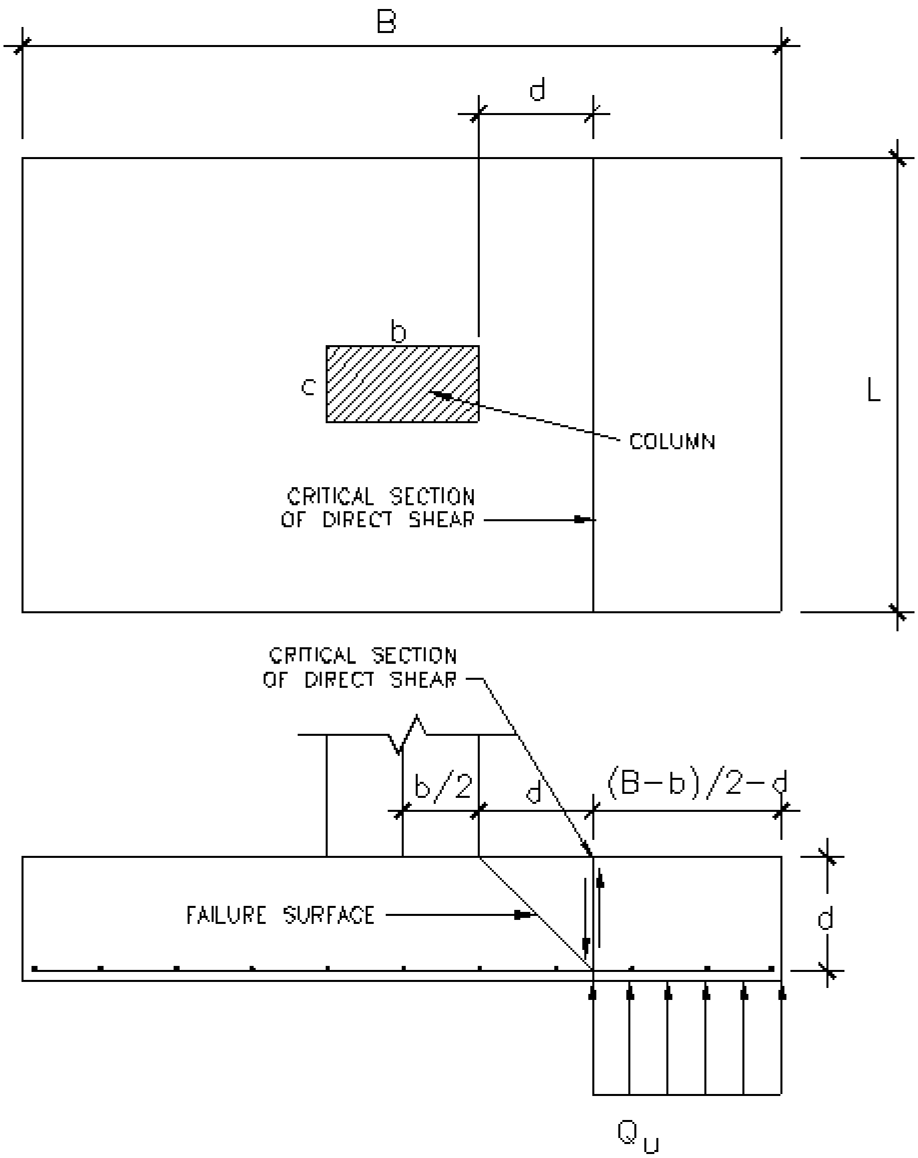


Figure 2.4. Critical section of direct shear

moffatt & nichol	CLIENT: Town of Genoa	JOB # : 222911 Carson City	
	PROJECT: Church Foundation Repair	SHEET: 1 OF 1	
	DESIGN FOR: Dead, Seismic, Snow Load Calculations	DESIGNER: CAW	DATE:
		CHECKER:	DATE:

References/Comments

1) ASCE 7-22 Minimum Design Loads and Associated Criteria for Buildings and Other Structures
2) This spreadsheet references information developed within separate Mathcad calculations
3) Some results from this spreadsheet are copied back to Mathcad calculations
4) Weights of Building Materials - Structural Design In Wood (Stalnaker), and McGraw Hill Access Engineering Web Page

Dead Loads — Material Weights (psf)

Building Component	H/L	W	Area	Qty	Asphalt Shingle	Roll Roofing	2x6 Joists @ 24" O.C.	2x4 Studs @16" O.C.	Plywood 1/2"	T&G Wood 1-1/2"	Insulation	T&G Wood 1/2"	Carpet	Siding	6x6 Beam/Post (plf)	Material Total	Weight	Moment Arm (A)	Righting Moment
	ft	ft	sf	ea	2	1	1.15	1.09	1.5	4.5	1.5	1.5	1.5	2	8.40	psf	lb	ft	ft-lb
West Roof	13.5	42	567		1	1	1		1			1				7.15	4,052	5	20,258
East Roof	13.5	42	567		1	1	1		1			1				7.15	4,052	15	60,775
North Gable	6.7	10	67			1		1	1		1	1		1		8.59	573	10	5,729
South Gable	6.7	10	67			1		1	1		1	1		1		8.59	573	10	5,729
North Wall	12.0	20	240			1		1	1		1	1		1		8.59	2,063	10	20,625
South Wall	12.0	20	240			1		1	1		1	1		1		8.59	2,063	10	20,625
West Wall	12.0	40	480			1		1	1		1	1		1		8.59	4,125	0	-
East Wall	12.0	40	480			1		1	1		1	1		1		8.59	4,125	20	82,500
Ceiling	20	40	800				1				1	1				4.15	3,317	10	33,167
Floor	20	40	800				1			1			1			7.15	5,717	10	57,167
Floor Frame	40			5											1		1,681	10	16,806
Posts	3			45											1		1,134	10	11,344
Bell Tower Walls	4	20	80			1		1	1					1		5.59	448	10	4,475
Bell Tower Roof	6	6	36		1	1	1		1							5.65	203	10	2,033
Bell				1													100	10	1,000
																Dead Load Only	34,223		342,232

Seismic Loads / **Snow Loads**

Building Component	Cs (g) (Note 1)	Horizontal Shear ,Fs	Moment Arm (A)	Overturning Moment	Snow Loads Material (psf) Snow
		lb	ft	ft-lb	45.1
West Roof	0.254	1,029	15.3	15,780	
East Roof	0.254	1,029	15.3	15,780	
North Gable	0.254	146	14.2	2,070	
South Gable	0.254	146	14.2	2,070	
North Wall	0.254	524	6	3,143	
South Wall	0.254	524	6	3,143	
West Wall	0.254	1,048	6	6,287	
East Wall	0.254	1,048	6	6,287	
Ceiling	0.254	842	12.0	10,109	
Floor	0.254	1,452	1	1,452	
Floor Frame	0.254	427	1	427	
Posts	0.254	288	0	-	
Bell Tower Walls	0.254	114	22.7	2,576	
Bell Tower Roof	0.254	52	26.7	1,377	
Bell	0.254	25	24.7	627	
Dead Load Only		8,693		71,126	

	H/L	W	Area
	ft	ft	sf
Roof Projection for Snow Loads	22	42	924

	Weight	Moment Arm	Righting Moment	Cs	Horizontal Shear	Moment Arm	Overturning Moment	Snow
15% of Total Snow Load for Seismic	6,251	10	62,510	0.254	1,588	15.3	24,346	41,672
Dead Load + 15% Snow Load for Seismic	40,474		404,742		10,280		95,472	

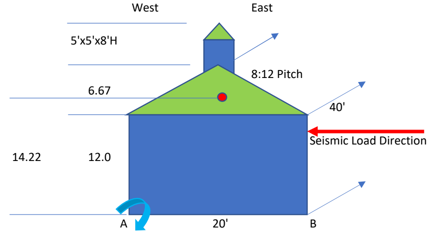
Dead Load Distributed to Exterior Footing 285 lb/ft

Snow Load Distributed to Exterior Footing 347 lb/ft

SS Lumber Weights
(Used in Material Weight Calcs Above)

SS Wood Density 40 pcf

	lb/ft
2x4	1.46
2x6	2.29
6x6	8.40



Notes
1) See Mathcad Calcs for seismic acceleration, Cs
2)

Seismic Only Global Check (DL Righting / Wind Overturning Moment) 4.2 FS

	Location A	Location B	
Seismic Global Reactions at A and B*	4774	-4774	lb
Seismic Reactions at Corners**	2387	-2387	lb
Seismic Distributed Load Along East & West Walls***	119	-119	lb/ft

*Assumes a moment couple of 20 feet
**Assumes all loads go to shear wall ends
***Assumes all seismic loads distributed to N/S wall footings
Reactions do not account for countering dead loads.

DB23-0477

moffatt & nichol	CLIENT: Town of Genoa	JOB # : 222911 Carson City	
	PROJECT: Church Foundation Repair	SHEET: 1 OF 1	
	DESIGN FOR: Wind Load Calculations	DESIGNER: CAW	DATE:
		CHECKER:	DATE:

References/Comments

1) ASCE 7-22 Minimum Design Loads and Associated Criteria for Buildings and Other Structures
2) This spreadsheet references information developed within separate Mathcad calculations
3) Some results from this spreadsheet are copied back to Mathcad calculations

Building Component	H/L ft	W ft	Area sf	Moment Arm (A) ft	Wind Pressure (Note 1) lb/SF	Wind Load lb	Overturning Moment ft-lb	Dead Load Righting Moment ft-lb	Shear lb	Wind Load Direction	Note
West Roof - x	13.5	42	567	15.3	-8.51	-4825	73986		4825	←	
West Roof - y	13.5	42	567	5	-12.77	-7241	36203			↑	
East Roof - x	13.5	42	567	15.3	5.37	3045	46687		3045	←	
East Roof - y	13.5	42	567	15.0	8.05	4564	-68465			↓	
West Wall	12	40	480	6	-9.68	-4646	27878		4646	←	
East Wall	12	40	480	6	19.13	9182	55094		9182	←	Note 2
Bell Tower	8	5	40	22.7	18.09	724	16402		724	←	
							187785	342232	22422		

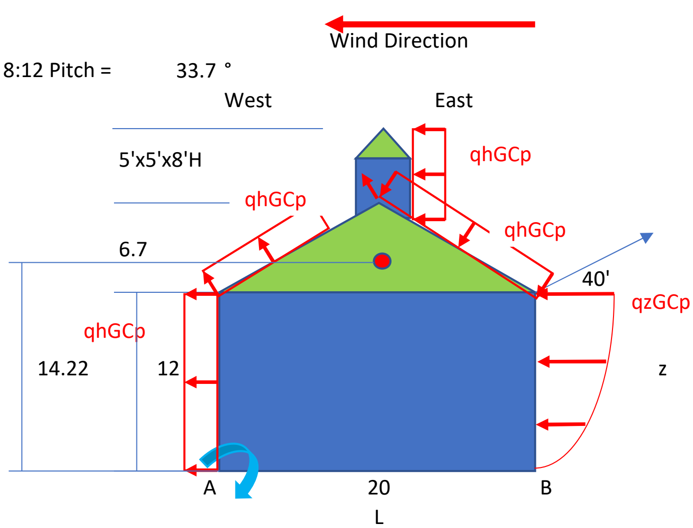
Notes
1) See Mathcad Calcs for wind pressures
2) Windward wall pressure assumed linear vs parabolic. Conservative.

Wind Only Global Check (DL Righting / Wind Overturning Moment) 1.8 FS

	Location A	Location B	
Wind Global Reactions at A and B*	9389	-9389	lb
Wind Reactions at Corners**	4695	-4695	lb
Wind Distributed Load Along East & West Walls***	235	-235	lb/ft

*Assumes a moment couple of 20 feet
**Assumes all loads go to shear wall ends
***Assumes all wind loads distributed to N/S wall footings
Reactions do not account for countering dead loads.

θ = 8:12 Pitch = 33.7 °



Wind load application perASCE 7-22 Figure 27.3-1
Windward wall pressure assumed linear vs parabolic. Conservative.

DB23-0477

moffatt & nichol			
CLIENT: Town of Genoa	JOB # : 222911 Carson City		
PROJECT: Church Foundation Repair	SHEET: 1 OF 1		
DESIGN FOR: Interior Dead Loads and Live Loads	DESIGNER: CAW	DATE:	
	CHECKER:	DATE:	

References/Comments

1) ASCE 7-22 Minimum Design Loads and Associated Criteria for Buildings and Other Structures
2) This spreadsheet references information developed within separate Mathcad calculations
3) Some results from this spreadsheet are copied back to Mathcad calculations
4) Weights of Building Materials - Structural Design In Wood (Stalnaker), and McGraw Hill Access Engineering Web Page
5) Live load for Assembly Area with Moveable Seats, Per ASCE7-22 Table 4.3-1

					Dead Load on Interior Supports Material Weights (psf)							**Live Load**
Building	H/L	W	Area	Qty	2x6 Joists @ 24" O.C.	6x6 Beam/Post (plf)	T&G Wood 1-1/2"	Carpet	10" Thick 150 pcf Concrete	Material Total	Weight	(psf)
Component	ft	ft	sf	ea	1.15	8.40	4.5	1.5	125	psf	lb	100
Floor	5	5	25				1	1		6.00	150	2500
Floor Frame	5			1		1					42	
Floor Frame	5			3	1						17	
Posts	3			1		1					25	
Footing - 10" Thick	2	2	4	1					1	125	500	
									Dead and Live Loads per Post Footing		734	2500

SS Lumber Weights
(Used in Material Weight Calcs Above)

SS Wood Density 40 pcf

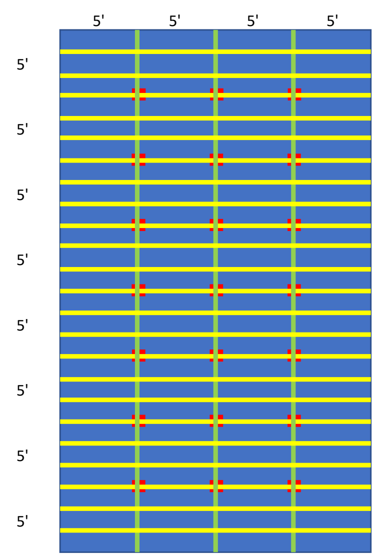
	lb/ft
2x4	1.46
2x6	2.29
6x6	8.40

Live Load Distributed to Exterior Footing (Note 1) 250 lb/ft

Notes
1) Assuming a 0.5 x L for exterior tributary area around perimeter.
See AISC beam diagram on Misc tab for four equal spans
Max shear at beam ends is 0.446 x L for first and third spans loaded.

Floor Framing Layout

1) Interior posts and footers are at 5 foot each way.
2) 6" x 6" beams run north/south and rest on the interior posts and exterior foundation.
3) 2" x 6" floor joists run east/west and rest on the 6" x 6" beams and exterior foundation.



	CLIENT: Town of Genoa	JOB # : 222911 Carson City	
moffatt & nichol	PROJECT: Church Foundation Repair	SHEET: 1 OF 1	
	DESIGN FOR: Load Combinations	DESIGNER: CAW	DATE:
		CHECKER:	DATE:

References/Comments

1) ASCE 7-22 Minimum Design Loads and Associated Criteria for Buildings and Other Structures
2) This spreadsheet references information developed within separate Mathcad calculations
3) Some results from this spreadsheet are copied back to Mathcad calculations

Load Combinations

Load combinations from ASCE7-22, Chapter 2

2.3 LOAD COMBINATIONS FOR STRENGTH DESIGN

2.3.1 Basic Combinations

1a. 1.4D
2a. 1.2D + 1.6L + (0.5Lr or 0.3S or 0.5R)
3a. 1.2D + (1.6Lr or 1.0S or 1.6R) + (L or 0.5W)
4a. 1.2D + 1.0(W or WT)+ L + (0.5Lr or 0.3S or 0.5R)
5a. 0.9D + 1.0(W or WT)

2.3.6 BasicCombinationswithSeismicLoadEffects

6. 1.2D + Ev + Eh + L + 0.15S
7. 0.9D − Ev + Eh

Applicable?	**Loading**
Yes	D=Dead load
No	Di =Weight of ice
Yes	E=Earthquake load
No	F =Load caused by fluids with well-defined pressures and maximum heights other than those caused by groundwater pressure
No	Fa =Flood load
No	H =Load due to lateral earth pressure (including lateral earth pressure from fixed or moving surcharge loads), ground water pressure, or pressure of bulk materials
Yes	L=Live load
No	Lr =Roof live load
No	N =Notional load for structural integrity, Section 1.4
No	R=Rain load
Yes	S=Snow load
No	T =Cumulative effect of self-straining forces and effects arising from contraction or expansion resulting from environmental or operational temperature changes, shrinkage, moisture changes, creep in component materials, movement caused by differential settlement, or combinations thereof
Yes	W =Wind load
No	Wi =Wind-on-ice, determined in accordance with Chapter 10
No	WT =Tornado load, determined in accordance with Chapter 32

Exterior Footing Assuming Distributed Loads (PLF)

Dead Load, D	see Dead-Seismic-Snow tab	
Snow Load, S	see Dead-Seismic-Snow tab	
Seismic Load, E	see Dead-Seismic-Snow tab	+/- (with 15% snow load)
Wind Load, W	see Wind tab	+/-
Live Load, L	see Interior Dead-Live tab	

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Load Factors and Distributed Loads

	Dead	Live	Snow	Wind	Siesmic
	285	250	347	235	119
Combination	D	L	S	W	E
1a	1.4				
2a	1.2	1.6	0.3		
3a-1	1.2	1	1		
3a-2	1.2		1	0.5	
4a	1.2	1	0.3		
5a-1	0.9			1	
5a-2	0.9			-1	
6	1.2	1	0.15		1
7-1	0.9				-1

Load Combinations and Load

Dead	Live	Snow	Wind	Siesmic	Total	
D	L	S	W	E	(PLF)	
399	0	0	0	0	399	
342	400	104	0	0	846	
342	250	347	0	0	939	
342	0	347	117	0	807	
342	250	104	0	0	696	
257	0	0	235	0	491	
257	0	0	-235	0	22	*
342	250	52	0	119	764	
257	0	0	0	-119	137	

** Max 939
Min 22

* Close to minimum. Add anchors along perimeter of chapel footing. Dead load does not include stem wall or footing, so anchors will provide higher factor of safety.

** Add stem wall and footing for check of max soil pressure.

Interior Footing Loads (lb)

Assuming that wind, siesmic and snow loads are carried by the exterior stem wall and footing. Interior posts and footings will carry live and tributary dead loads from floor and framing. See Interior Dead-Live tab for point loads.

Dead Load, D see Dead-Seismic-Snow tab
Live Load, L see Interior Dead-Live tab

Load Factors and Distributed Loads

	Dead	Live	Snow	Wind	Siesmic	
	734	2500	0	0	0	(lb)
Combination	D	L	S	W	E	
1a	1.4					
2a	1.2	1.6	0.3			
3a-1	1.2	1	1			
3a-2	1.2		1	0.5		
4a	1.2	1	0.3			
5a-1	0.9			1		
5a-2	0.9			-1		
6	1.2	1	0.15		1	
7-1	0.9				-1	

Load Combinations and Load

Dead	Live	Snow	Wind	Siesmic	Total
D	L	S	W	E	(lb)
1028	0	0	0	0	1028
881	4000	0	0	0	4881
881	2500	0	0	0	3381
881	0	0	0	0	881
881	2500	0	0	0	3381
661	0	0	0	0	661
661	0	0	0	0	661
881	2500	0	0	0	3381
661	0	0	0	0	661

Max 4881
Min 661

WoodWorks® Shearwalls 2023

Genoa Church.wsw **Jan. 30, 2023 11:48:20**

Project Information

DESIGN SETTINGS

Design Code	Wind Standard	Seismic Standard
IBC 2021/AWC SDPWS 2021	ASCE 7-16 Directional (All heights)	ASCE 7-16

Load Combinations		Building Code Capacity Modification	
For Design (ASD)	**For Deflection (Strength)**	**Wind**	**Seismic**
0.70 Seismic + 0.60 Dead	1.00 Seismic + 0.90 Dead	1.00	1.00
0.60 Wind + 0.60 Dead	1.00 Wind + 0.90 Dead		

Service Conditions and Load Duration				Max Shearwall Offset [ft]	
Duration Factor	**Temperature Range**	**Moisture Content Fabrication**	**Moisture Content Service**	**Plan (within story)**	**Elevation (between stories)**
1.60	T<=100F	19% (<=19%)	10% (<=19%)	0.50	-

Maximum Height-to-width Ratio						
Wood panels Blocked	**Wood panels Unblocked**	**Fiberboard**	**Lumber Wind**	**Lumber Seismic**	**Gypsum Blocked**	**Gypsum Unblocked**
3.5	2.0	-	2.0	2.0	2.0	1.5

Ignore shear resistance contribution of...		Forces based on...	
Wall segments	**Seismic**	**Hold-downs**	Applied loads
Side with invalid aspect ratio	Don't ignore	**Drag struts**	Applied loads

Shearwall relative rigidity:	Deflection-based stiffness of wall segments
Non-identical materials and construction on the shearline:	Allowed, except for material type
Deflection Equation:	3-term from SDPWS 4.3-1
Drift limit for wind design:	1 / 500 story height
FTAO strap:	Continuous at top of highest opening and bottom of lowest

SITE INFORMATION

Wind
ASCE 7-16 Directional (All heights)

Design Wind Speed	120 mph
Serviceability Wind Speed	100 mph
Exposure	Exposure C
Enclosure	Partially open
Min Wind Loads: Walls	16 psf
Roofs	8 psf

Topographic Information [ft]		
Shape	**Height**	**Length**
-	-	-

Site Location: -

Elev: 4800ft
Rigid building - Static analysis

Case 2	**E-W loads**	**N-S loads**
Eccentricity (%)	15	15
Loaded at	75%	

Seismic
ASCE 7-16 12.8 Equivalent Lateral Force Procedure

Risk Category	Category II - All others
Structure Type	Irregular
Building System	Bearing Wall
Design Category	D
Site Class	D

Spectral Response Acceleration
S1: 0.700g **Ss:** 1.870g

Fundamental Period	**E-W**	**N-S**
T Used	0.155s	0.155s
Approximate Ta	0.155s	0.155s
Maximum T	0.217s	0.217s
Response Factor R	2.00	2.00

Fa: 1.20 **Fv:** 1.70

Structural Data

STORY INFORMATION

	Story Elev [ft]	Floor/Ceiling Depth [in]	Wall Height [ft]	Hold-down Length subject to shrinkage [in]	Hold-down Bolt length [in]
Ceiling	12.83	0.0			
Level 1	0.83	10.0	12.00	16.0	16.0
Foundation	0.00				

BLOCK and ROOF INFORMATION

Block Dimensions [ft]			Roof Panels Face	Type	Slope	Overhang [ft]
Block 1	1 Story	N-S Ridge				
Location X,Y =	0.00	0.00	**North**	Gable	90.0	1.00
Extent X,Y =	20.00	40.00	**South**	Gable	90.0	1.00
Ridge X Location, Offset	10.00	0.00	**East**	Side	33.7	1.00
Ridge Elevation, Height	19.50	6.67	**West**	Side	33.7	1.00
Block 2	1 Story	E-W Ridge				
Location X,Y =	20.00	26.25	**North**	Side	20.0	1.00
Extent X,Y =	13.25	24.75	**South**	Side	20.0	1.00
Ridge Y Location, Offset	38.63	0.00	**East**	Gable	90.0	1.00
Ridge Elevation, Height	17.34	4.50	**West**	Gable	90.0	0.00
Block 3	1 Story	E-W Ridge				
Location X,Y =	4.00	40.25	**North**	Side	20.0	1.00
Extent X,Y =	16.00	10.75	**South**	Side	20.0	0.00
Ridge Y Location, Offset	45.63	0.00	**East**	Joined	90.0	0.00
Ridge Elevation, Height	14.79	1.96	**West**	Gable	90.0	1.00

SHEATHING MATERIALS by WALL GROUP

Grp	Surf	Material	Ratng	Sheathing Thick in	GU in	Ply	Or	Gvtv lbs/in	Fasteners Size	Type	RS	Eg in	Fd in	Bk	Apply Notes
1	Both	Lumber siding		3/4	-	-	Horz	25000	8d	Common	N	3	2	N	4,8
2	Ext	Structural sheath	24/0	5/16	-	3	Horz	25000	6d	Common	N	3	2	N	1
	Int	GSB 4x8		1/2	-	-	Horz	40000	11 ga	Galv	N	7	7	N	
3	Both	Lumber siding		3/4	-	-	Horz	25000	8d	Common	N	3	2	N	4,8

Legend:
Grp – Wall Design Group number, used to reference wall in other tables (created by program)
Surf – Exterior or interior surface when applied to exterior wall
Ratng – Span rating, see SDPWS Table C4.2.3C
Thick – Nominal panel thickness
GU - Gypsum underlay thickness
Ply – Number of plies (or layers) in construction of plywood sheets
Or – Orientation of longer dimension of sheathing panels or lumber planks. Dbl. = Double diagonal.
Gvtv – Shear stiffness in lb/in. of depth from SDPWS Tables C4.2.3A-B
Type – Fastener type from SDPWS Tables 4.3A-D:
Common: common wire nail; Box: galvanized box nail; Casing: casing nail; Roof: galvanized roofing nail; Cooler: cooler nail; WBoard: wallboard nail; Screw: drywall screw; Gauge: nail measured by gauge; Galv: galvanized gauge nail; GWB: Gypsum wallboard blued nail
Size - From Tables 4.3A-D and Table A1; shown in Wall Input fastener dropdown
Common nails: 6d = 0.113 x 2", 8d = 0.131 x 2.5", 10d = 0.148 x 3", 12d = 0.148 x 3.5"
Box or casing nails: 6d = 0.099 x 2", 8d = 0.113 x 2.5", 10d = 0.128 x 3", 12d = 0.126 x 3.5"
Gauge, roofing and GWB nails: 13 ga = 0.92" x 1-1/8"; 11 ga = 0.120" x 1-1/8" (GWB nail for gypsum lath & plaster), 1-1/4" (gyp. L&P), 1-1/2" (wire lath & plaster, 1/2" fiberboard ,1/2" GWB), 1-3/4" (GSB, 5/8" GWB, 25/32" fiberboard, 2-ply GWB base), 2-3/8" (2-ply GWB face)
Cooler or wallboard nail: 5d = .086" x 1-5/8"; 6d = .092" x 1-7/8"; 8d = .113" x 2-3/8"; 6/8d = 6d base ply, 8d face ply for 2-ply GWB.
Drywall screws: No. 6, 1-1/4" long.
RS – Ring-shank nails (non-shearwalls only), with increased withdrawal capacity as per NDS 12.2.3.2.
Eg – Panel edge fastener spacing. For lumber sheathing, no. of nails per board at shear wall boundary. For 2-ply GWB, spacing of all nails in face ply.
Fd – Field spacing interior to panels. For lumber sheathing, no. of nails per board at interior studs. For 2-ply GWB, spacing of all nails in face ply.
Bk – Sheathing is nailed to blocking at all panel edges; Y(es) or N(o)
Apply Notes – Notes below table legend which apply to sheathing side

Notes:
1.Capacity has been reduced for framing specific gravity according to SDPWS Table 4.3A Note 3. A factor of 0.93 is applied for Hem.-Fir framing and 0.92 for S.-P.-F. For other materials with specific gravity G less than 0.5, it is G + 0.5.
4. This material does not contribute to seismic shear resistance as it is not allowed in Seismic Design Category D according to SDPWS 4.3.7.9 for horizontal lumber sheathing.
8. Nails per board is for 1x6 and smaller boards.

FRAMING MATERIALS and STANDARD WALL by WALL GROUP

Wall Grp	Species	Grade	b in	d in	Spcg in	SG	E psi^6	Fcp	Standard Wall
1	S-P-F	Stud	1.50	5.50	16	0.42	1.20	425	
2	S-P-F	Stud	1.50	5.50	16	0.42	1.20	425	
3	S-P-F	Stud	1.50	5.50	16	0.42	1.20	425	

Legend:
Wall Grp – Wall Design Group
b – Stud breadth (thickness)
d – Stud depth (width)
Spcg – Maximum on-centre spacing of studs for design, actual spacing may be less.
SG – Specific gravity
E – Modulus of elasticity
Standard Wall - Standard wall designed as group.
Fcp - Compressive strength perpendicular to grain

Notes:
Check manufacture requirements for stud size, grade and specific gravity (G) for all shearwall hold-downs.
The following factors are applied to Fcp for compressive design and deformation under wall segment end studs :
Bearing area factor Cb from NDS 3.10.4, under window openings.

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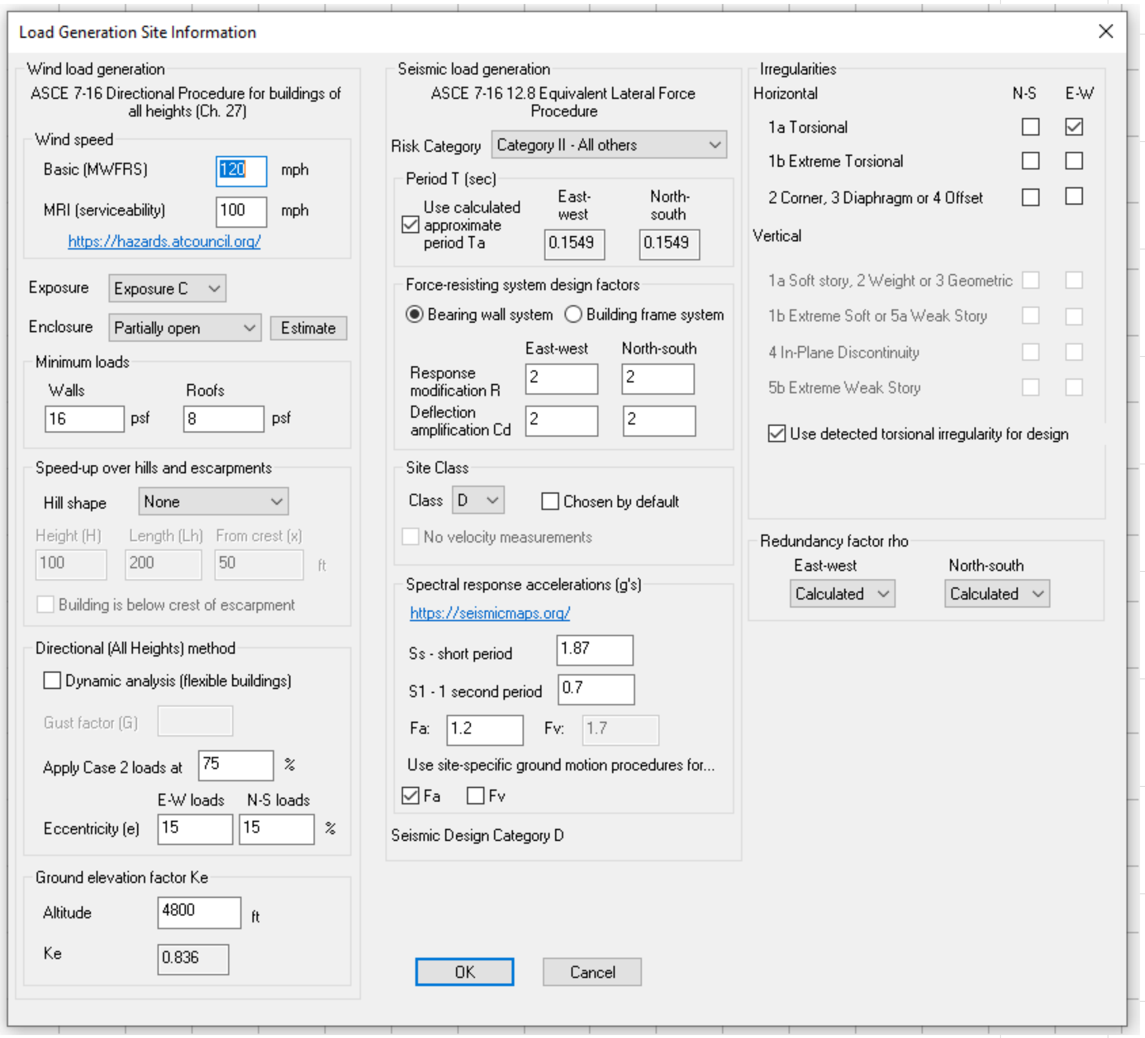
SHEARLINE, WALL and OPENING DIMENSIONS

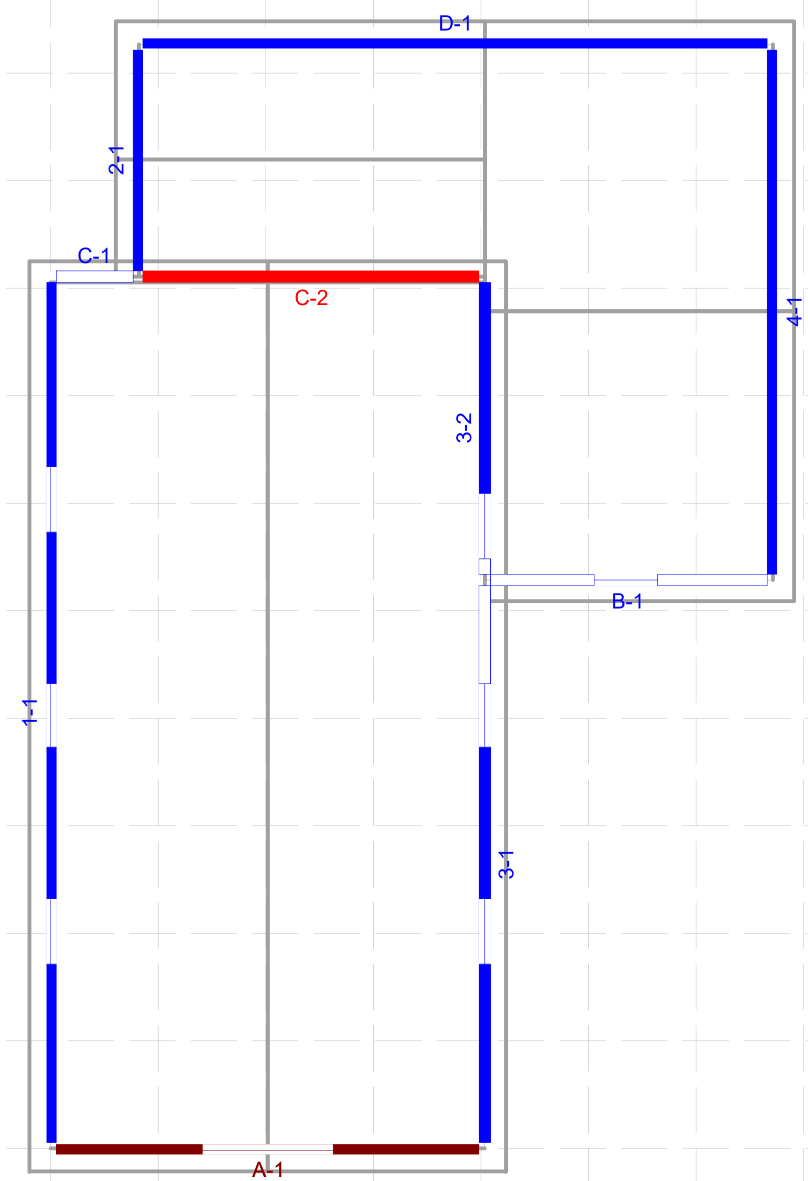
North-south Shearlines	Type	Wall Group	Location X [ft]	Extent [ft] Start	End	Length [ft]	FHS [ft]	Aspect Ratio	Height [ft]	Studs S	N
Line 1											
Level 1											
Line 1		3	0.00	0.00	40.25	40.25	31.25	-	12.00	-	-
Wall 1-1	Seg	3	0.00	0.00	40.25	40.25	31.25	-	-	2	2
Segment 1		-	-	0.00	8.50	8.50	8.25	1.41	-	2	2
Opening 1		-	-	8.50	11.50	3.00	-	-	6.00	2	2
Segment 2		-	-	11.50	18.50	7.00	6.75	1.71	-	2	2
Opening 2		-	-	18.50	21.50	3.00	-	-	6.00	2	2
Segment 3		-	-	21.50	28.50	7.00	6.75	1.71	-	2	2
Opening 3		-	-	28.50	31.50	3.00	-	-	6.00	2	2
Segment 4		-	-	31.50	40.25	8.75	8.50	1.37	-	2	2
Line 2											
Level 1											
Line 2	Seg	2	4.00	0.00	51.00	51.00	10.50	-	12.00	-	-
Wall 2-1	Seg	2	4.00	40.25	51.00	10.75	10.50	1.12	-	2	2
Line 3											
Level 1											
Line 3		3,1	20.00	0.00	51.00	51.00	25.50	-	12.00	-	-
Wall 3-1	Seg	3	20.00	0.00	26.25	26.25	15.50	-	-	2	2
Segment 1		-	-	0.00	8.50	8.50	8.25	1.41	-	2	2
Opening 1		-	-	8.50	11.50	3.00	-	-	6.00	2	2
Segment 2		-	-	11.50	18.50	7.00	6.75	1.71	-	2	2
Opening 2		-	-	18.50	21.50	3.00	-	-	6.00	2	2
Segment 3		-	-	21.50	26.25	4.75	4.50	2.53	-	2	2
Wall 3-2	Seg	1	20.00	26.25	40.25	14.00	10.00	-	-	2	2
Segment 1		-	-	26.25	27.25	1.00	0.75	12.00	-	2	2
Opening 1		-	-	27.25	30.25	3.00	-	-	6.67	2	2
Segment 2		-	-	30.25	40.25	10.00	9.75	1.20	-	2	2
Line 4											
Level 1											
Line 4	Seg	2	33.25	26.25	51.00	24.75	24.50	-	12.00	-	-
Wall 4-1	Seg	2	33.25	26.25	51.00	24.75	24.50	0.48	-	2	2

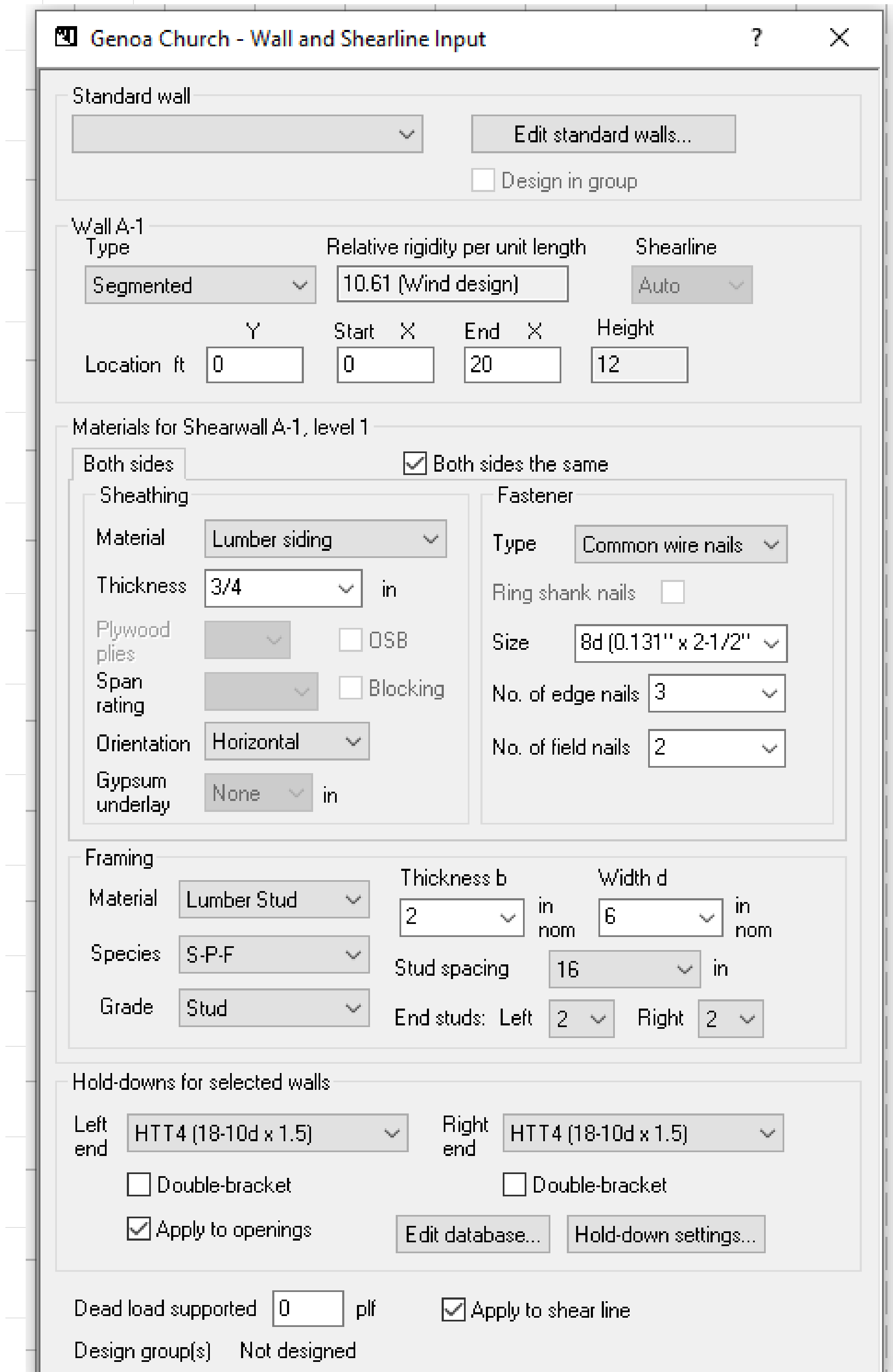
East-west Shearlines	Type	Wall Group	Location Y [ft]	Extent [ft] Start	End	Length [ft]	FHS [ft]	Aspect Ratio	Height [ft]	Studs W	E
Line A											
Level 1											
Line A		1	0.00	0.00	20.00	20.00	14.00	-	12.00	-	-
Wall A-1	Seg	1	0.00	0.00	20.00	20.00	14.00	-	-	2	2
Segment 1		-	-	0.00	7.00	7.00	6.75	1.71	-	2	2
Opening 1		-	-	7.00	13.00	6.00	-	-	6.67	2	2
Segment 2		-	-	13.00	20.00	7.00	6.75	1.71	-	2	2
Line B											
Level 1											
Line B		2	26.25	0.00	33.25	33.25	0.00	-	12.00	-	-
Wall B-1	Seg	2	26.25	20.00	33.25	13.25	0.00	-	-	2	2
Segment 1		-	-	20.00	25.00	5.00	4.75	2.40	-	2	2
Opening 1		-	-	25.00	28.00	3.00	-	-	6.67	2	2
Segment 2		-	-	28.00	33.25	5.25	5.00	2.29	-	2	2
Line C											
Level 1											
Line C		3	40.25	0.00	33.25	33.25	16.00	-	12.00	-	-
Wall C-1	Seg	3	40.25	0.00	4.00	4.00	3.75	3.00	-	2	2
Wall C-2	Seg	3	40.25	4.00	20.00	16.00	15.75	0.75	-	2	2
Line D											
Level 1											
Line D	Seg	2	51.00	4.00	33.25	29.25	29.00	-	12.00	-	-
Wall D-1	Seg	2	51.00	4.00	33.25	29.25	29.00	0.41	-	2	2

Legend:
Type – Seg = Segmented, Prf = Perforated, FT = FTAO (force transfer around openings), NSW = non-shearwall
Location – Position in structure perpendicular to wall
Length – Shear line: Distance between exterior perpendicular walls defining the shear line extent
Wall, segment, or opening: End-to-end length of the element
FHS – Depending on element, shows different definitions of full-height sheathing length (FHS):
Shear lines with multiple walls, segmented walls, or FTAO walls: Total shear-resisting FHS
Individual wall segments or walls without openings: Distance between hold-downs beff
Perforated walls: Sum of factored segment lengths bi defined in SDPWS 4.3.5.6
Aspect Ratio – Ratio of wall height to segment length (h/b); for FTAO walls, the aspect ratio of the central pier
Wall Group – Wall design group defined in Sheathing and Framing Materials tables, where it shows associated Standard Wall

Level 1 of 1





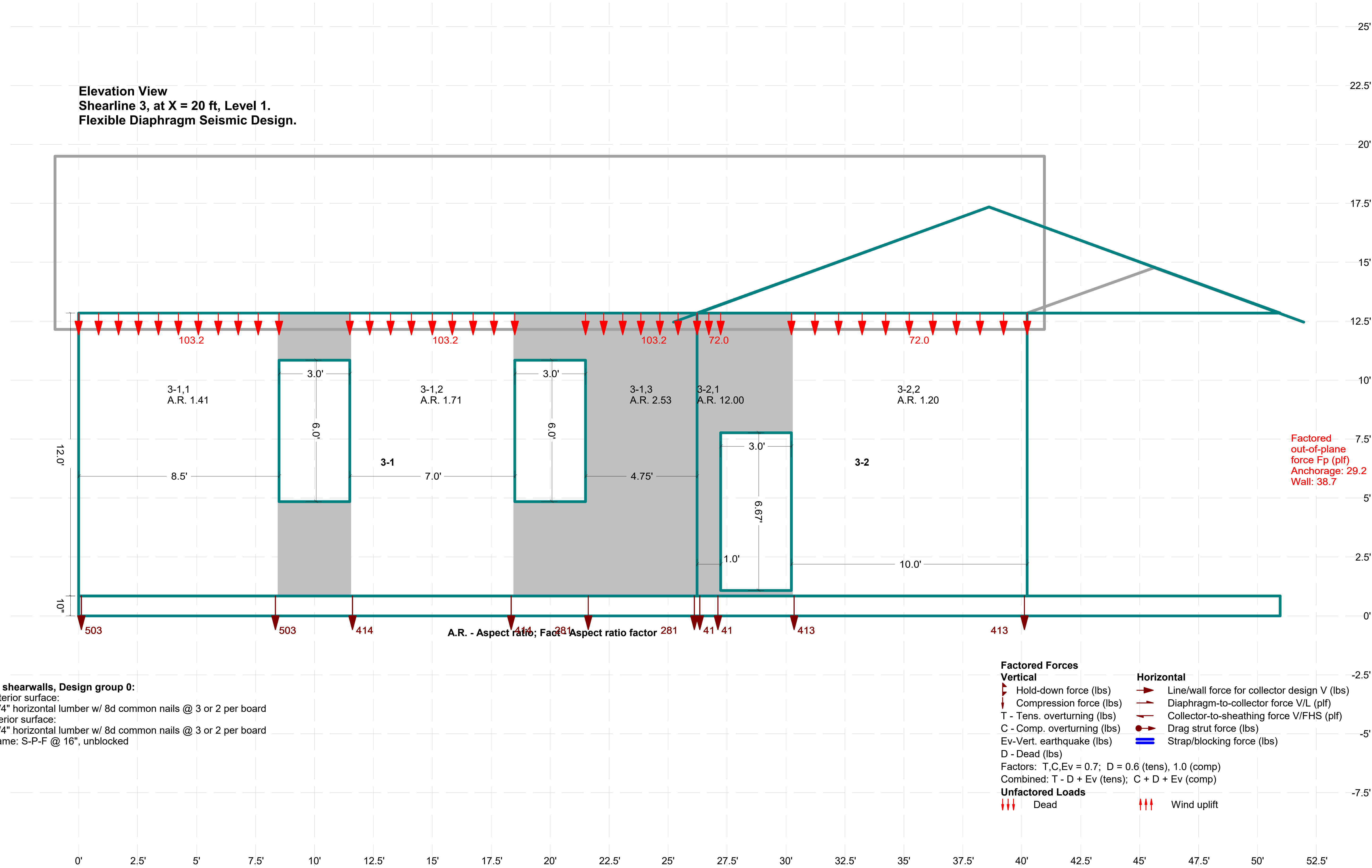


-10'

Segmented Perforated FTAO Non-shearwall Aspect factor Orange = Selected wall(s) Red = Capacity failure for Flexible, Wind design.

-5' 0' 5' 10' 15' 20' 25' 30' 35' 40' 45'

Elevation View
Shearline 3, at X = 20 ft, Level 1.
Flexible Diaphragm Seismic Design.



All shearwalls, Design group 0:
Exterior surface:
3/4" horizontal lumber w/ 8d common nails @ 3 or 2 per board
Interior surface:
3/4" horizontal lumber w/ 8d common nails @ 3 or 2 per board
Frame: S-P-F @ 16", unblocked

Factored Forces

Vertical
- Hold-down force (lbs)
- Compression force (lbs)
- T - Tens. overturning (lbs)
- C - Comp. overturning (lbs)
- Ev-Vert. earthquake (lbs)
- D - Dead (lbs)

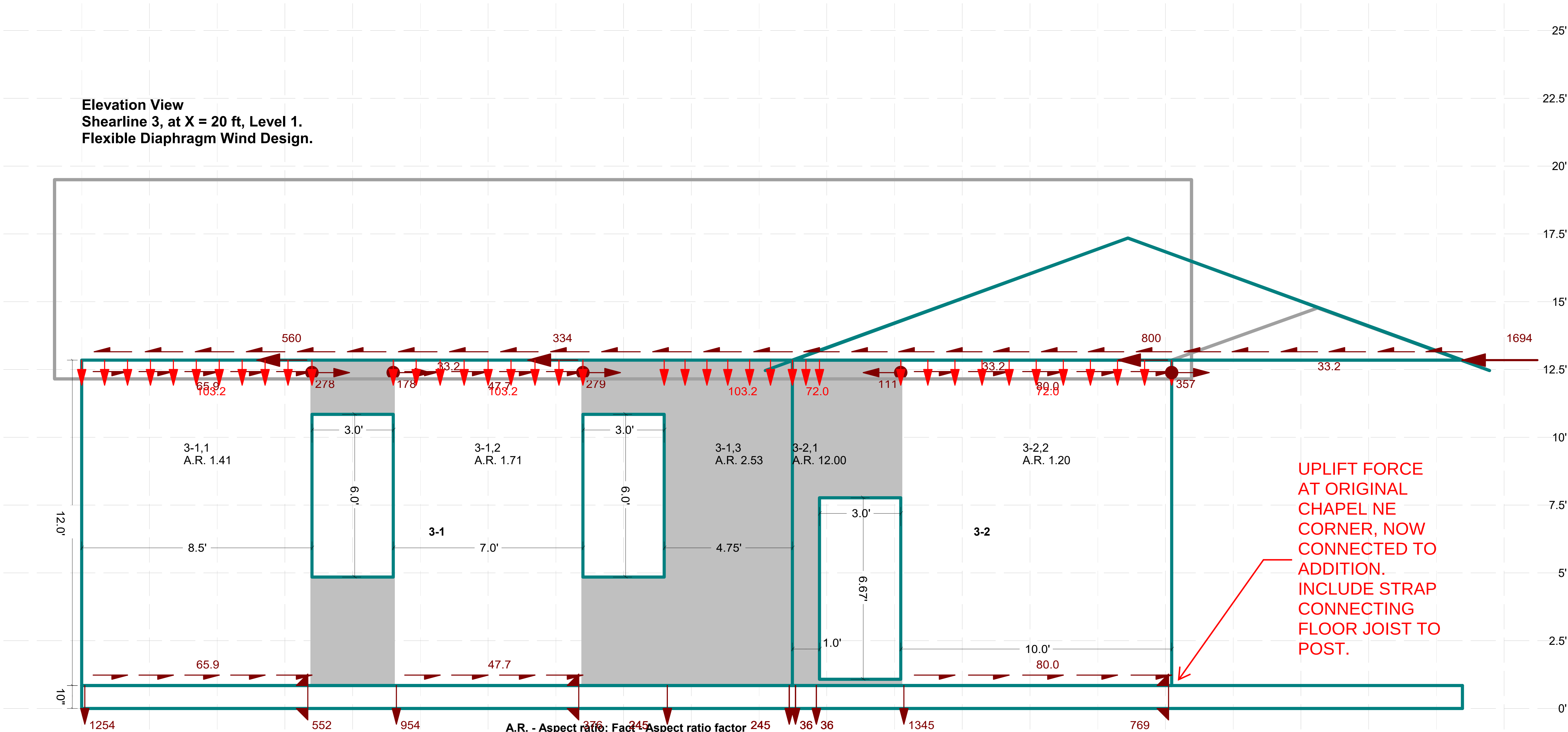
Horizontal
- Line/wall force for collector design V (lbs)
- Diaphragm-to-collector force V/L (plf)
- Collector-to-sheathing force V/FHS (plf)
- Drag strut force (lbs)
- Strap/blocking force (lbs)

Factors: T,C,Ev = 0.7; D = 0.6 (tens), 1.0 (comp)
Combined: T - D + Ev (tens); C + D + Ev (comp)

Unfactored Loads
Dead
Wind uplift

DB23-0477

Elevation View
Shearline 3, at X = 20 ft, Level 1.
Flexible Diaphragm Wind Design.



A.R. - Aspect ratio; Fact - Aspect ratio factor

Shearwalls, Design group 3*: 3-1, 3-2,
Exterior surface:
3/4" horizontal lumber w/ 8d common nails @ 3 or 2 per board
Shear capacity: 70.0 plf
C&C sheath. load: 17.7 / 21.8 psf; cap. 123.1 psf
Nail withdr. load 4.9 lbs; cap. 57.9 lbs
Interior surface:
3/4" horizontal lumber w/ 8d common nails @ 3 or 2 per board
Shear capacity: 70.0 plf
Frame: S-P-F @ 16", unblocked
*Design results are for the wall containing the critical segment.
View the Design Results tables for the specification of other walls on the shearline
Critical Segment: 3-2,1:
Design shear force: 80.7 plf
Combined capacity (added): 140.0 plf

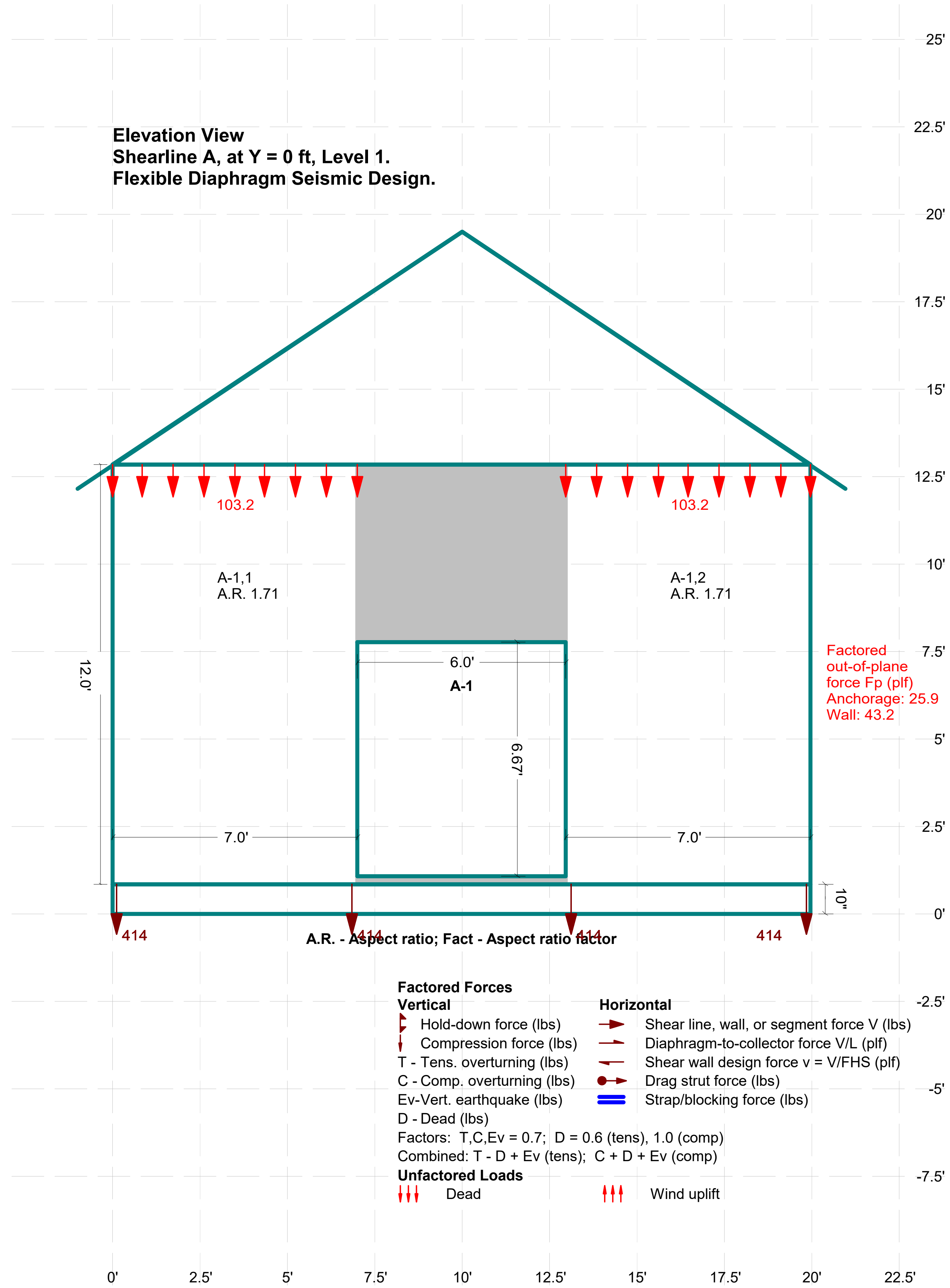
UPLIFT FORCE.
INCLUDE STRAP AT
OPENING STUD
FRAME, BOTH
SIDES. TYPICAL
ALL WINDOWS

Factored Forces
Vertical
Hold-down force (lbs)
Compression force (lbs)
T - Tens. overturning (lbs)
C - Comp. overturning (lbs)
U - Wind uplift (lbs)
D - Dead (lbs)
Factors: T,C,U = 0.6; D = 0.6 (tens), 1.0 (comp)
Combined: T - D + U (tens); C + D - U (comp)
Unfactored Loads
Dead
Wind uplift

Horizontal
Line/wall force for collector design V (lbs)
Diaphragm-to-collector force V/L (plf)
Collector-to-sheathing force V/FHS (plf)
Drag strut force (lbs)
Strap/blocking force (lbs)

-2.5' -5' -7.5'

South 0' 2.5' 5' 7.5' 10' 12.5' 15' 17.5' 20' 22.5' 25' 27.5' 30' 32.5' 35' 37.5' 40' 42.5' 45' 47.5' 50' 52.5' **North**



Factored Forces

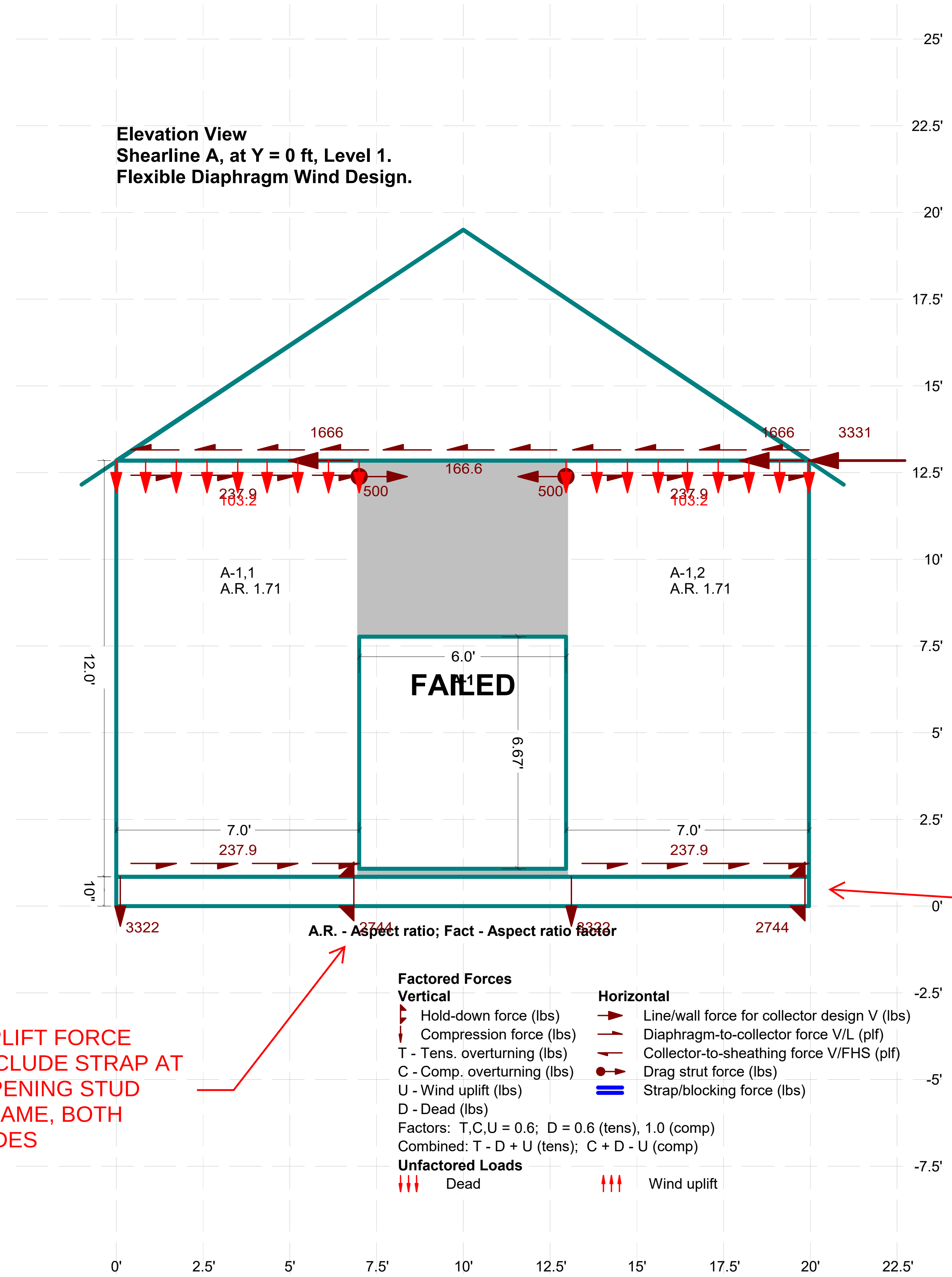
Vertical	**Horizontal**
Hold-down force (lbs)	Shear line, wall, or segment force V (lbs)
Compression force (lbs)	Diaphragm-to-collector force V/L (plf)
T - Tens. overturning (lbs)	Shear wall design force v = V/FHS (plf)
C - Comp. overturning (lbs)	Drag strut force (lbs)
Ev-Vert. earthquake (lbs)	Strap/blocking force (lbs)
D - Dead (lbs)	

Factors: T,C,Ev = 0.7; D = 0.6 (tens), 1.0 (comp)
Combined: T - D + Ev (tens); C + D + Ev (comp)

Unfactored Loads

Dead Wind uplift

All shearwalls, Design group 0:
Exterior surface:
3/4" horizontal lumber w/ 8d common nails @ 3 or 2 per board
Interior surface:
3/4" horizontal lumber w/ 8d common nails @ 3 or 2 per board
Frame: S-P-F @ 16", unblocked



ANALYSIS AND DESIGN OF EXISTING STRUCTURE IS NOT PART OF THE SCOPE OF WORK. INTENT OF MODEL IS TO DERIVE VERTICAL ANCHOR LOADS FROM WIND AND SEISMIC.

FAILURE NOTE IS FOR THE SHEAR CAPACITY OF THE EXISTING WALL.

UPLIFT FORCE INCLUDE STRAP AT CORNERS, BOTH SIDES

UPLIFT FORCE INCLUDE STRAP AT OPENING STUD FRAME, BOTH SIDES

Factored Forces

Vertical
- Hold-down force (lbs)
- Compression force (lbs)
- T - Tens. overturning (lbs)
- C - Comp. overturning (lbs)
- U - Wind uplift (lbs)
- D - Dead (lbs)

Horizontal
- Line/wall force for collector design V (lbs)
- Diaphragm-to-collector force V/L (plf)
- Collector-to-sheathing force V/FHS (plf)
- Drag strut force (lbs)
- Strap/blocking force (lbs)

Factors: T,C,U = 0.6; D = 0.6 (tens), 1.0 (comp)
Combined: T - D + U (tens); C + D - U (comp)

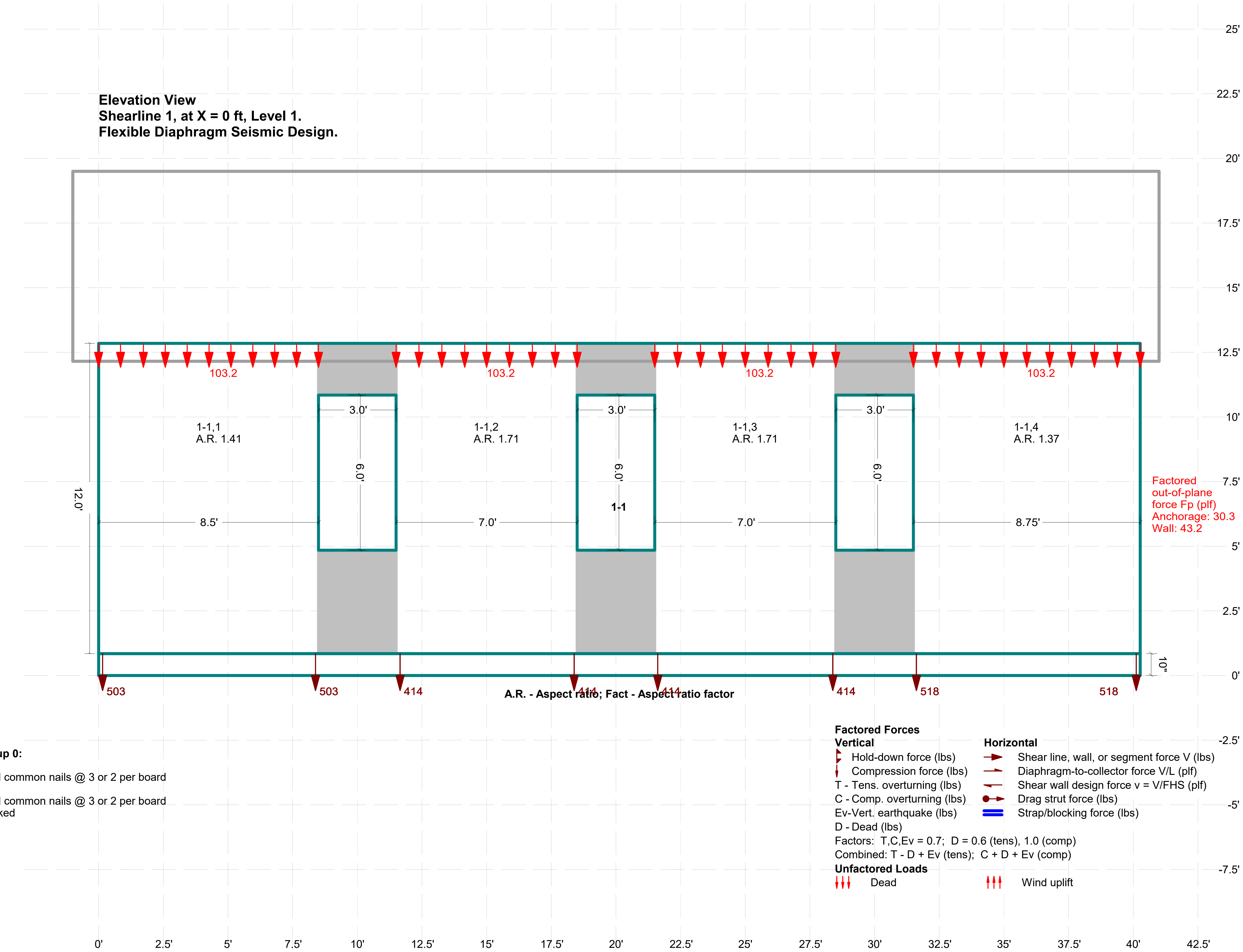
Unfactored Loads
Dead Wind uplift

All shearwalls, Design group 1:
Exterior surface:
3/4" horizontal lumber w/ 8d common nails @ 3 or 2 per board
Shear capacity: 70.0 plf
C&C sheath. load: 17.7 / 21.8 psf; cap. 123.1 psf
Nail withdr. load 4.9 lbs; cap. 0.0
Interior surface:
3/4" horizontal lumber w/ 8d common nails @ 3 or 2 per board
Shear capacity: 70.0 plf
Frame: S-P-F @ 16", unblocked
Critical Segment: A-1,1:
Design shear force: 237.9 plf
Combined capacity (added): 140.0 plf

WoodWorks® Shearwalls | SOFTWARE FOR WOOD DESIGN

Genoa Church.wsw | WoodWorks® Shearwalls 2023 | Jan. 30, 2023 11:11:57

Elevation View
Shearline 1, at X = 0 ft, Level 1.
Flexible Diaphragm Seismic Design.



A.R. - Aspect ratio; Fact - Aspect ratio factor

All shearwalls, Design group 0:
Exterior surface:
3/4" horizontal lumber w/ 8d common nails @ 3 or 2 per board
Interior surface:
3/4" horizontal lumber w/ 8d common nails @ 3 or 2 per board
Frame: S-P-F @ 16", unblocked

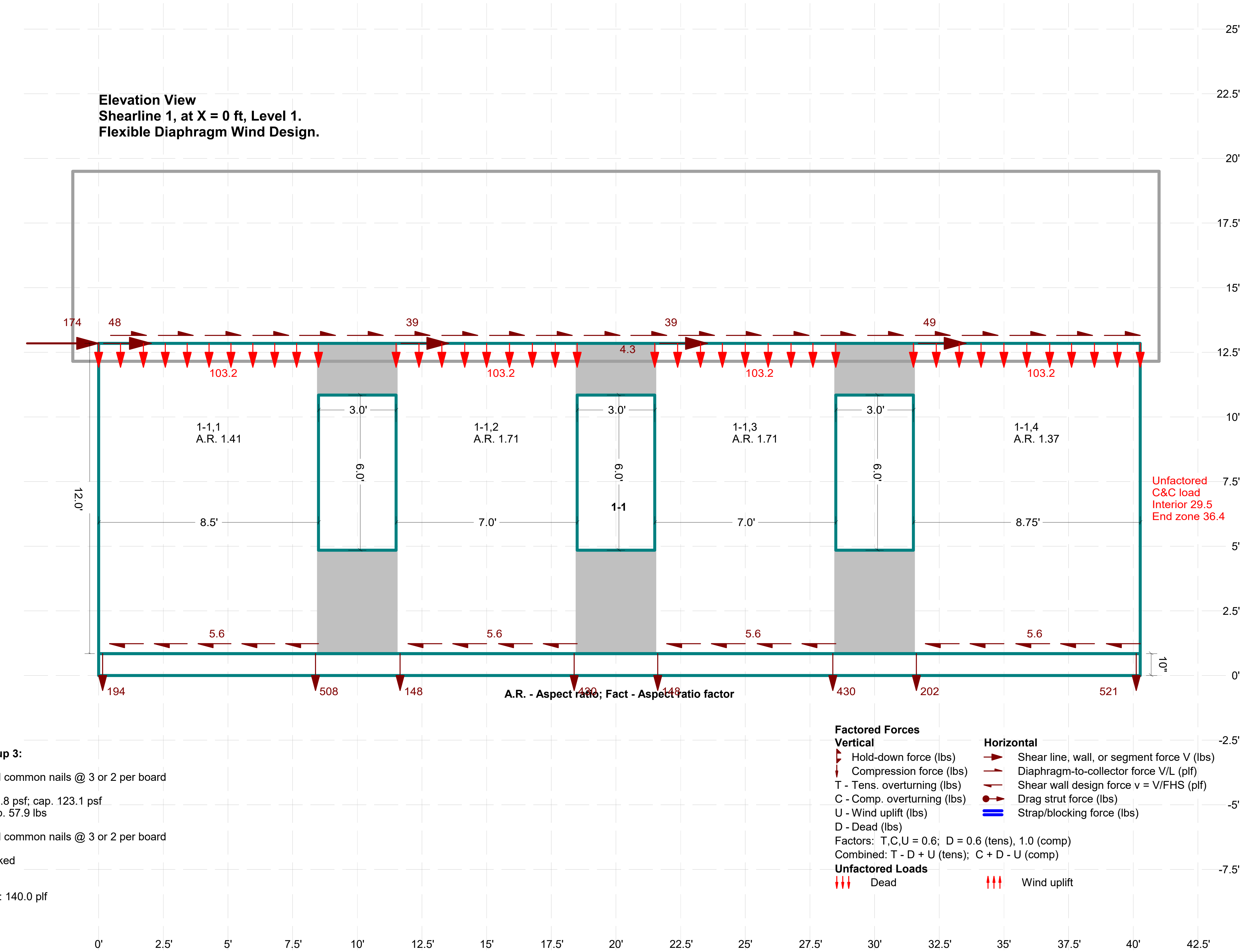
Factored Forces

Vertical
Hold-down force (lbs)
Compression force (lbs)
T - Tens. overturning (lbs)
C - Comp. overturning (lbs)
Ev-Vert. earthquake (lbs)
D - Dead (lbs)
Factors: T,C,Ev = 0.7; D = 0.6 (tens), 1.0 (comp)
Combined: T - D + Ev (tens); C + D + Ev (comp)

Horizontal
Shear line, wall, or segment force V (lbs)
Diaphragm-to-collector force V/L (plf)
Shear wall design force v = V/FHS (plf)
Drag strut force (lbs)
Strap/blocking force (lbs)

Unfactored Loads
Dead
Wind uplift

Elevation View
Shearline 1, at X = 0 ft, Level 1.
Flexible Diaphragm Wind Design.



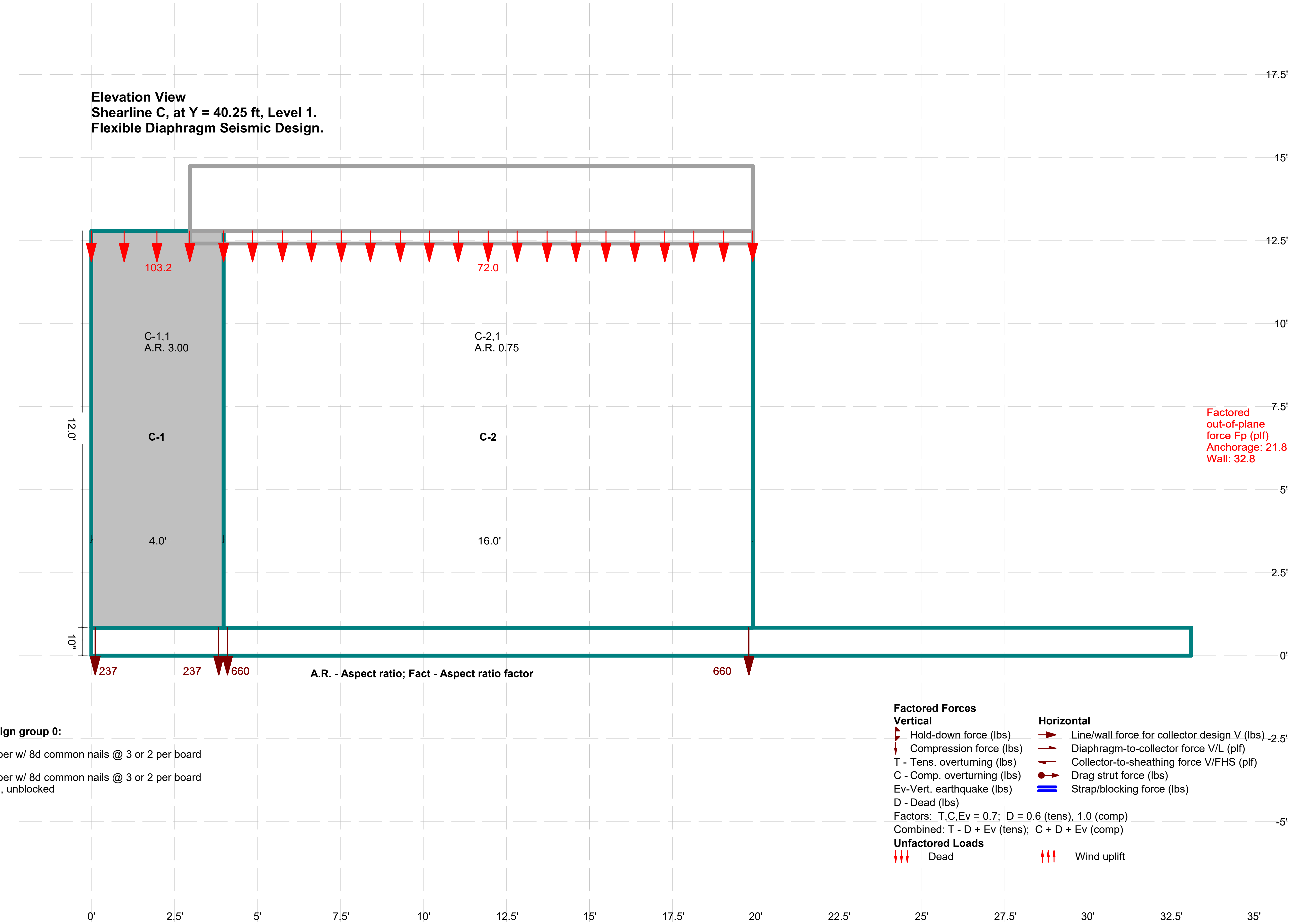
All shearwalls, Design group 3:
Exterior surface:
3/4" horizontal lumber w/ 8d common nails @ 3 or 2 per board
Shear capacity: 70.0 plf
C&C sheath. load: 17.7 / 21.8 psf; cap. 123.1 psf
Nail withdr. load 4.9 lbs; cap. 57.9 lbs
Interior surface:
3/4" horizontal lumber w/ 8d common nails @ 3 or 2 per board
Shear capacity: 70.0 plf
Frame: S-P-F @ 16", unblocked
Critical Segment: 1-1,4:
Design shear force: 5.6 plf
Combined capacity (added): 140.0 plf

Factored Forces

Vertical	**Horizontal**
Hold-down force (lbs)	Shear line, wall, or segment force V (lbs)
Compression force (lbs)	Diaphragm-to-collector force V/L (plf)
T - Tens. overturning (lbs)	Shear wall design force v = V/FHS (plf)
C - Comp. overturning (lbs)	Drag strut force (lbs)
U - Wind uplift (lbs)	Strap/blocking force (lbs)
D - Dead (lbs)	

Factors: T,C,U = 0.6; D = 0.6 (tens), 1.0 (comp)
Combined: T - D + U (tens); C + D - U (comp)

Unfactored Loads
Dead
Wind uplift



All shearwalls, Design group 0:
Exterior surface:
3/4" horizontal lumber w/ 8d common nails @ 3 or 2 per board
Interior surface:
3/4" horizontal lumber w/ 8d common nails @ 3 or 2 per board
Frame: S-P-F @ 16", unblocked

Factored Forces

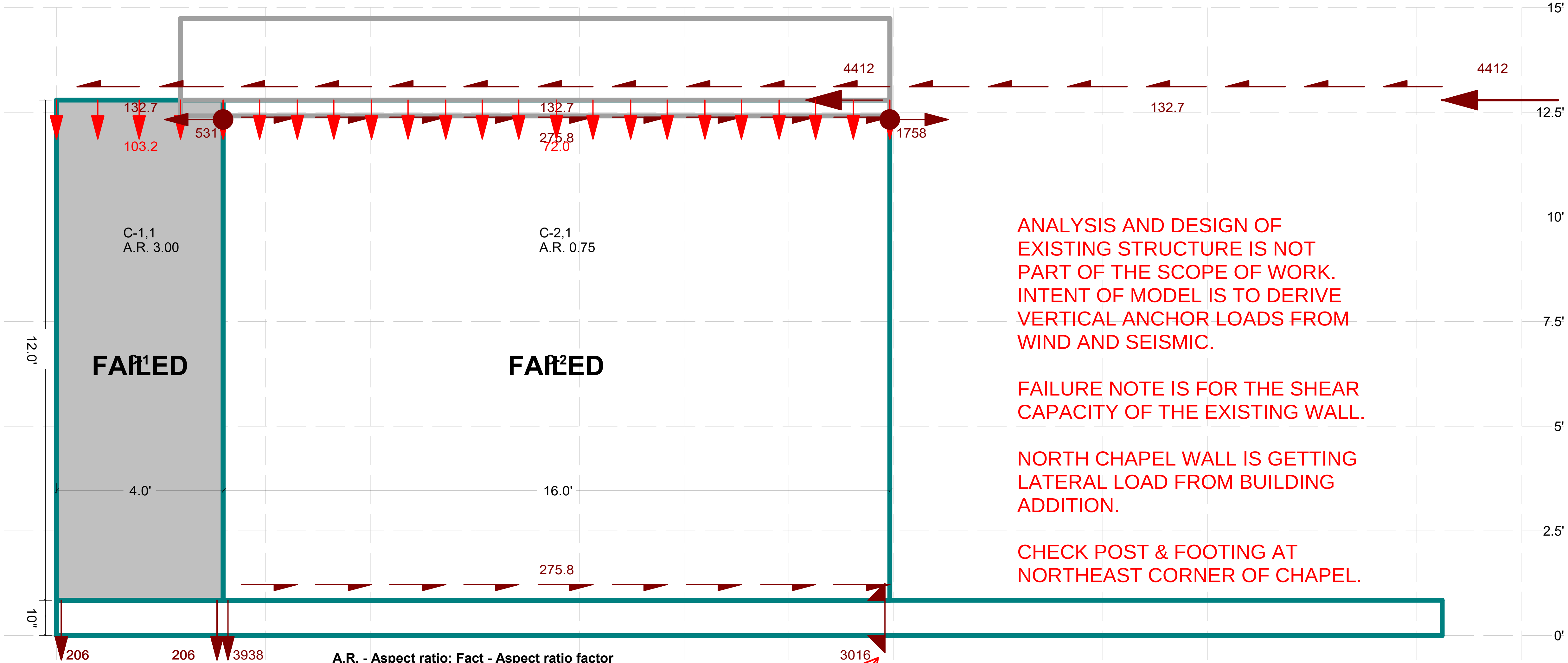
Vertical
- Hold-down force (lbs)
- Compression force (lbs)
- T - Tens. overturning (lbs)
- C - Comp. overturning (lbs)
- Ev-Vert. earthquake (lbs)
- D - Dead (lbs)

Horizontal
- Line/wall force for collector design V (lbs)
- Diaphragm-to-collector force V/L (plf)
- Collector-to-sheathing force V/FHS (plf)
- Drag strut force (lbs)
- Strap/blocking force (lbs)

Factors: T,C,Ev = 0.7; D = 0.6 (tens), 1.0 (comp)
Combined: T - D + Ev (tens); C + D + Ev (comp)

Unfactored Loads
Dead Wind uplift

Elevation View
Shearline C, at Y = 40.25 ft, Level 1.
Flexible Diaphragm Wind Design.



ANALYSIS AND DESIGN OF EXISTING STRUCTURE IS NOT PART OF THE SCOPE OF WORK. INTENT OF MODEL IS TO DERIVE VERTICAL ANCHOR LOADS FROM WIND AND SEISMIC.

FAILURE NOTE IS FOR THE SHEAR CAPACITY OF THE EXISTING WALL.

NORTH CHAPEL WALL IS GETTING LATERAL LOAD FROM BUILDING ADDITION.

CHECK POST & FOOTING AT NORTHEAST CORNER OF CHAPEL.

UPLIFT FORCE INCLUDE STRAP AT CORNERS, BOTH SIDES. THIS PART OF ORIGINAL CHAPEL WALL FRAMED TO BUILDING ADDITION

All shearwalls, Design group 3:
Exterior surface:
3/4" horizontal lumber w/ 8d common nails @ 3 or 2 per board
Shear capacity: 70.0 plf
C&C sheath. load: 17.7 / 21.8 psf; cap. 0.0
Nail withdr. load 0.0 lbs; cap. 0.0
Interior surface:
3/4" horizontal lumber w/ 8d common nails @ 3 or 2 per board
Shear capacity: 70.0 plf
Frame: S-P-F @ 16", unblocked
Critical Segment: C-2,1:
Design shear force: 275.8 plf
Combined capacity (added): 140.0 plf

Factored Forces

Vertical
- Hold-down force (lbs)
- Compression force (lbs)
- T - Tens. overturning (lbs)
- C - Comp. overturning (lbs)
- U - Wind uplift (lbs)
- D - Dead (lbs)

Horizontal
- Line/wall force for collector design V (lbs)
- Diaphragm-to-collector force V/L (plf)
- Collector-to-sheathing force V/FHS (plf)
- Drag strut force (lbs)
- Strap/blocking force (lbs)

Factors: T,C,U = 0.6; D = 0.6 (tens), 1.0 (comp)
Combined: T - D + U (tens); C + D - U (comp)

Unfactored Loads
Dead — Wind uplift