PRAXIS ENGINEERING, LLC
205 ALLEN ST.
KELSO, WA 98626
(360) 575-8348

**January 23, 2024**

# Nisqually Tribe – Spec House G
# 12338 Squalli-Absch Road
# Olympia, WA 98513

## Lateral analysis for a single story residence.

110 mph Ultimate Wind Speed, Exposure C, Seismic Zone – D1
1500 psf Assumed Minimum Soil Bearing Capacity

## Limiting Conditions and Warning

Professional engineering provided herein is based upon plans and information provided by client and is limited to attached documents only, unless otherwise noted in signed and sealed documents and/or plans provided by professional engineer. If changes are made to the attached elevations or floorplans, contact our office before construction begins. No liability is assigned to any unsigned or unstamped plan, specification, or documents.

For payment of a one-time fee, Praxis Engineering, LLC grants the owner and/or contractor, a limited license to use this analysis and design to construct one single house or structure. After the initial analysis and design is purchased, customers may obtain a wet stamped renewal sheet for a subsequent house or structure (if the same design conditions exist) by paying a reduced additional order fee.


01/23/2024

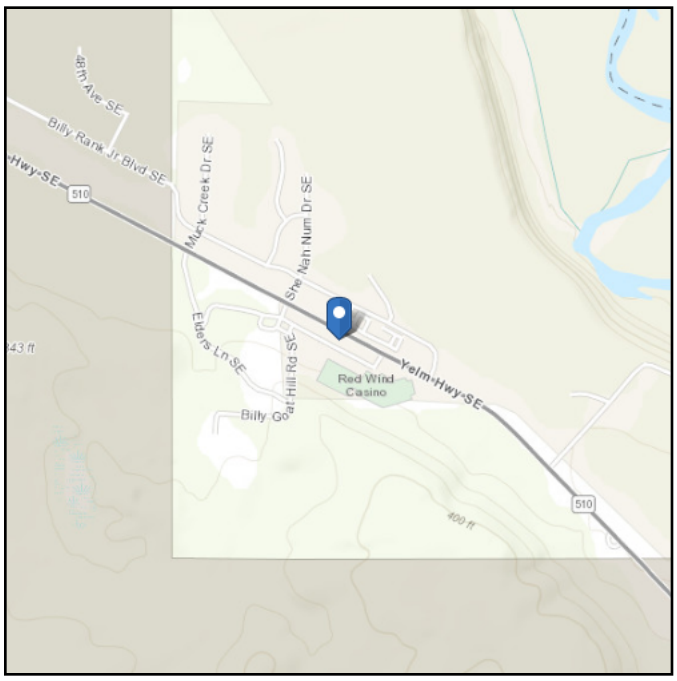
SIGNATURE MUST APPEAR IN BLUE INK TO BE A VALID SIGNATURE

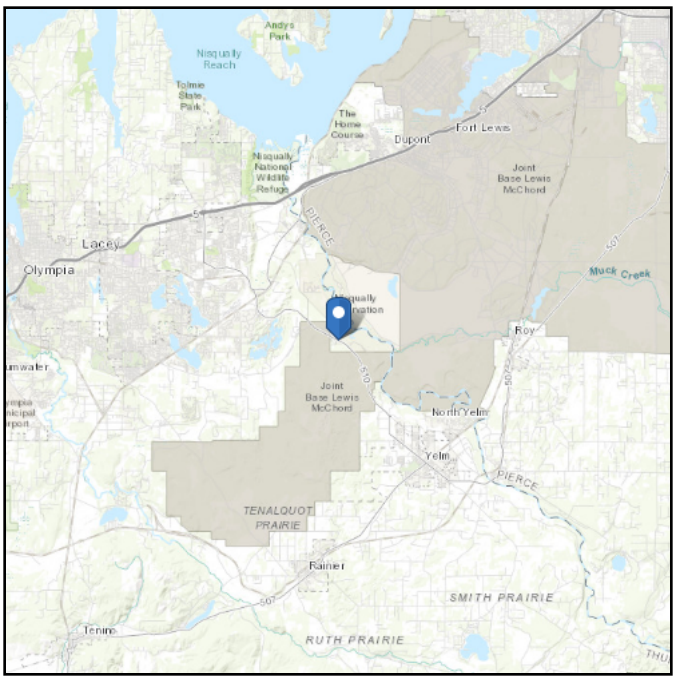
# ASCE Hazards Report

**Address:**
No Address at This Location

**Standard:** ASCE/SEI 7-16
**Risk Category:** II
**Soil Class:** D - Stiff Soil

**Latitude:** 47.001324
**Longitude:** -122.669395
**Elevation:** 263.71501154583547 ft (NAVD 88)




## Seismic

**Site Soil Class:** D - Stiff Soil

**Results:**

| | | | |
|---|---|---|---|
| $S_S$ : | 1.333 | $S_{D1}$ : | N/A |
| $S_1$ : | 0.481 | $T_L$ : | 16 |
| $F_a$ : | 1 | PGA : | 0.536 |
| $F_v$ : | N/A | $PGA_M$ : | 0.59 |
| $S_{MS}$ : | 1.333 | $F_{PGA}$ : | 1.1 |
| $S_{M1}$ : | N/A | $I_e$ : | 1 |
| $S_{DS}$ : | 0.888 | $C_v$ : | 1.367 |

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

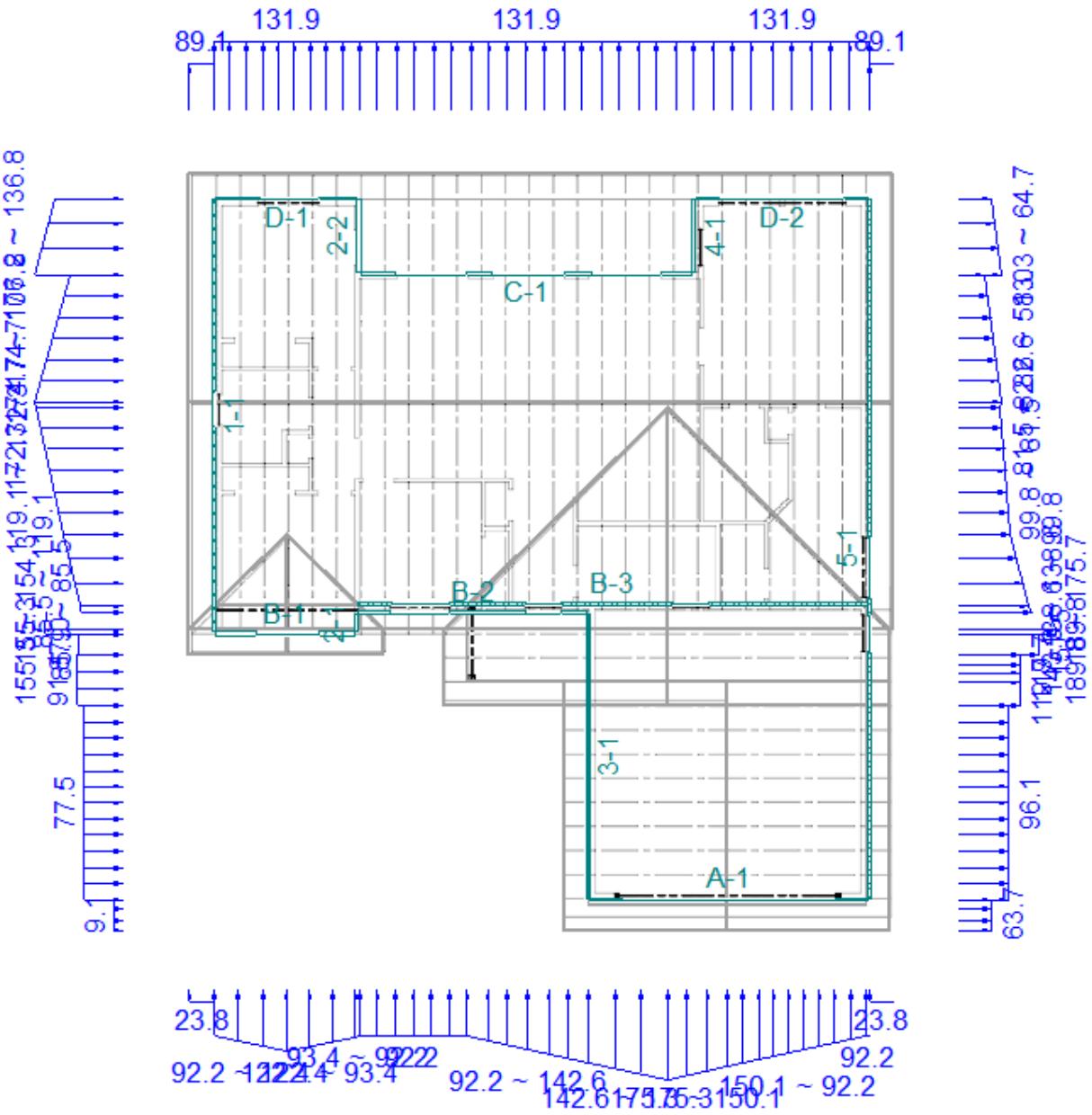
**Data Accessed:** Fri Jan 12 2024

**Date Source:** USGS Seismic Design Maps

| | |
|---|---|
| **PROJECT** | NISQUALLY TRIBE SPEC PLAN G |
| **ADDRESS** | 12338 SQUALLI-ABSCH RD, OLYMPIA, WA |
| **DATE** | 1/18/2024 |
| **ENGR** | LB |

PRAXIS ENGINEERING

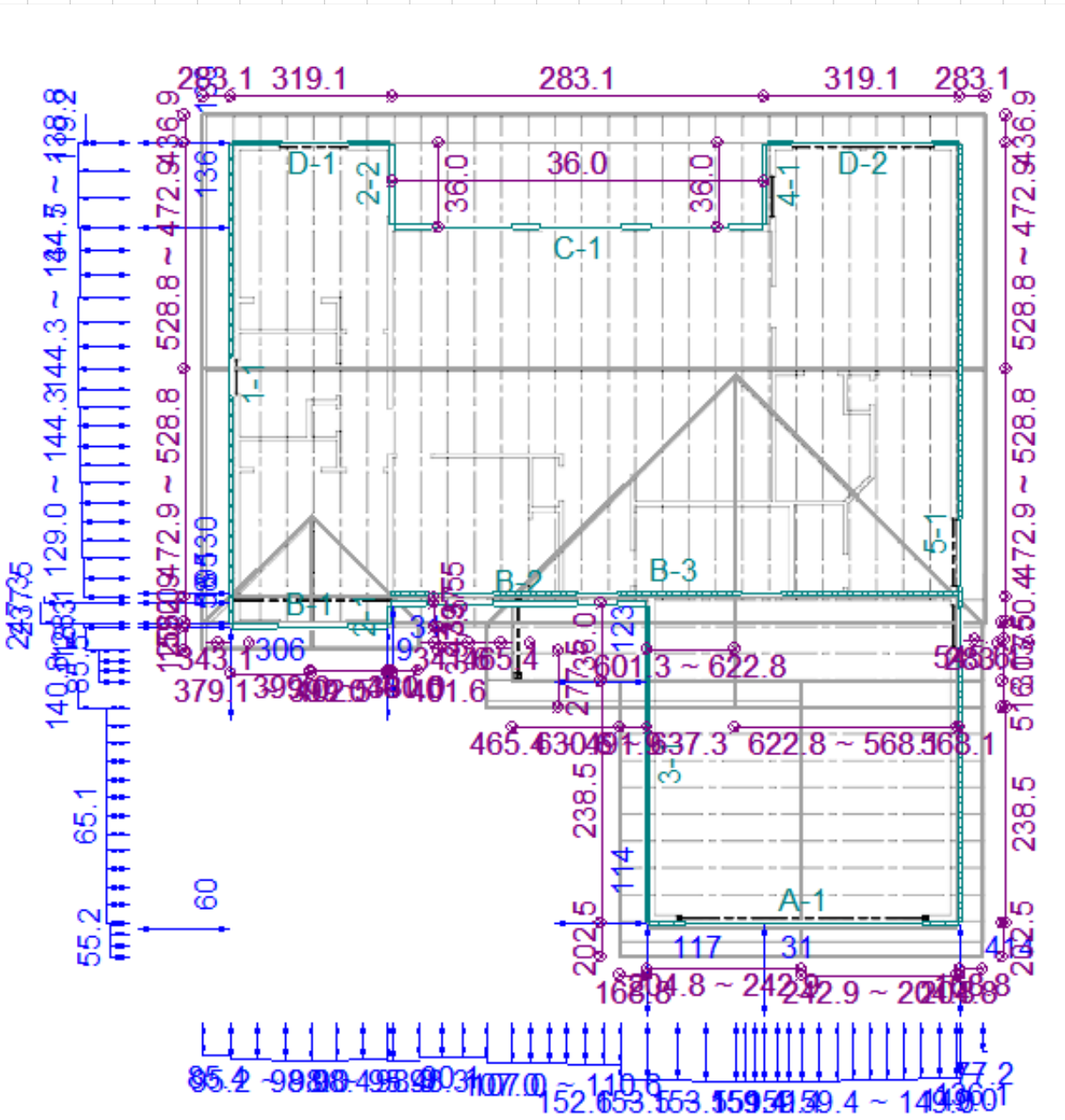
# WIND DIAGRAM



| | |
|---|---|
| **PROJECT** | NISQUALLY TRIBE SPEC PLAN G |
| **ADDRESS** | 12338 SQUALLI-ABSCH RD, OLYMPIA, WA |
| **DATE** | 1/18/2024 |
| **ENGR** | LB |

PRAXIS ENGINEERING

# SEISMIC DIAGRAM



# WoodWorks® Shearwalls

**SOFTWARE FOR WOOD DESIGN**

**WoodWorks® Shearwalls 2023**

**Nisqually Spec G Lateral.wsw** **Jan. 18, 2024 15:06:26**

## Project Information

**COMPANY AND PROJECT INFORMATION**

| Company | Project |
|---|---|
| PRAXIS ENGINEERING<br>205 ALLEN ST, KELSO, WA | |

**DESIGN SETTINGS**

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

**Load Combinations**

| For Design (ASD) | For Deflection (Strength) |
|---|---|
| 0.70 Seismic + 0.60 Dead | 1.00 Seismic + 0.90 Dead |
| 0.60 Wind + 0.60 Dead | 1.00 Wind + 0.90 Dead |

**Building Code Capacity Modification**

| Wind | Seismic |
|---|---|
| 1.00 | 1.00 |

**Service Conditions and Load Duration**

| Duration Factor | Temperature Range | Moisture Content | |
|---|---|---|---|
| | | Fabrication | Service |
| - | - | 19% (<=19%) | 10% (<=19%) |

**Max Shearwall Offset [ft]**

| Plan (within story) | Elevation (between stories) |
|---|---|
| 3.00 | - |

**Maximum Height-to-width Ratio**

| Wood panels | | Fiberboard | Lumber | | Gypsum | |
|---|---|---|---|---|---|---|
| Blocked | Unblocked | | Wind | Seismic | Blocked | Unblocked |
| 3.5 | 2.0 | - | - | - | 2.0 | 1.5 |

**Ignore shear resistance contribution of...**

| Wall segments | Seismic |
|---|---|
| Side with invalid aspect ratio | Any gypsum, lumber, fiberboard |

**Forces based on...**

| | |
|---|---|
| Hold-downs | Applied loads |
| Drag struts | Applied loads |

**Shearwall relative rigidity:** Wall capacity

**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** | 110 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: 0ft
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** | Regular |
| **Building System** | Bearing Wall |
| **Design Category** | D |
| **Site Class** | D |

**Spectral Response Acceleration**
**S1:** 0.480g **Ss:** 1.330g

| Fundamental Period | E-W | N-S |
|---|---|---|
| **T Used** | 0.133s | 0.133s |
| **Approximate Ta** | 0.133s | 0.133s |
| **Maximum T** | 0.186s | 0.186s |
| **Response Factor R** | 6.50 | 6.50 |

**Fa:** 1.00 **Fv:** 1.82

## Structural Data

**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** | Ext | Struct Sh OSB | 24/16 | 7/16 | - | - | Vert | 83500 | 8d | Common | N | 4 | 12 | Y | 2,3 |
| **2** | Ext | Struct Sh OSB | 24/16 | 7/16 | - | - | Vert | 83500 | 8d | Common | N | 6 | 12 | Y | 3 |

*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:
2. Framing at adjoining panel edges must be 3" nominal or wider with staggered nailing according to SDPWS 4.3.7.1 (5)
3. Shear capacity for current design has been increased to the value for 15/32" sheathing with same nailing because stud spacing is 16" max. or panel orientation is horizontal. See SDPWS Table 4.3A Note 2.

**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** | D.Fir-L | No.2 | 1.50 | 5.50 | 16 | 0.50 | 1.60 | 625 | |
| **2** | D.Fir-L | No.2 | 1.50 | 5.50 | 16 | 0.50 | 1.60 | 625 | |

*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.

## Loads

**DEAD LOADS (for hold-down calculations)**

| Shear Line | Level | Profile | Tributary Width [ft] | Location [ft] Start | Location [ft] End | Mag [lbs,psf,psi] Start | Mag [lbs,psf,psi] End |
|---|---|---|---|---|---|---|---|
| A | 1 | Line | | 0.00 | 23.50 | 90.0 | |
| A | 1 | Area | 4.00 | 0.00 | 23.50 | 15.0 | |
| B | 1 | Line | | -31.00 | -19.00 | 90.0 | |
| B | 1 | Area | 4.00 | -31.00 | -19.00 | 15.0 | |
| B | 1 | Line | | -19.00 | 23.50 | 90.0 | |
| B | 1 | Line | | -19.00 | 0.00 | 90.0 | |
| B | 1 | Area | 17.00 | -19.00 | 23.50 | 15.0 | |
| C | 1 | Line | | -19.00 | 9.00 | 90.0 | |
| C | 1 | Area | 19.00 | -19.00 | 9.00 | 15.0 | |
| D | 1 | Line | | -31.00 | -19.00 | 90.0 | |
| D | 1 | Area | 19.00 | -31.00 | -19.00 | 15.0 | |
| D | 1 | Line | | 9.00 | 23.50 | 90.0 | |
| D | 1 | Area | 19.00 | 9.00 | 23.50 | 15.0 | |
| 1 | 1 | Line | | 22.00 | 58.00 | 90.0 | |
| 1 | 1 | Area | 4.00 | 22.00 | 58.00 | 15.0 | |
| 2 | 1 | Line | | 22.00 | 24.00 | 90.0 | |
| 2 | 1 | Line | | 52.00 | 58.00 | 90.0 | |
| 3 | 1 | Line | | 0.00 | 24.00 | 90.0 | |
| 3 | 1 | Area | 13.50 | 0.00 | 24.00 | 15.0 | |
| 4 | 1 | Line | | 52.00 | 58.00 | 90.0 | |
| 5 | 1 | Line | | 0.00 | 58.00 | 90.0 | |
| 5 | 1 | Area | 4.00 | 0.00 | 58.00 | 15.0 | |

## Design Summary

### SHEARWALL DESIGN

**Wind Shear Loads, Flexible Diaphragm**
All shearwalls have sufficient design capacity.

**Seismic Loads, Flexible Diaphragm**
All shearwalls have sufficient design capacity.

### HOLD-DOWN DESIGN

**Wind Loads, Flexible Diaphragm**
All hold-downs have sufficient design capacity.

**Seismic Loads, Flexible Diaphragm**
All hold-downs have sufficient design capacity.

### COMPRESSION FORCE DESIGN

**Wind Loads, Flexible Diaphragm**
Bottom plate has sufficient perpendicular-to-grain compressive capacity under all wall end studs.

**Seismic Loads, Flexible Diaphragm**
Bottom plate has sufficient perpendicular-to-grain compressive capacity under all wall end studs.

*Refer to the Deflection table for possible issues regarding fastener slippage (SDPWS Table C4.2.3D) for walls that otherwise pass.*

## Flexible Diaphragm Wind Design
## ASCE 7 Directional (All Heights) Loads

**SHEAR RESULTS**

| N-S Shearlines | W Gp | For Dir | ASD Shear Force [plf] v | vmax/vft | V [lbs] | Asp-Cub Int | Asp-Cub Ext | Allowable Shear [plf] Int | Ext | Co | C | Cmb | V [lbs] | Resp. Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Line 1** | | | | | | | | | | | | | | |
| **Level 1** | | | | | | | | | | | | | | |
| Ln1, Lev1 | 2 | S->N | 69.9 | 71.6 | 2323 | - | 1.0 | - | 356 | 0.98 | | 356 | 11835 | 0.20 |
| | 2 | N->S | 66.2 | 67.9 | 2203 | - | 1.0 | - | 356 | 0.98 | | 356 | 11835 | 0.19 |
| **Line 3** | | | | | | | | | | | | | | |
| Ln3, Lev1 | - | S->N | - | - | 4222 | - | - | - | - | - | | - | 8669 | - |
| | - | N->S | - | - | 3556 | - | - | - | - | - | | - | 8669 | - |
| Wall 3-1 | 2^ | S->N | 177.8 | - | 4222 | - | 1.0 | - | 365 | - | | 365 | 8669 | 0.49 |
| | 2 | N->S | 149.7 | - | 3556 | - | 1.0 | - | 365 | - | | 365 | 8669 | 0.41 |
| **Line 5** | | | | | | | | | | | | | | |
| Ln5, Lev1 | 2 | S->N | 40.2 | 45.6 | 1950 | - | 1.0 | - | 322 | 0.88 | | 322 | 15595 | 0.13 |
| | 2 | N->S | 34.2 | 38.8 | 1659 | - | 1.0 | - | 322 | 0.88 | | 322 | 15595 | 0.11 |

| E-W Shearlines | W Gp | For Dir | ASD Shear Force [plf] v | vmax/vft | V [lbs] | Asp-Cub Int | Asp-Cub Ext | Allowable Shear [plf] Int | Ext | Co | C | Cmb | V [lbs] | Resp. Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Line A** | | | | | | | | | | | | | | |
| **Level 1** | | | | | | | | | | | | | | |
| LnA, Lev1 | - | W->E | - | - | 1432 | - | - | - | - | - | | - | 1790 | - |
| | - | E->W | - | - | 1429 | - | - | - | - | - | | - | 1790 | - |
| Wall A-1 | 1^ | W->E | - | - | 1432 | - | 1.0 | - | 532 | - | | - | 1790 | - |
| | 1 | E->W | - | - | 1429 | - | 1.0 | - | 532 | - | | - | 1790 | - |
| Seg. 1 | - | W->E | 260.3 | - | 716 | - | .61 | - | 325 | - | | 325 | 895 | 0.80 |
| | - | E->W | 259.8 | - | 715 | - | .61 | - | 325 | - | | 325 | 895 | 0.80 |
| Seg. 2 | - | W->E | 260.3 | - | 716 | - | .61 | - | 325 | - | | 325 | 895 | 0.80 |
| | - | E->W | 259.8 | - | 715 | - | .61 | - | 325 | - | | 325 | 895 | 0.80 |
| **Line B** | | | | | | | | | | | | | | |
| LnB, Lev1 | 2 | W->E | 122.1 | 157.2 | 3876 | - | .97 | - | 283 | 0.80 | | 283 | 8999 | 0.43 |
| | 2 | E->W | 121.9 | 156.9 | 3869 | - | .97 | - | 283 | 0.80 | | 283 | 8999 | 0.43 |
| **Line D** | | | | | | | | | | | | | | |
| LnD, Lev1 | - | Both | - | - | 2220 | - | - | - | - | - | | - | 13401 | - |
| Wall D-1 | 1 | Both | - | - | 1230 | - | 1.0 | - | 532 | - | | - | 6390 | - |
| Seg. 1 | - | Both | 175.7 | 11.0 | 659 | - | 1.0 | - | 532 | - | | 532 | 1997 | 0.33 |
| Open. 1 | - | Both | - | 230.6 | 1153 | - | - | - | 532 | - | | 532 | 2663 | 0.43 |
| Seg. 2 | - | Both | 175.7 | 11.0 | 571 | - | 1.0 | - | 532 | - | | 532 | 1731 | 0.33 |
| Wall D-2 | 1 | Both | - | - | 991 | - | 1.0 | - | 532 | - | | - | 7011 | - |
| Seg. 1 | - | Both | 247.7 | -290.4 | 495 | - | .67 | - | 355 | - | | 355 | 710 | 0.70 |
| Open. 1 | - | Both | - | 205.0 | 2152 | - | - | - | 532 | - | | 532 | 5591 | 0.38 |
| Seg. 2 | - | Both | 247.7 | -290.4 | 495 | - | .67 | - | 355 | - | | 355 | 710 | 0.70 |

*Legend:*
*W Gp - Wall design group defined in Sheathing and Framing Materials tables, where it shows associated Standard Wall. "^" means that this wall is critical for all walls in the Standard Wall group.*
*For Dir - Direction of wind force along shearline.*
*v – Design shear force on segment = ASD-factored shear force per unit length of full-height sheathing (FHS)*
*vmax/vft - Perforated walls: Collector and in-plane anchorage force as per SDPWS eqn. 4.3-9 = V/FHS/Co. FHS is factored for narrow segments as per 4.3.3.4*
*FTAO walls: Shear force in piers above and below either openings or piers beside opening(s). Aspect ratio factor does not apply to these piers.*
*V – ASD factored shear force. For shearline: total shearline force. For wall: total of all segments on wall. For segment: force on segment*
*Asp/Cub – For wall: Unblocked structural wood panel factor Cub from SDPWS 4.3.5.3. For segment or FTAO pier: Aspect ratio factor from SDPWS 4.3.5.5.1. For perforated wall: Either Cub or sum bi / FHS, where bi is segment length adjusted per SDPWS 4.3.3.4.*
*Int, Ext - Nominal unit shear capacity of interior and exterior sheathing, factored by Table 4.3-1 Note 3 for framing specific gravity and Note 10 for presence of hold-downs. For wall segments, also include unblocked factor Cub and aspect ratio adjustments.*
*Co - Adjustment factor for perforated walls from SDPWS Equation 4.3-6.*
*C - Sheathing combination rule, A = Add capacities, S = Strongest side or twice weakest, G = Stiffness-based using Eqns. 4.3-3,-4.*
*Cmb - Combined interior and exterior unit shear capacity including perforated wall factor Co.*
*V – Total factored shear capacity of shearline, wall or segment.*
*Crit Resp – Response ratio = v/Cmb = design shear force/unit shear capacity. "S" indicates that the seismic design criterion was critical in selecting wall.*

Notes:
Refer to Elevation View diagrams for individual level for uplift anchorage force t for perforated walls given by SDPWS 4.3.6.4.2,1.

**Hold-Down and Compression Design (flexible wind design)**

| Level 1 Line-Wall | Posit'n | Location [ft] X | Location [ft] Y | Load Case | Tensile Hold-down or Compressive Stud Force [lbs] Shear | Dead | Uplift | Cmb'd | Hold-down | Cap [lbs] | Crit Resp. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Line 1** | | | | | | | | | | | |
| 1-1 | L End | -31.00 | 22.00 | 1 | -842 | 2700 | | 3542 | Compression | 10312 | 0.34 |
| 1-1 | R End | -31.00 | 58.00 | 1 | -888 | 2700 | | 3588 | Compression | 10312 | 0.35 |
| **Line 3** | | | | | | | | | | | |
| 3-1 | L End | 0.00 | 0.00 | 1 | -1362 | 3473 | | 4835 | Compression | 10312 | 0.47 |
| 3-1 | R End | 0.00 | 23.50 | 1 | -1617 | 3473 | | 5090 | Compression | 10312 | 0.49 |
| **Line 5** | | | | | | | | | | | |
| 5-1 | L End | 23.50 | 0.00 | 1 | -431 | 4350 | | 4781 | Compression | 10312 | 0.46 |
| 5-1 | R End | 23.50 | 58.00 | 1 | -506 | 4350 | | 4856 | Compression | 10312 | 0.47 |
| **Line A** | | | | | | | | | | | |
| A-1 | L End | 0.00 | 0.00 | 1 | 2577 | 124 | | 2454 | HDU2-SDS | 3075 | 0.80 |
| A-1 | L End | 0.00 | 0.00 | 1 | -2572 | 206 | | 2779 | Compression | 10312 | 0.27 |
| A-1 | L Op 1 | 2.50 | 0.00 | 1 | 2572 | 923 | | 1650 | HDU2-SDS | 3075 | 0.54 |
| A-1 | L Op 1 | 2.50 | 0.00 | 1 | -2577 | 1538 | | 4115 | Compression | 10312 | 0.40 |
| A-1 | R Op 1 | 20.50 | 0.00 | 1 | 2577 | 923 | | 1655 | HDU2-SDS | 3075 | 0.54 |
| A-1 | R Op 1 | 20.50 | 0.00 | 1 | -2572 | 1538 | | 4110 | Compression | 10312 | 0.40 |
| A-1 | R End | 23.00 | 0.00 | 1 | 2572 | 124 | | 2449 | HDU2-SDS | 3075 | 0.80 |
| A-1 | R End | 23.00 | 0.00 | 1 | -2577 | 206 | | 2784 | Compression | 10312 | 0.27 |
| **Line B** | | | | | | | | | | | |
| B-1 | L End | -31.00 | 22.00 | 1 | 0 | 263 | | 262 | Compression | | - |
| B-1 | L Op 1 | -27.50 | 22.00 | 1 | 0 | 656 | | 656 | Compression | | - |
| B-1 | R Op 1 | -22.00 | 22.00 | 1 | 0 | 619 | | 619 | Compression | | - |
| B-1 | R End | -19.50 | 22.00 | 1 | 0 | 225 | | 225 | Compression | | - |
| B-3 | L End | -19.00 | 24.50 | 1 | -1424 | 9270 | | 10693 | Compression | 25781 | 0.41 |
| B-2 | L Op 2 | -16.50 | 24.00 | 1 | 0 | 1686 | | 1686 | Compression | | - |
| B-2 | R Op 2 | -11.50 | 24.00 | 1 | 0 | 2447 | | 2447 | Compression | | - |
| B-2 | L Op 2 | -5.50 | 24.00 | 1 | 0 | 2012 | | 2012 | Compression | | - |
| | V Elem | -2.00 | 24.00 | 1 | 0 | 1142 | | 1142 | Compression | | |
| | V Elem | -0.00 | 24.00 | 1 | 0 | 489 | | 489 | Compression | | |
| B-3 | R End | 23.00 | 24.50 | 1 | -1426 | 7724 | | 9150 | Compression | 25781 | 0.35 |
| **Line D** | | | | | | | | | | | |
| D-1 | L End | -31.00 | 58.00 | 1 | -942 | 2250 | | 3192 | Compression | 10312 | 0.31 |
| D-1 | R End | -19.00 | 58.00 | 1 | -942 | 2250 | | 3192 | Compression | 11601 | 0.28 |
| D-2 | L End | 9.00 | 58.00 | 1 | -626 | 2719 | | 3344 | Compression | 10312 | 0.32 |
| D-2 | R End | 23.00 | 58.00 | 1 | -626 | 2719 | | 3344 | Compression | 11601 | 0.29 |

*Legend:*
*Line-Wall:*
*At wall or opening – Shearline and wall number*
*At vertical element – Shearline*
*Posit'n – Position of stud pack that hold-down is attached to or which is applying compression force:*
*V Elem – Vertical element: column or strengthened studs required where not at wall end or opening*
*L or R End – At left or right wall end*
*L or R Op n – At left or right side of opening n*
*t @ Op n – Uplift force t at opening n from offset opening in perforated wall above, from SDPWS 4.3.6.4.2.1*
*Location – Co-ordinates in Plan View*
*Load Case – Results are for critical load case:*
*ASCE 7 All Heights: Case 1 or 2 from Fig. 27.3-8*
*ASCE 7 Low-rise: Windward corner(s) and Case A or B from Fig. 28.3-1*
*ASCE 7 Minimum loads (27.1.5 / 28.3.4): "Min"*
*Tensile Hold-down or Compressive Stud Force – Upwards force on hold-down at one end of the wall or downward force on bottom plate under studs at the other end, for each force direction. Includes forces transferred from upper levels.*
*Shear – Overturning component = V x h / beff from SDPWS Eqn. 4.3-7; V = force on segment, ASD-factored by 0.60; h = wall height, beff = wall segment length – (tension stud pack width + hold-down anchor bolt offset) – (1/2 compression stud pack width). For perforated walls = V x h / Co sum (bi) from SDPWS Eqn. 4.3-8.*
*Dead – Dead load resisting component, factored for ASD by 0.60 for tension and 1.0 for compression*
*Uplift – Uplift wind load component, factored for ASD by 0.60*
*Cmb'd – Sum of ASD-factored overturning, dead and uplift forces. May also include the uplift force t from perforated walls from SDPWS 4.3.6.4.2.1 when openings are staggered.*
*Hold-down – Device model number from hold-down database; "Compression" for bearing of end stud pack on bottom plate*
*Cap – Hold-downs: Allowable ASD tension load from database; Compression: allowable ASD bearing force = Ct CM Cb Fcp A; A = cross sectional area of end studs. Refer to Framing materials table for details*
*Crit. Resp. – Critical Response = Combined ASD force / Allowable ASD tension load*

Notes:
HDU2-SDS2.5 for studs with thickness > 0'-3" and depth > 0'-3.5" : Uses 6 1/4" x 2.5" SDS heavy-duty screws; 5/8" anchor bolt.
Refer to the Shear Line Dimensions table for wall height h, effective segment length beff and perforated wall adjusted sum of bi, to the Story Table

## Flexible Diaphragm Seismic Design

**SEISMIC INFORMATION**

| Level | Mass [lbs] | Area [sq.ft] | Story Shear Fx [lbs] E-W | Story Shear Fx [lbs] N-S | Shear Resistance [lbs] E-W | Shear Resistance [lbs] N-S | Diaphragm Force [lbs] E-W Fpx | Diaphragm Force [lbs] E-W Design | Diaphragm Force [lbs] N-S Fpx | Diaphragm Force [lbs] N-S Design |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 59787 | 2257.5 | 5709 | 5709 | 17279 | 25785 | 7421 | 7421 | 7421 | 7421 |
| All | **59787** | - | **8155** | **8155** | - | - | - | - | - | - |

*Legend:*
*Mass – Sum of all generated and input building masses on level = wx in ASCE 7 Eqn. 12.8-12.*
*Story Shear – Total ASD-factored shear force induced at level x from Eqn. 12.8-11.*
*Shear Resistance – Lateral design strength of all shear-resisting elements on story, for use in weak story evaluation (4.1.8).*
*Diaphragm Force – used by Shearwalls only for drag strut forces, as per Exception to 12.10.2.1.*
*Fpx - Minimum ASD-factored force for diaphragm design from Eqns. 12.10-1, -2, and -3.*
*Design = The greater of the story shear and Fpx + transfer forces from discontinuous shearlines, factored by overstrength (omega) as per 12.10.1.1. Omega = 2.5 as per 12.2-1.*

**Redundancy Factor p (rho):**
E-W 1.00, N-S 1.00
Automatically calculated according to ASCE 7 12.3.4.2.

**Vertical Earthquake Load Ev**
Ev = 0.2 Sds D; Sds = 0.89; Ev = 0.177 D unfactored; 0.124 D factored; total dead load factor: 0.6 - 0.124 = 0.476 tension, 1.0 + 0.124 = 1.124 compression.

**SHEAR RESULTS (flexible seismic design)**

| N-S Shearlines | W Gp | For Dir | ASD Shear Force [plf] v | vmax/vft | V [lbs] | Asp-Cub Int | Asp-Cub Ext | Allowable Shear [plf] Int | Ext | Co | C | Cmb | V [lbs] | Resp. Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Line 1** | | | | | | | | | | | | | | |
| **Level 1** | | | | | | | | | | | | | | |
| Ln1, Lev1 | 2 | Both | 42.4 | 43.5 | 1410 | - | 1.0 | - | 254 | 0.98 | | 254 | 8454 | 0.17 |
| **Line 3** | | | | | | | | | | | | | | |
| Ln3, Lev1 | - | Both | - | - | 2562 | - | - | - | - | - | | - | 6192 | - |
| Wall 3-1 | 2 | Both | 107.9 | - | 2562 | - | 1.0 | - | 261 | - | | 261 | 6192 | 0.41 |
| **Line 5** | | | | | | | | | | | | | | |
| Ln5, Lev1 | 2 | Both | 35.8 | 40.7 | 1737 | - | 1.0 | - | 230 | 0.88 | | 230 | 11140 | 0.16 |

| E-W Shearlines | W Gp | For Dir | ASD Shear Force [plf] v | vmax/vft | V [lbs] | Asp-Cub Int | Asp-Cub Ext | Allowable Shear [plf] Int | Ext | Co | C | Cmb | V [lbs] | Resp. Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Line A** | | | | | | | | | | | | | | |
| **Level 1** | | | | | | | | | | | | | | |
| LnA, Lev1 | - | Both | - | - | 869 | - | - | - | - | - | | - | 1278 | - |
| Wall A-1 | 1 | Both | - | - | 869 | - | 1.0 | - | 380 | - | | - | 1278 | - |
| Seg. 1 | - | Both | 158.0 | - | 435 | - | .61 | - | 232 | - | | 232 | 639 | 0.68 |
| Seg. 2 | - | Both | 158.0 | - | 435 | - | .61 | - | 232 | - | | 232 | 639 | 0.68 |
| **Line B** | | | | | | | | | | | | | | |
| LnB, Lev1 | 2 | Both | 90.2 | 116.1 | 2863 | - | .97 | - | 202 | 0.80 | | 202 | 6428 | 0.45 |
| **Line D** | | | | | | | | | | | | | | |
| LnD, Lev1 | - | Both | - | - | 1977 | - | - | - | - | - | | - | 9572 | - |
| Wall D-1 | 1 | Both | - | - | 1095 | - | 1.0 | - | 380 | - | | - | 4564 | - |
| Seg. 1 | - | Both | 156.4 | 9.8 | 586 | - | 1.0 | - | 380 | - | | 380 | 1426 | 0.41 |
| Open. 1 | - | Both | - | 205.3 | 1026 | - | - | - | 380 | - | | 380 | 1902 | 0.54 |
| Seg. 2 | - | Both | 156.4 | 9.8 | 508 | - | 1.0 | - | 380 | - | | 380 | 1236 | 0.41 |
| Wall D-2 | 1 | Both | - | - | 882 | - | 1.0 | - | 380 | - | | - | 5008 | - |
| Seg. 1 | - | Both | 220.5 | -258.5 | 441 | - | .67 | - | 254 | - | | 254 | 507 | 0.87 |
| Open. 1 | - | Both | - | 182.5 | 1916 | - | - | - | 380 | - | | 380 | 3994 | 0.48 |
| Seg. 2 | - | Both | 220.5 | -258.5 | 441 | - | .67 | - | 254 | - | | 254 | 507 | 0.87 |

*Legend:*
*W Gp - Wall design group defined in Sheathing and Framing Materials tables, where it shows associated Standard Wall. "^" means that this wall is critical for all walls in the Standard Wall group.*
*For Dir – Direction of seismic force along shearline.*
*v – Design shear force on segment = ASD-factored shear force per unit length of full-height sheathing (FHS)*
*vmax/vft - Perforated walls: Collector and in-plane anchorage force as per SDPWS eqn. 4.3-9 = V/FHS/Co. FHS is factored for narrow segments as per 4.3.3.4*
*FTAO walls: Shear force in piers above and below either openings or piers beside opening(s). Aspect ratio factor does not apply to these piers.*
*V – ASD factored shear force. For shearline: total shearline force. For wall: total of all segments on wall. For segment: force on segment*
*Asp/Cub – For wall: Unblocked structural wood panel factor Cub from SDPWS 4.3.5.3. For segment or FTAO pier: Aspect ratio factor from SDPWS 4.3.5.5.1. For perforated wall: Either Cub or sum bi / FHS, where bi is segment length adjusted per SDPWS 4.3.3.4.*
*Int, Ext - Nominal unit shear capacity of interior and exterior sheathing, factored by Table 4.3-1 Note 3 for framing specific gravity and Note 10 for presence of hold-downs. For wall segments, also include unblocked factor Cub and aspect ratio adjustments.*
*Co - Adjustment factor for perforated walls from SDPWS Equation 4.3-6.*
*C - Sheathing combination rule, A = Add capacities, S = Strongest side or twice weakest, G = Stiffness-based using Eqns. 4.3-3,-4.*
*Cmb - Combined interior and exterior unit shear capacity including perforated wall factor Co.*
*V – Total factored shear capacity of shearline, wall or segment.*
*Crit Resp – Response ratio = v/Cmb = design shear force/unit shear capacity. "W" indicates that the wind design criterion was critical in selecting wall.*

Notes:
Refer to Elevation View diagrams for individual level for uplift anchorage force t for perforated walls given by SDPWS 4.3.6.4.2,1.

**Hold-Down and Compression Design (flexible seismic design)**

| Level 1 Line-Wall | Posit'n | Location [ft] X | Location [ft] Y | Tensile Hold-down or Compressive Stud Force [lbs] Shear | Dead | Ev | Cmb'd | Hold-down | Cap [lbs] | Crit Resp. |
|---|---|---|---|---|---|---|---|---|---|---|
| **Line 1** | | | | | | | | | | |
| 1-1 | L End | -31.00 | 22.00 | -539 | 2700 | 335 | 3574 | Compression | 10312 | 0.35 |
| 1-1 | R End | -31.00 | 58.00 | -539 | 2700 | 335 | 3574 | Compression | 10312 | 0.35 |
| **Line 3** | | | | | | | | | | |
| 3-1 | L End | 0.00 | 0.00 | -981 | 3473 | 431 | 4886 | Compression | 10312 | 0.47 |
| 3-1 | R End | 0.00 | 23.50 | -981 | 3473 | 431 | 4886 | Compression | 10312 | 0.47 |
| **Line 5** | | | | | | | | | | |
| 5-1 | L End | 23.50 | 0.00 | -451 | 4350 | 540 | 5341 | Compression | 10312 | 0.52 |
| 5-1 | R End | 23.50 | 58.00 | -451 | 4350 | 540 | 5341 | Compression | 10312 | 0.52 |
| **Line A** | | | | | | | | | | |
| A-1 | L End | 0.00 | 0.00 | 1564 | 124 | 26 | 1466 | HDU2-SDS | 3075 | 0.48 |
| A-1 | L End | 0.00 | 0.00 | -1564 | 206 | 26 | 1796 | Compression | 10312 | 0.17 |
| A-1 | L Op 1 | 2.50 | 0.00 | 1564 | 923 | 191 | 833 | HDU2-SDS | 3075 | 0.27 |
| A-1 | L Op 1 | 2.50 | 0.00 | -1564 | 1538 | 191 | 3292 | Compression | 10312 | 0.32 |
| A-1 | R Op 1 | 20.50 | 0.00 | 1564 | 923 | 191 | 833 | HDU2-SDS | 3075 | 0.27 |
| A-1 | R Op 1 | 20.50 | 0.00 | -1564 | 1538 | 191 | 3292 | Compression | 10312 | 0.32 |
| A-1 | R End | 23.00 | 0.00 | 1564 | 124 | 26 | 1466 | HDU2-SDS | 3075 | 0.48 |
| A-1 | R End | 23.00 | 0.00 | -1564 | 206 | 26 | 1796 | Compression | 10312 | 0.17 |
| **Line B** | | | | | | | | | | |
| B-1 | L End | -31.00 | 22.00 | 0 | 263 | 33 | 295 | Compression | | - |
| B-1 | L Op 1 | -27.50 | 22.00 | 0 | 656 | 81 | 738 | Compression | | - |
| B-1 | R Op 1 | -22.00 | 22.00 | 0 | 619 | 77 | 695 | Compression | | - |
| B-1 | R End | -19.50 | 22.00 | 0 | 225 | 28 | 253 | Compression | | - |
| B-3 | L End | -19.00 | 24.50 | -1053 | 9270 | 1151 | 11474 | Compression | 25781 | 0.45 |
| B-2 | L Op 2 | -16.50 | 24.00 | 0 | 1686 | 209 | 1895 | Compression | | - |
| B-2 | R Op 2 | -11.50 | 24.00 | 0 | 2447 | 304 | 2751 | Compression | | - |
| B-2 | L Op 2 | -5.50 | 24.00 | 0 | 2012 | 250 | 2262 | Compression | | - |
| | V Elem | -2.00 | 24.00 | 0 | 1142 | 142 | 1284 | Compression | | |
| | V Elem | -0.00 | 24.00 | 0 | 489 | 61 | 550 | Compression | | |
| B-3 | R End | 23.00 | 24.50 | -1053 | 7724 | 959 | 9736 | Compression | 25781 | 0.38 |
| **Line D** | | | | | | | | | | |
| D-1 | L End | -31.00 | 58.00 | -838 | 2250 | 279 | 3368 | Compression | 10312 | 0.33 |
| D-1 | R End | -19.00 | 58.00 | -838 | 2250 | 279 | 3368 | Compression | 11601 | 0.29 |
| D-2 | L End | 9.00 | 58.00 | -557 | 2719 | 337 | 3613 | Compression | 10312 | 0.35 |
| D-2 | R End | 23.00 | 58.00 | -557 | 2719 | 337 | 3613 | Compression | 11601 | 0.31 |

*Legend:*
*Line-Wall:*
*At wall or opening – Shearline and wall number*
*At vertical element – Shearline*
*Posit'n – Position of stud pack that hold-down is attached to:*
*V Elem – Vertical element: column or strengthened studs required where not at wall end or opening*
*L or R End – At left or right wall end*
*L or R Op n – At left or right side of opening n*
*t @ Op n – Uplift force t at opening n from offset opening in perforated wall above, from SDPWS 4.3.6.4.2.1*
*Location – Co-ordinates in Plan View*
*Tensile Hold-down or Compressive Stud Force – Upwards force on hold-down at one end of the wall or downward force on bottom plate under studs at the other end, for each force direction. Includes forces transferred from upper levels.*
*Shear – Overturning component = V x h / beff from SDPWS Eqn. 4.3-7; V = force on segment, ASD-factored by 0.70; h = wall height , beff = wall segment length – (tension stud pack width + hold-down anchor bolt offset) – (1/2 compression stud pack width). For perforated walls = V x h / Co sum (bi) from SDPWS Eqn. 4.3-8.*
*Dead – Dead load resisting component, factored for ASD by 0.60 for tension and 1.0 for compression*
*Ev – Vertical seismic load effect from ASCE 7 12.4.2.2 = -0.2 Sds x ASD factor x unfactored D = 0.207 SDS x factored D. Refer to Seismic Information table for more details.*
*Cmb'd – Sum of ASD-factored overturning, dead and vertical seismic forces. May also include the uplift force t from perforated walls from SDPWS 4.3.6.4.2.1 when openings are staggered.*
*Hold-down – Device model number from hold-down database; "Compression" for bearing of end stud pack on bottom plate*
*Cap – Hold-downs: Allowable ASD tension load from database; Compression: Allowable ASD bearing force = Ct CM Cb Fcp A; A = cross sectional area of end studs. Refer to Framing materials table for details.*
*Crit. Resp. – Critical Response = Combined ASD force/Allowable ASD tension load*

Notes:
HDU2-SDS2.5 for studs with thickness > 0'-3" and depth > 0'-3.5" : Uses 6 1/4" x 2.5" SDS heavy-duty screws; 5/8" anchor bolt.
Combined force from ASCE 7 2.4.1 load combination 10 = - (0.6D - 0.7Ev + 0.7Eh); Eh (from 12.4.2.1) = - shear overturning force
Refer to the Shear Line Dimensions table for wall height h, effective segment length beff and perforated wall adjusted sum of bi, to the Story Table for joist depth, and to the Shear Results table for perforated factor Co.
Designer is responsible for design of connection from wall to floor or foundation for shear force shown in Shear Results table. Refer to SDPWS