

## STRUCTURAL ANALYSIS

For:  
City of Orland ADU's Std.  
Orland, CA  
749 SQFT  
Project # 23M-007

July 24, 2023

(PC1 SUBMITTAL)

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## SCOPE OF WORK

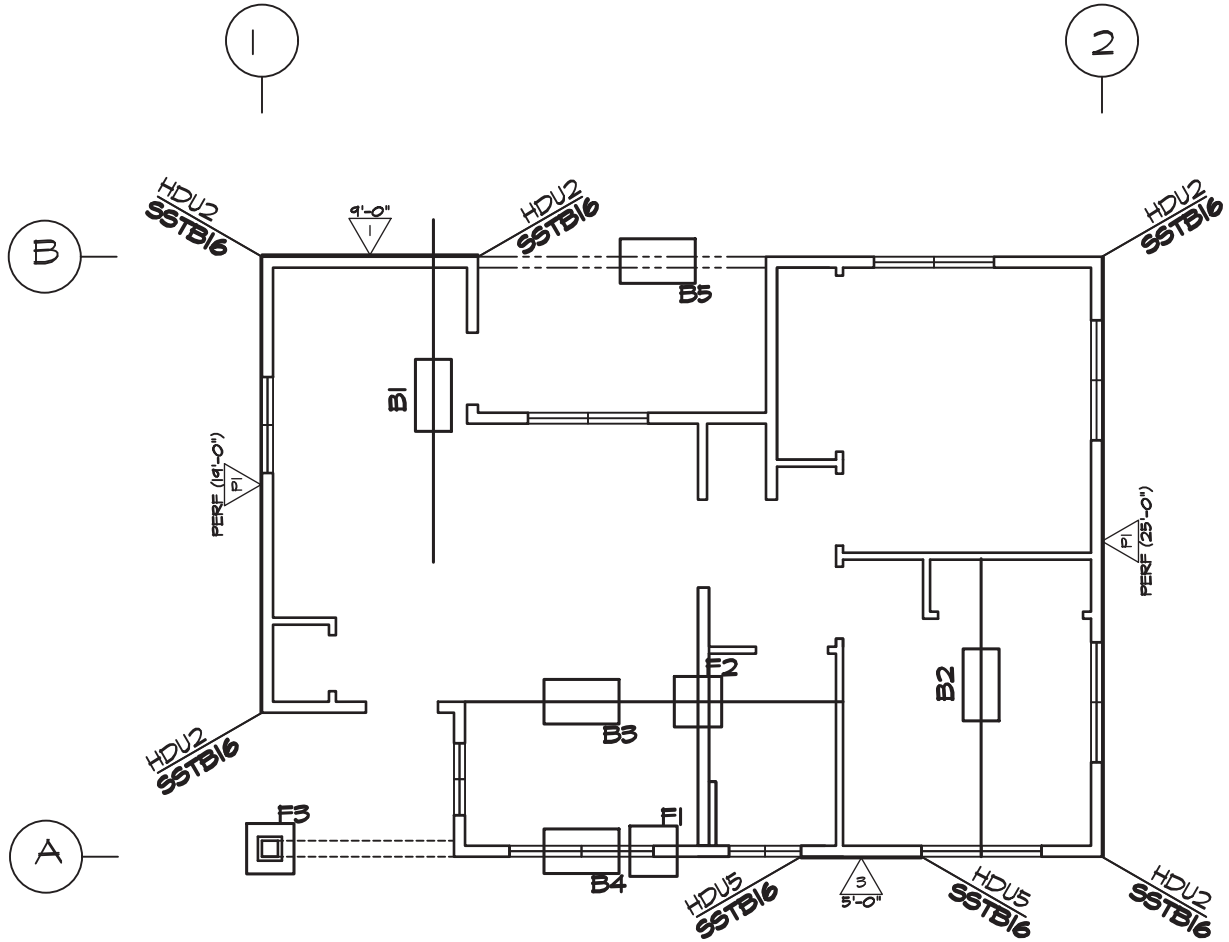
### Scope

The following Structural Analysis is for a new light-wood framed single family residence to be built on a new slab-on-grade floor. Analysis of structure was performed with respect to the forces of seismic and wind and gravity using the applicable chapters of the A.S.C.E. 7-16.

The structural design of this project used two methods for lateral restraint system: Perforated shear wall design (SDPWS 2021 sec. 4.3.5.3) and segmented shear wall design (SDPWS 2021 sec. 4.3.5.1). Analysis and design for gravity loads were performed to verify beam design per AWC NDS 2021 for wood members.

### Analysis

The building was analyzed as 1 diaphragm and idealized as flexible for a simplified analysis. The footings and beams were designed with appropriate design loads using the Enercalc and Forte web software.



PROJECT LAYOUT

1/8" = 1'-0"



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750 PALISADE ADU  
 123 MY WAY  
 ORLAND, CA

JOB # 23M-007 Job #23M-007 749 Palisade



# Orland, CA 95963, USA

Latitude, Longitude: 39.7473803, -122.1963748



|                                       |                                  |
|---------------------------------------|----------------------------------|
| <b>Date</b>                           | 4/4/2023, 3:10:58 PM             |
| <b>Design Code Reference Document</b> | ASCE7-16                         |
| <b>Risk Category</b>                  | II                               |
| <b>Site Class</b>                     | D - Default (See Section 11.4.3) |

| Type            | Value                    | Description   |
|-----------------|--------------------------|---|
| S <sub>S</sub>  | 0.842                    | MCE <sub>R</sub> ground motion. (for 0.2 second period) |
| S <sub>1</sub>  | 0.355                    | MCE <sub>R</sub> ground motion. (for 1.0s period)       |
| S <sub>MS</sub> | 1.01                     | Site-modified spectral acceleration value               |
| S <sub>M1</sub> | null -See Section 11.4.8 | Site-modified spectral acceleration value               |
| S <sub>DS</sub> | 0.673                    | Numeric seismic design value at 0.2 second SA           |
| S <sub>D1</sub> | null -See Section 11.4.8 | Numeric seismic design value at 1.0 second SA           |

| Type              | Value                    | Description   |
|-------------------|--------------------------|---|
| SDC               | null -See Section 11.4.8 | Seismic design category   |
| F <sub>a</sub>    | 1.2                      | Site amplification factor at 0.2 second   |
| F <sub>v</sub>    | null -See Section 11.4.8 | Site amplification factor at 1.0 second   |
| PGA               | 0.373                    | MCE <sub>G</sub> peak ground acceleration   |
| F <sub>PGA</sub>  | 1.227                    | Site amplification factor at PGA  |
| PGA <sub>M</sub>  | 0.457                    | Site modified peak ground acceleration  |
| T <sub>L</sub>    | 16                       | Long-period transition period in seconds  |
| SsRT              | 0.842                    | Probabilistic risk-targeted ground motion. (0.2 second)                                   |
| SsUH              | 0.928                    | Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration  |
| SsD               | 1.5                      | Factored deterministic acceleration value. (0.2 second)                                   |
| S1RT              | 0.355                    | Probabilistic risk-targeted ground motion. (1.0 second)                                   |
| S1UH              | 0.397                    | Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration. |
| S1D               | 0.6                      | Factored deterministic acceleration value. (1.0 second)                                   |
| PGAd              | 0.5                      | Factored deterministic acceleration value. (Peak Ground Acceleration)                     |
| PGA <sub>UH</sub> | 0.373                    | Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration        |
| C <sub>RS</sub>   | 0.907                    | Mapped value of the risk coefficient at short periods                                     |

## Design Loads / Criteria

| Gravity Loads: Per ASCE 7-16                       |                   |              | SEISMIC   |          |
|--|-------------------|--------------|---|----------|
| Roof Dead Loads:<br><br>Slope= 6 /12<br>27 Degrees | Comp Roofing      | 5 psf        | ASCE 7-16<br>EQUIVALENT LATERAL<br>FORCE PROCEEDURE                                   |          |
|  | 1/2" Roof ply     | 1.8 psf      |   |          |
|  | Framing           | 1.5 psf      |   |          |
|  | Insulation        | 1 psf        | Design Category: D (default)  |          |
|  | 1/2" covering     | 2.8 psf      | I =   | II       |
|  | Solar             | 3 psf        | Ss =  | 0.842    |
|  | Misc              | 1 psf        | S1 =  | 0.355    |
|  | Total =           | 16.1 psf     | SMS =   | 1.01     |
|  | Total Sloped=     | 19.00 psf    | SM1 =   | null     |
| Roof Live Loads                                    | Construction=     | 20 psf       | SDS =   | 0.673    |
|  | Ground Snow=      | 0 psf        | SD1 =   | null     |
|  | Flat Roof Snow=   | 0 psf        | TL =  | 16       |
|  | Sloped Roof Snow= | 0.0 psf      | RO =  | 1.3      |
|  |                   |              | R =   | 6.5      |
|  |                   |              | <b>SNOW LOAD</b>  |          |
| Exterior Wall Dead Load                            | Wood              | 2.00 psf     | Sloped Roof   | 0.0 PSF  |
|  | 3/8" ply          | 2.40 psf     | Seismic =   | 0 PSF    |
|  | 2x6 Framing       | 1.70 psf     | <b>WIND</b>   |          |
|  | 1/2" sheetrock    | 2.20 psf     | MAIN WIND FORCE RESISTING SYSTEM,<br>ALL HEIGHTS METHOD ASCE 7-16<br>CHAPTERS 26 & 27 |          |
|  | Insulation        | 1.10 psf     |   |          |
|  | Misc              | 1.00 psf     |   |          |
| Wall total=  | 11.00 psf         | WIND SPEED = | 95 MPH  |          |
| Interior wall dead load                            | 2x Framing        | 1.7 psf      | EXPOSURE =  | C        |
|  | 1/2" sheetrock    | 4.4 psf      | ENCLOSURE =   | ENCLOSED |
|  | Misc              | 1 psf        |   |          |
|  | Wall total=       | 8 psf        |   |          |

## WoodWorks® Shearwalls 2023

23M-007 750 Palisade.wsw

Apr. 6, 2023 13:21:32

## Project Information

## DESIGN SETTINGS

|   |                                     |   |  |                                      |   |
|---|-------------------------------------|---|--|--------------------------------------|---|
| <b>Design Code</b><br>IBC 2021/AWC SDPWS 2021                                 |                                     | <b>Wind Standard</b><br>ASCE 7-16 Directional (All heights)                           |  | <b>Seismic Standard</b><br>ASCE 7-16 |   |
| <b>Load Combinations</b>  |                                     |   | <b>Building Code Capacity Modification</b>     |                                      |   |
| <b>For Design (ASD)</b><br>0.70 Seismic + 0.60 Dead<br>0.60 Wind + 0.60 Dead  |                                     | <b>For Deflection (Strength)</b><br>1.00 Seismic + 0.90 Dead<br>1.00 Wind + 0.90 Dead |  | <b>Wind</b><br>1.00                  | <b>Seismic</b><br>1.00                  |
| <b>Service Conditions and Load Duration</b>                                   |                                     |   |  | <b>Max Shearwall Offset [ft]</b>     |   |
| <b>Duration Factor</b><br>1.60  | <b>Temperature Range</b><br>T<=100F | <b>Moisture Content Fabrication</b><br>24% (>19%)                                     | <b>Moisture Content Service</b><br>10% (<=19%) | <b>Plan (within story)</b><br>0.50   | <b>Elevation (between stories)</b><br>- |
| <b>Maximum Height-to-width Ratio</b>  |                                     |   |  |                                      |   |
| <b>Wood panels</b>  |                                     | <b>Fiberboard</b>   | <b>Lumber</b>                                  |                                      | <b>Gypsum</b>                           |
| <b>Blocked</b><br>3.5   | <b>Unblocked</b><br>2.0             | -   | <b>Wind</b><br>-                               | <b>Seismic</b><br>-                  | <b>Blocked</b><br>-                     |
| <b>Ignore shear resistance contribution of...</b>                             |                                     |   | <b>Forces based on...</b>                      |                                      |   |
| <b>Wall segments</b><br>Side with invalid aspect ratio                        |                                     | <b>Seismic</b><br>Any gypsum, lumber, fiberboard                                      |  | <b>Hold-downs</b>                    | Applied loads                           |
|   |                                     |   |  | <b>Drag struts</b>                   | Applied loads                           |
| <b>Shearwall relative rigidity:</b> Wall capacity                             |                                     |   |  |                                      |   |
| <b>Non-identical materials and construction on the shearline:</b> Not allowed |                                     |   |  |                                      |   |
| <b>Deflection Equation:</b> 4-term from SDPWS C4.3.4-1                        |                                     |   |  |                                      |   |
| <b>Drift limit for wind design:</b> 1 / 100 story height                      |                                     |   |  |                                      |   |
| <b>FTAO strap:</b> Continuous at top of highest opening and bottom of lowest  |                                     |   |  |                                      |   |

## SITE INFORMATION

|  |                    |                    |   |                          |            |
|--|--------------------|--------------------|---|--------------------------|------------|
| <b>Wind</b><br>ASCE 7-16 Directional (All heights) |                    |                    | <b>Seismic</b><br>ASCE 7-16 12.8 Equivalent Lateral Force Procedure |                          |            |
| <b>Design Wind Speed</b>                           | 95 mph             |                    | <b>Risk Category</b>  | Category II - All others |            |
| <b>Serviceability Wind Speed</b>                   | 100 mph            |                    | <b>Structure Type</b>   | Regular                  |            |
| <b>Exposure</b>                                    | Exposure C         |                    | <b>Building System</b>  | Bearing Wall             |            |
| <b>Enclosure</b>                                   | Partially open     |                    | <b>Design Category</b>  | D                        |            |
| <b>Min Wind Loads: Walls</b>                       | 16 psf             |                    | <b>Site Class</b>   | D                        |            |
| <b>Roofs</b>                                       | 8 psf              |                    | <b>Spectral Response Acceleration</b>                               |                          |            |
| <b>Topographic Information [ft]</b>                |                    |                    | <b>S1:</b> 0.355g   | <b>Ss:</b> 0.842g        |            |
| <b>Shape</b><br>-                                  | <b>Height</b><br>- | <b>Length</b><br>- | <b>Fundamental Period</b>   | <b>E-W</b>               | <b>N-S</b> |
| <b>Site Location:</b> -                            |                    |                    | <b>T Used</b>   | 0.133s                   | 0.133s     |
| Elev: 0ft  |                    |                    | <b>Approximate Ta</b>   | 0.133s                   | 0.133s     |
| Rigid building - Static analysis                   |                    |                    | <b>Maximum T</b>  | 0.186s                   | 0.186s     |
| <b>Case 2</b>                                      |                    |                    | <b>Response Factor R</b>  | 6.50                     | 6.50       |
| <b>Eccentricity (%)</b>                            | <b>E-W loads</b>   | <b>N-S loads</b>   | <b>Fa:</b> 1.37   | <b>Fv:</b> 1.95          |            |
|  | 15                 | 15                 |   |                          |            |
| <b>Loaded at</b>                                   | 75%                |                    |   |                          |            |

## Structural Data

## STORY INFORMATION

|            | Story Elev [ft] | Floor/Ceiling Depth [in] | Wall Height [ft] | Hold-down Length subject to shrinkage [in] | Bolt length [in] |
|------------|-----------------|--------------------------|------------------|--|------------------|
| Ceiling    | 9.00            | 0.0                      |                  |  |                  |
| Level 1    | 0.00            | 0.0                      | 9.00             | 3.75                                       | 4.5              |
| Foundation | 0.00            |                          |                  |  |                  |

## BLOCK and ROOF INFORMATION

| Block Dimensions [ft]    | Block   |           | Face  | Type  | Roof Panels |               |
|--------------------------|---------|-----------|-------|-------|-------------|---------------|
|                          | 1 Story | E-W Ridge |       |       | Slope       | Overhang [ft] |
| Block 1                  | 1       |           |       |       |             |               |
| Location X,Y =           | 0.25    | 0.25      | North | Side  | 30.8        | 1.50          |
| Extent X,Y =             | 34.50   | 24.50     | South | Side  | 28.8        | 1.62          |
| Ridge Y Location, Offset | 13.00   | 0.50      | East  | Gable | 90.0        | 1.06          |
| Ridge Elevation, Height  | 16.00   | 7.00      | West  | Gable | 90.0        | 1.06          |



## SHEATHING MATERIALS by WALL GROUP

| Grp | Surf | Material      | Ratng | Sheathing   |          |     |      |       | Gvtv<br>lbs/in | Size | Fasteners |          |          |    |     | Apply<br>Notes |
|-----|------|---------------|-------|-------------|----------|-----|------|-------|----------------|------|-----------|----------|----------|----|-----|----------------|
|     |      |               |       | Thick<br>in | GU<br>in | Ply | Or   | Type  |                |      | RS        | Eg<br>in | Fd<br>in | Bk |     |                |
| 1   | 1    | Struct Sh OSB | 24/0  | 3/8         | -        | -   | Horz | 77500 | 8d             | Box  | N         | 3        | 12       | Y  | 2,3 |                |
| 2   | Ext  | Struct Sh OSB | 24/0  | 3/8         | -        | -   | Horz | 77500 | 8d             | Box  | 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<br>Grp | Species | Grade | b<br>in | d<br>in | Spcg<br>in | SG   | E<br>psi <sup>6</sup> | Fcp | Standard Wall  |
|-------------|---------|-------|---------|---------|------------|------|-----------------------|-----|----------------|
| 1           | D.Fir-L | No.1  | 1.50    | 5.50    | 16         | 0.50 | 1.70                  | 625 |                |
| 2           | 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 | Non Shear Wall |

## 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.

## SHEARLINE, WALL and OPENING DIMENSIONS

| North-south Shearlines | Type | Wall Group | Location X [ft] | Extent [ft] Start | Extent [ft] End | Length [ft] | FHS [ft] | Aspect Ratio | Height [ft] | Studs S | Studs N |
|------------------------|------|------------|-----------------|-------------------|-----------------|-------------|----------|--------------|-------------|---------|---------|
| <b>Line 1</b>          |      |            |                 |                   |                 |             |          |              |             |         |         |
| <b>Level 1</b>         |      |            |                 |                   |                 |             |          |              |             |         |         |
| Line 1                 |      | 2          | 0.50            | 0.25              | 24.75           | 24.50       | 14.50    | -            | 9.00        | -       | -       |
| Wall 1-1               | NSW  |            | 0.25            | 0.25              | 24.75           | 24.50       | 0.00     | -            | -           | 2       | 2       |
| Segment 1              |      | -          | -               | 0.25              | 0.25            | 0.00        | -        | -            | -           | 2       | 2       |
| Opening 1              |      | -          | -               | 0.25              | 6.00            | 5.75        | -        | -            | 9.00        | 2       | 2       |
| Segment 2              |      | -          | -               | 6.00              | 24.75           | 18.75       | -        | -            | -           | 2       | 2       |
| Wall 1-2               | Prf  | 2          | 0.50            | 6.00              | 24.50           | 18.50       | 14.50    | -            | -           | 3       | 3       |
| Segment 1              |      | -          | -               | 6.00              | 16.00           | 10.00       | 10.00    | 0.90         | -           | -       | -       |
| Opening 1              |      | -          | -               | 16.00             | 20.00           | 4.00        | 4.00     | -            | 3.00        | -       | -       |
| Segment 2              |      | -          | -               | 20.00             | 24.50           | 4.50        | 4.50     | 2.00         | -           | -       | -       |
| <b>Line 2</b>          |      |            |                 |                   |                 |             |          |              |             |         |         |
| <b>Level 1</b>         |      |            |                 |                   |                 |             |          |              |             |         |         |
| Line 2                 |      | 2          | 34.75           | 0.25              | 24.75           | 24.50       | 12.96    | -            | 9.00        | -       | -       |
| Wall 2-1               | Prf  | 2          | 34.75           | 0.25              | 24.75           | 24.50       | 12.96    | -            | -           | 2       | 2       |
| Segment 1              |      | -          | -               | 0.25              | 4.25            | 4.00        | 3.56     | 2.25         | -           | -       | -       |
| Opening 1              |      | -          | -               | 4.25              | 9.25            | 5.00        | 5.00     | -            | 1.00        | -       | -       |
| Segment 2              |      | -          | -               | 9.25              | 17.17           | 7.92        | 7.92     | 1.14         | -           | -       | -       |
| Opening 2              |      | -          | -               | 17.17             | 22.17           | 5.00        | 5.00     | -            | 1.00        | -       | -       |
| Segment 3              |      | -          | -               | 22.17             | 24.75           | 2.58        | 1.48     | 3.48         | -           | -       | -       |
| East-west Shearlines   | Type | Wall Group | Location Y [ft] | Extent [ft] Start | Extent [ft] End | Length [ft] | FHS [ft] | Aspect Ratio | Height [ft] | Studs W | Studs E |
| <b>Line A</b>          |      |            |                 |                   |                 |             |          |              |             |         |         |
| <b>Level 1</b>         |      |            |                 |                   |                 |             |          |              |             |         |         |
| Line A                 |      | 1          | 0.50            | 0.25              | 34.75           | 34.50       | 4.75     | -            | 9.00        | -       | -       |
| Wall A-1               | NSW  |            | 0.25            | 0.25              | 34.75           | 34.50       | 0.00     | -            | -           | 2       | 2       |
| Segment 1              |      | -          | -               | 0.25              | 0.25            | 0.00        | -        | -            | -           | 2       | 2       |
| Opening 1              |      | -          | -               | 0.25              | 8.08            | 7.83        | -        | -            | 4.00        | 2       | 2       |
| Segment 2              |      | -          | -               | 8.08              | 10.33           | 2.25        | -        | -            | -           | 2       | 2       |
| Opening 2              |      | -          | -               | 10.33             | 16.33           | 6.00        | -        | -            | 4.00        | 2       | 2       |
| Segment 3              |      | -          | -               | 16.33             | 19.50           | 3.17        | -        | -            | -           | 2       | 2       |
| Opening 3              |      | -          | -               | 19.50             | 22.50           | 3.00        | -        | -            | 4.00        | 2       | 2       |
| Segment 4              |      | -          | -               | 22.50             | 27.50           | 5.00        | -        | -            | -           | 2       | 2       |
| Opening 4              |      | -          | -               | 27.50             | 32.50           | 5.00        | -        | -            | 4.00        | 2       | 2       |
| Segment 5              |      | -          | -               | 32.50             | 34.75           | 2.25        | -        | -            | -           | 2       | 2       |
| Wall A-2               | Seg  | 1          | 0.50            | 22.50             | 27.50           | 5.00        | 4.75     | 1.80         | -           | 2       | 2       |
| <b>Line B</b>          |      |            |                 |                   |                 |             |          |              |             |         |         |
| <b>Level 1</b>         |      |            |                 |                   |                 |             |          |              |             |         |         |
| Line B                 |      | 2          | 24.50           | 0.25              | 34.75           | 34.50       | 8.75     | -            | 9.00        | -       | -       |
| Wall B-1               | NSW  |            | 24.75           | 0.25              | 34.75           | 34.50       | 0.00     | -            | -           | 2       | 2       |
| Segment 1              |      | -          | -               | 0.25              | 9.25            | 9.00        | -        | -            | -           | 2       | 2       |
| Opening 1              |      | -          | -               | 9.25              | 21.25           | 12.00       | -        | -            | 9.00        | 2       | 2       |
| Segment 2              |      | -          | -               | 21.25             | 25.50           | 4.25        | -        | -            | -           | 2       | 2       |
| Opening 2              |      | -          | -               | 25.50             | 30.50           | 5.00        | -        | -            | 4.00        | 2       | 2       |
| Segment 3              |      | -          | -               | 30.50             | 34.75           | 4.25        | -        | -            | -           | 2       | 2       |
| Wall B-2               | Seg  | 2          | 24.50           | 0.50              | 9.50            | 9.00        | 8.75     | 1.00         | -           | 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

Studs: Number of end studs at the south and north or west and east ends of a wall segment or a perforated or FTAO wall.

## Loads

## WIND SHEAR LOADS (as entered or generated)

| Level 1<br>Block | F | Element | Load<br>Case | Wnd<br>Dir | Surf<br>Dir | Prof | Location [ft] |       | Magnitude<br>[lbs,plf,psf] |      | Trib<br>Ht<br>[ft] |
|------------------|---|---------|--------------|------------|-------------|------|---------------|-------|----------------------------|------|--------------------|
|                  |   |         |              |            |             |      | Start         | End   | Start                      | End  |                    |
| Block 1          | W | Wall    | Min          | W->E       | Wind        | Area | 0.25          | 24.75 | 8.0                        |      | 4.50               |
| Block 1          | W | L Gable | 1            | W->E       | Wind        | Area | 0.25          | 13.00 | 0.0                        | 11.3 | 7.00               |
| Block 1          | W | L Gable | Min          | W->E       | Wind        | Area | 0.25          | 13.00 | 0.0                        | 8.0  | 7.00               |
| Block 1          | W | Wall    | 1            | W->E       | Wind        | Area | 0.25          | 24.75 | 11.3                       |      | 4.50               |
| Block 1          | W | R Gable | 1            | W->E       | Wind        | Area | 13.00         | 24.75 | 11.3                       | 0.0  | 7.00               |
| Block 1          | W | R Gable | Min          | W->E       | Wind        | Area | 13.00         | 24.75 | 8.0                        | 0.0  | 7.00               |
| Block 1          | E | L Gable | 1            | W->E       | Lee         | Area | 0.25          | 13.00 | 0.0                        | 5.9  | 7.00               |
| Block 1          | E | L Gable | Min          | W->E       | Lee         | Area | 0.25          | 13.00 | 0.0                        | 8.0  | 7.00               |
| Block 1          | E | Wall    | Min          | W->E       | Lee         | Area | 0.25          | 24.75 | 8.0                        |      | 4.50               |
| Block 1          | E | Wall    | 1            | W->E       | Lee         | Area | 0.25          | 24.75 | 5.9                        |      | 4.50               |
| Block 1          | E | R Gable | Min          | W->E       | Lee         | Area | 13.00         | 24.75 | 8.0                        | 0.0  | 7.00               |
| Block 1          | E | R Gable | 1            | W->E       | Lee         | Area | 13.00         | 24.75 | 5.9                        | 0.0  | 7.00               |
| Block 1          | W | L Gable | 1            | E->W       | Lee         | Area | 0.25          | 13.00 | 0.0                        | 5.9  | 7.00               |
| Block 1          | W | L Gable | Min          | E->W       | Lee         | Area | 0.25          | 13.00 | 0.0                        | 8.0  | 7.00               |
| Block 1          | W | Wall    | Min          | E->W       | Lee         | Area | 0.25          | 24.75 | 8.0                        |      | 4.50               |
| Block 1          | W | Wall    | 1            | E->W       | Lee         | Area | 0.25          | 24.75 | 5.9                        |      | 4.50               |
| Block 1          | W | R Gable | 1            | E->W       | Lee         | Area | 13.00         | 24.75 | 5.9                        | 0.0  | 7.00               |
| Block 1          | W | R Gable | Min          | E->W       | Lee         | Area | 13.00         | 24.75 | 8.0                        | 0.0  | 7.00               |
| Block 1          | E | Wall    | 1            | E->W       | Wind        | Area | 0.25          | 24.75 | 11.3                       |      | 4.50               |
| Block 1          | E | L Gable | 1            | E->W       | Wind        | Area | 0.25          | 13.00 | 0.0                        | 11.3 | 7.00               |
| Block 1          | E | Wall    | Min          | E->W       | Wind        | Area | 0.25          | 24.75 | 8.0                        |      | 4.50               |
| Block 1          | E | L Gable | Min          | E->W       | Wind        | Area | 0.25          | 13.00 | 0.0                        | 8.0  | 7.00               |
| Block 1          | E | R Gable | Min          | E->W       | Wind        | Area | 13.00         | 24.75 | 8.0                        | 0.0  | 7.00               |
| Block 1          | E | R Gable | 1            | E->W       | Wind        | Area | 13.00         | 24.75 | 11.3                       | 0.0  | 7.00               |
| Block 1          | S | Roof    | Min          | S->N       | Wind        | Area | -0.81         | 35.81 | 4.3                        |      | 7.89               |
| Block 1          | S | Roof    | 1            | S->N       | Wind        | Area | -0.81         | 35.81 | 2.8                        |      | 7.89               |
| Block 1          | S | Wall    | 1            | S->N       | Wind        | Area | 0.25          | 34.75 | 11.3                       |      | 4.50               |
| Block 1          | S | Wall    | Min          | S->N       | Wind        | Area | 0.25          | 34.75 | 8.0                        |      | 4.50               |
| Block 1          | N | Roof    | 1            | S->N       | Lee         | Area | -0.81         | 35.81 | 8.5                        |      | 7.89               |
| Block 1          | N | Roof    | Min          | S->N       | Lee         | Area | -0.81         | 35.81 | 4.0                        |      | 7.89               |
| Block 1          | N | Wall    | 1            | S->N       | Lee         | Area | 0.25          | 34.75 | 7.1                        |      | 4.50               |
| Block 1          | N | Wall    | Min          | S->N       | Lee         | Area | 0.25          | 34.75 | 8.0                        |      | 4.50               |
| Block 1          | S | Roof    | 1            | N->S       | Lee         | Area | -0.81         | 35.81 | 8.5                        |      | 7.89               |
| Block 1          | S | Roof    | Min          | N->S       | Lee         | Area | -0.81         | 35.81 | 4.3                        |      | 7.89               |
| Block 1          | S | Wall    | 1            | N->S       | Lee         | Area | 0.25          | 34.75 | 7.1                        |      | 4.50               |
| Block 1          | S | Wall    | Min          | N->S       | Lee         | Area | 0.25          | 34.75 | 8.0                        |      | 4.50               |
| Block 1          | N | Roof    | 1            | N->S       | Wind        | Area | -0.81         | 35.81 | 3.1                        |      | 7.89               |
| Block 1          | N | Roof    | Min          | N->S       | Wind        | Area | -0.81         | 35.81 | 4.0                        |      | 7.89               |
| Block 1          | N | Wall    | 1            | N->S       | Wind        | Area | 0.25          | 34.75 | 11.3                       |      | 4.50               |
| Block 1          | N | Wall    | Min          | N->S       | Wind        | Area | 0.25          | 34.75 | 8.0                        |      | 4.50               |

## Legend:

Block - Block used in load generation

Accum. = loads from one block combined with another

Manual = user-entered loads (so no block)

F - Building face (north, south, east or west)

Element - Building surface on which loads generated or entered

Load Case - One of the following:

ASCE 7 All Heights: Case 1 or 2 from Fig 27.3-8 or minimum loads from 27.1.5

ASCE 7 Low-rise: Reference corner and Case A or B from Fig 28.3-1 or minimum loads from 28.3.4

Wind Dir - Direction of wind for loads with positive magnitude, also direction of MWFRS.

Surf Dir - Windward or leeward side of the building for loads in given direction

Prof - Profile (distribution)

Location - Start and end points on building element

Magnitude - Start = intensity of uniform and point loads or leftmost intensity of trapezoidal load, End = right intensity of trap load

Trib Ht - Tributary height of area loads only

## Notes:

All loads entered by the user or generated by program are specified (unfactored) loads. The program applies a load factor of 0.60 to wind loads before distributing them to the shearlines.

## WIND C&amp;C LOADS

| Block   | Building Face | Wind Direction | Level | Magnitude [psf] |          |
|---------|---------------|----------------|-------|-----------------|----------|
|         |               |                |       | Interior        | End Zone |
| Block 1 | West          | Windward       | 1     | 21.3            | 26.3     |
| Block 1 | West          | Windward       | 1     | 21.3            | 26.3     |
| Block 1 | West          | Windward       | 1     | 21.3            | 26.3     |
| Block 1 | West          | Windward       | 1     | 21.3            | 26.3     |
| Block 1 | East          | Leeward        | 1     | 21.3            | 26.3     |
| Block 1 | East          | Leeward        | 1     | 21.3            | 26.3     |
| Block 1 | East          | Leeward        | 1     | 21.3            | 26.3     |
| Block 1 | East          | Leeward        | 1     | 21.3            | 26.3     |
| Block 1 | West          | Leeward        | 1     | 21.3            | 26.3     |
| Block 1 | West          | Leeward        | 1     | 21.3            | 26.3     |
| Block 1 | West          | Leeward        | 1     | 21.3            | 26.3     |
| Block 1 | West          | Leeward        | 1     | 21.3            | 26.3     |
| Block 1 | East          | Windward       | 1     | 21.3            | 26.3     |
| Block 1 | East          | Windward       | 1     | 21.3            | 26.3     |
| Block 1 | East          | Windward       | 1     | 21.3            | 26.3     |
| Block 1 | East          | Windward       | 1     | 21.3            | 26.3     |
| Block 1 | South         | Windward       | 1     | 21.3            | 26.3     |
| Block 1 | South         | Windward       | 1     | 21.3            | 26.3     |
| Block 1 | South         | Windward       | 1     | 21.3            | 26.3     |
| Block 1 | South         | Windward       | 1     | 21.3            | 26.3     |
| Block 1 | North         | Leeward        | 1     | 21.3            | 26.3     |
| Block 1 | North         | Leeward        | 1     | 21.3            | 26.3     |
| Block 1 | North         | Leeward        | 1     | 21.3            | 26.3     |
| Block 1 | North         | Leeward        | 1     | 21.3            | 26.3     |
| Block 1 | South         | Leeward        | 1     | 21.3            | 26.3     |
| Block 1 | South         | Leeward        | 1     | 21.3            | 26.3     |
| Block 1 | South         | Leeward        | 1     | 21.3            | 26.3     |
| Block 1 | South         | Leeward        | 1     | 21.3            | 26.3     |
| Block 1 | North         | Windward       | 1     | 21.3            | 26.3     |
| Block 1 | North         | Windward       | 1     | 21.3            | 26.3     |
| Block 1 | North         | Windward       | 1     | 21.3            | 26.3     |
| Block 1 | North         | Windward       | 1     | 21.3            | 26.3     |

## DEAD LOADS (for hold-down calculations)

| Shear Line | Level | Profile | Tributary Width [ft] | Location [ft] |       | Mag [lbs,psf,psi] |     |
|------------|-------|---------|----------------------|---------------|-------|-------------------|-----|
|            |       |         |                      | Start         | End   | Start             | End |
| A          | 1     | Line    |                      | 0.25          | 34.75 | 135.0*            |     |
| A          | 1     | Line    |                      | 22.50         | 27.50 | 54.0*             |     |
| B          | 1     | Line    |                      | 0.25          | 34.75 | 135.0*            |     |
| B          | 1     | Line    |                      | 0.25          | 34.75 | 400.0             |     |
| B          | 1     | Line    |                      | 0.50          | 9.50  | 400.0             |     |
| B          | 1     | Line    |                      | 0.50          | 9.50  | 54.0*             |     |
| 1          | 1     | Line    |                      | 0.25          | 24.75 | 135.0*            |     |
| 1          | 1     | Line    |                      | 0.25          | 24.75 | 200.0             |     |
| 1          | 1     | Line    |                      | 6.00          | 24.50 | 54.0*             |     |
| 1          | 1     | Line    |                      | 6.00          | 24.50 | 200.0             |     |
| 2          | 1     | Line    |                      | 0.25          | 24.75 | 135.0*            |     |
| 2          | 1     | Line    |                      | 0.25          | 24.75 | 400.0             |     |

## BUILDING MASSES

| Level 1<br>Force<br>Dir | Building<br>Element | Block   | Wall<br>Line | Profile | Location [ft] |       | Magnitude<br>[lbs,plf,psf] |       | Trib<br>Width<br>[ft] |
|-------------------------|---------------------|---------|--------------|---------|---------------|-------|----------------------------|-------|-----------------------|
|                         |                     |         |              |         | Start         | End   | Start                      | End   |                       |
| E-W                     | Snow                | Block 1 |              | Line    | -1.37         | 26.25 | 109.9                      | 109.9 |                       |
| E-W                     | Snow                | Block 1 | 2            | Line    | -1.37         | 26.25 | 109.9                      | 109.9 |                       |
| E-W                     | Roof                | Block 1 |              | Line    | -1.37         | 26.25 | 366.2                      | 366.2 |                       |
| E-W                     | Roof                | Block 1 | 2            | Line    | -1.37         | 26.25 | 366.2                      | 366.2 |                       |
| E-W                     | R Gable             | Block 1 |              | Line    | 0.25          | 13.00 | 105.0                      | 0.0   |                       |
| E-W                     | L Gable             | Block 1 |              | Line    | 13.00         | 24.75 | 0.0                        | 105.0 |                       |
| E-W                     | L Gable             | Block 1 | 2            | Line    | 0.25          | 13.00 | 105.0                      | 0.0   |                       |
| E-W                     | R Gable             | Block 1 | 2            | Line    | 13.00         | 24.75 | 0.0                        | 105.0 |                       |
| N-S                     | Snow                | Block 1 |              | Line    | -0.81         | 35.81 | 83.2                       | 83.2  |                       |
| N-S                     | Snow                | Block 1 |              | Line    | -0.81         | 35.81 | 82.5                       | 82.5  |                       |
| N-S                     | Roof                | Block 1 |              | Line    | -0.81         | 35.81 | 277.5                      | 277.5 |                       |
| N-S                     | Roof                | Block 1 |              | Line    | -0.81         | 35.81 | 274.9                      | 274.9 |                       |
| Both                    | Wall 1-1            | n/a     |              | Line    | 0.25          | 24.75 | 67.5                       | 67.5  |                       |
| Both                    | Wall 1-2            | n/a     | 1            | Line    | 6.00          | 24.50 | 27.0                       | 27.0  |                       |
| Both                    | Wall 2-1            | n/a     | 2            | Line    | 0.25          | 24.75 | 67.5                       | 67.5  |                       |
| Both                    | Wall A-1            | n/a     |              | Line    | 0.25          | 34.75 | 67.5                       | 67.5  |                       |
| Both                    | Wall A-2            | n/a     | A            | Line    | 22.50         | 27.50 | 27.0                       | 27.0  |                       |
| Both                    | Wall B-2            | n/a     | B            | Line    | 0.50          | 9.50  | 27.0                       | 27.0  |                       |
| Both                    | Wall B-1            | n/a     |              | Line    | 0.25          | 34.75 | 67.5                       | 67.5  |                       |

**Legend:**

*Force Dir* - Direction in which the mass is used for seismic load generation, E-W, N-S, or Both

*Building element* - Roof, gable end, wall or floor area used to generate mass, wall line for user-applied masses, Floor F# - refer to Plan View for floor area number

*Wall line* - Shearline that equivalent line load is assigned to

*Location* - Start and end points of equivalent line load on wall line

*Trib Width* - Tributary width; for user applied area loads only

## SEISMIC LOADS

| Level 1   |         | Location [ft] |       | Mag [lbs,plf,psf] |       |
|-----------|---------|---------------|-------|-------------------|-------|
| Force Dir | Profile | Start         | End   | Start             | End   |
| E-W       | Line    | -1.37         | 0.25  | 112.7             | 112.7 |
| E-W       | Point   | 0.25          | 0.25  | 276               | 276   |
| E-W       | Line    | 0.25          | 6.00  | 128.6             | 139.8 |
| E-W       | Point   | 0.50          | 0.50  | 16                | 16    |
| E-W       | Line    | 6.00          | 13.00 | 143.0             | 156.7 |
| E-W       | Line    | 13.00         | 24.50 | 156.7             | 132.4 |
| E-W       | Point   | 24.50         | 24.50 | 29                | 29    |
| E-W       | Line    | 24.50         | 24.75 | 129.2             | 128.6 |
| E-W       | Point   | 24.75         | 24.75 | 276               | 276   |
| E-W       | Line    | 24.75         | 26.25 | 112.7             | 112.7 |
| N-S       | Line    | -0.81         | 0.25  | 85.0              | 85.0  |
| N-S       | Point   | 0.25          | 0.25  | 348               | 348   |
| N-S       | Line    | 0.25          | 0.50  | 100.9             | 100.9 |
| N-S       | Point   | 0.50          | 0.50  | 59                | 59    |
| N-S       | Line    | 0.50          | 9.50  | 104.1             | 104.1 |
| N-S       | Line    | 9.50          | 22.50 | 100.9             | 100.9 |
| N-S       | Line    | 22.50         | 27.50 | 104.1             | 104.1 |
| N-S       | Line    | 27.50         | 34.75 | 100.9             | 100.9 |
| N-S       | Point   | 34.75         | 34.75 | 348               | 348   |
| N-S       | Line    | 34.75         | 35.81 | 85.0              | 85.0  |

**Legend:**

Loads in table can be accumulation of loads from several building masses, so they do not correspond with a particular building element.

Location - Start and end of load in direction perpendicular to seismic force direction

**Notes:**

All loads entered by the user or generated by program are specified (unfactored) loads. The program applies a load factor of 0.70 and redundancy factor to seismic loads before distributing them to the shearlines.

## Design Summary

### SHEARWALL DESIGN

**Wind Shear Loads, Flexible Diaphragm**

All shearwalls have sufficient design capacity.

**Components and Cladding Wind Loads, Out-of-plane Sheathing**

All shearwalls have sufficient design capacity.

**Components and Cladding Wind Loads, Nail Withdrawal**

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.

*This Design Summary does not include failures that occur due to excessive story drift from ASCE 7 CC.2.2 (wind) or 12.12 (seismic).*

*Refer to Story Drift table in this report to verify this design criterion.*

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

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

**SHEAR RESULTS**

| N-S<br>Shearlines | W<br>Gp | For<br>Dir | ASD Shear Force [plf] |          |         | Asp-Cub |     | Allowable Shear [plf] |     |      |   | Resp.<br>Ratio |      |         |
|-------------------|---------|------------|-----------------------|----------|---------|---------|-----|-----------------------|-----|------|---|----------------|------|---------|
|                   |         |            | v                     | vmax/vft | V [lbs] | Int     | Ext | Int                   | Ext | Co   | C |                | Cmb  | V [lbs] |
| <b>Line 1</b>     |         |            |                       |          |         |         |     |                       |     |      |   |                |      |         |
| <b>Level 1</b>    |         |            |                       |          |         |         |     |                       |     |      |   |                |      |         |
| Ln1, Lev1         | 2       | S->N       | 127.8                 | 127.8    | 1852    | -       | 1.0 | -                     | 365 | 1.00 |   | 365            | 5293 | 0.35    |
|                   | 2       | N->S       | 129.2                 | 129.2    | 1873    | -       | 1.0 | -                     | 365 | 1.00 |   | 365            | 5293 | 0.35    |
| <b>Line 2</b>     |         |            |                       |          |         |         |     |                       |     |      |   |                |      |         |
| Ln2, Lev1         | 2       | S->N       | 126.0                 | 141.0    | 1827    | -       | .89 | -                     | 326 | 1.00 |   | 326            | 4729 | 0.39    |
|                   | 2       | N->S       | 127.4                 | 142.5    | 1847    | -       | .89 | -                     | 326 | 1.00 |   | 326            | 4729 | 0.39    |
| E-W<br>Shearlines | W<br>Gp | For<br>Dir | ASD Shear Force [plf] |          |         | Asp-Cub |     | Allowable Shear [plf] |     |      |   | Resp.<br>Ratio |      |         |
|                   |         |            | v                     | vmax/vft | V [lbs] | Int     | Ext | Int                   | Ext | Co   | C |                | Cmb  | V [lbs] |
| <b>Line A</b>     |         |            |                       |          |         |         |     |                       |     |      |   |                |      |         |
| <b>Level 1</b>    |         |            |                       |          |         |         |     |                       |     |      |   |                |      |         |
| LnA, Lev1         | -       | Both       | -                     | -        | 1009    | -       | -   | -                     | 685 | -    |   | -              | 3425 | -       |
| Wall A-2          | 1       | Both       | 201.8                 | -        | 1009    | -       | 1.0 | -                     | 685 | -    |   | 685            | 3425 | 0.29    |
| <b>Line B</b>     |         |            |                       |          |         |         |     |                       |     |      |   |                |      |         |
| LnB, Lev1         | -       | Both       | -                     | -        | 1021    | -       | -   | -                     | 365 | -    |   | -              | 3285 | -       |
| Wall B-2          | 2       | Both       | 113.5                 | -        | 1021    | -       | 1.0 | -                     | 365 | -    |   | 365            | 3285 | 0.31    |

**Legend:**

W Gp - Wall design group defined in Sheathing and Framing Materials tables, where it shows associated Standard Wall. "A" 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<br>Line-Wall | Posit'n | Location [ft] |       | Load Case | Tensile Hold-down or Compressive Stud Force [lbs] |       |        |       | Hold-down   | Cap [lbs] | Crit Resp. |
|----------------------|---------|---------------|-------|-----------|---|-------|--------|-------|-------------|-----------|------------|
|                      |         | X             | Y     |           | Shear   | Dead  | Uplift | Cmb'd |             |           |            |
| <b>Line 1</b>        |         |               |       |           |   |       |        |       |             |           |            |
|                      | V Elem  | 0.25          | 0.12  | 1         | 0   | 575   |        | 575   | Compression |           |            |
| 1-2                  | L End   | 0.50          | 6.13  | 1         | -1183   | 11545 |        | 12727 | Compression | 15469     | 0.82       |
| 1-2                  | R End   | 0.50          | 24.38 | 1         | -1170   | 5448  |        | 6618  | Compression | 15469     | 0.43       |
| 1-1                  | R End   | 0.25          | 24.63 | 1         | 0   | 5459  |        | 5459  | Compression |           | -          |
| <b>Line 2</b>        |         |               |       |           |   |       |        |       |             |           |            |
| 2-1                  | L End   | 34.75         | 0.38  | 1         | -1818   | 6554  |        | 8372  | Compression | 10312     | 0.81       |
| 2-1                  | R End   | 34.75         | 24.63 | 1         | -1798   | 6554  |        | 8352  | Compression | 10312     | 0.81       |
| <b>Line A</b>        |         |               |       |           |   |       |        |       |             |           |            |
|                      | V Elem  | 8.21          | 0.25  | 1         | 0   | 152   |        | 152   | Compression |           |            |
|                      | V Elem  | 10.21         | 0.25  | 1         | 0   | 152   |        | 152   | Compression |           |            |
| A-1                  | R Op 2  | 16.46         | 0.25  | 1         | 0   | 214   |        | 214   | Compression |           | -          |
| A-1                  | L Op 3  | 19.38         | 0.25  | 1         | 0   | 214   |        | 214   | Compression |           | -          |
| A-2                  | L End   | 22.63         | 0.50  | 1         | 1912  | 567   |        | 1345  | HDU5-SDS    | 5645      | 0.24       |
| A-2                  | L End   | 22.63         | 0.50  | 1         | -1912   | 945   |        | 2857  | Compression | 10312     | 0.28       |
| A-2                  | R End   | 27.38         | 0.50  | 1         | 1912  | 567   |        | 1345  | HDU5-SDS    | 5645      | 0.24       |
| A-2                  | R End   | 27.38         | 0.50  | 1         | -1912   | 945   |        | 2857  | Compression | 10312     | 0.28       |
|                      | V Elem  | 32.62         | 0.25  | 1         | 0   | 152   |        | 152   | Compression |           |            |
|                      | V Elem  | 34.63         | 0.25  | 1         | 0   | 152   |        | 152   | Compression |           |            |
| <b>Line B</b>        |         |               |       |           |   |       |        |       |             |           |            |
| B-1                  | L End   | 0.38          | 24.75 | 1         | 0   | -320  |        | 320   |             |           |            |
| B-2                  | L End   | 0.63          | 24.50 | 1         | -1050   | 4451  |        | 5501  | Compression | 10312     | 0.53       |
| B-1                  | L Op 2  | 9.13          | 24.75 | 1         | 0   | 15225 |        | 15225 | Compression |           | -          |
| B-2                  | R End   | 9.38          | 24.50 | 1         | -1050   | 4451  |        | 5501  | Compression | 10312     | 0.53       |
| B-1                  | R Op 2  | 21.38         | 24.75 | 1         | 0   | 9594  |        | 9594  | Compression |           | -          |
| B-1                  | L Op 2  | 25.38         | 24.75 | 1         | 0   | -1602 |        | 1602  |             |           |            |
| B-1                  | R Op 2  | 30.63         | 24.75 | 1         | 0   | 2137  |        | 2137  | Compression |           | -          |
| B-1                  | R End   | 34.63         | 24.75 | 1         | 0   | 1137  |        | 1137  | Compression |           | -          |

## 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 =  $V \times h / beff$  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 =  $V \times h / Co$  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:

HDU5-SDS2.5 for studs with thickness &gt; 0'-3" and depth &gt; 0'-3.5" : Uses 14 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 for joist depth, and to the Shear Results table for perforated factor  $Co$ .

Most severe of wind load cases is used for overturning calculation.

Designer is responsible for design of connection from wall to floor or foundation for shear force shown in Shear Results table. Refer to SDPWS 4.3.6.4.3 for foundation anchor bolt requirements.

## COLLECTOR FORCES (flexible wind design)

| Level 1<br>Line-<br>Wall | Position on Wall<br>or Opening | Location [ft] |       | Load<br>Case | Drag Strut<br>Force [lbs] |      | Strap/Blocking<br>Force [lbs] |      |
|--------------------------|--------------------------------|---------------|-------|--------------|---------------------------|------|-------------------------------|------|
|                          |                                | X             | Y     |              | --->                      | <--- | --->                          | <--- |
| <b>Line 1</b>            |                                |               |       |              |                           |      |                               |      |
| 1-2                      | Left Wall End                  | 0.50          | 6.00  |              | -435                      | 440  |                               |      |
| 1-2                      | Left Opening 1                 | 0.50          | 16.00 |              | 87                        | -88  |                               |      |
| 1-2                      | Right Opening 1                | 0.50          | 20.00 |              | -216                      | 218  |                               |      |
| 1-2                      | Right Wall End                 | 0.50          | 24.50 |              | 19                        | -19  |                               |      |
| <b>Line 2</b>            |                                |               |       |              |                           |      |                               |      |
| 2-1                      | Left Opening 1                 | 34.75         | 4.25  |              | 266                       | -269 |                               |      |
| 2-1                      | Right Opening 1                | 34.75         | 9.25  |              | -239                      | 242  |                               |      |
| 2-1                      | Left Opening 2                 | 34.75         | 17.17 |              | 287                       | -290 |                               |      |
| 2-1                      | Right Opening 2                | 34.75         | 22.17 |              | -172                      | 174  |                               |      |
| <b>Line A</b>            |                                |               |       |              |                           |      |                               |      |
| A-2                      | Left Wall End                  | 22.50         | 0.50  |              | -651                      | 651  |                               |      |
| A-2                      | Right Wall End                 | 27.50         | 0.50  |              | 212                       | -212 |                               |      |
| <b>Line B</b>            |                                |               |       |              |                           |      |                               |      |
| B-2                      | Left Wall End                  | 0.50          | 24.50 |              | -7                        | 7    |                               |      |
| B-2                      | Right Wall End                 | 9.50          | 24.50 |              | 748                       | -748 |                               |      |

## Legend:

Line-Wall - Shearline and wall number

Position...- Side of opening or wall end that drag strut is attached to

Location - Co-ordinates in Plan View

Load Case - Results are for critical load case:

ASCE 7 All heights Case 1 or 2

ASCE 7 Low-rise corner; Case A or B

Drag strut Force - Axial force in transfer element at openings, gaps, or changes in design shear along shearline. + : tension; - : compression.

Based on ASD-factored shearline force (vmax from 4.3.6.4.1.1 for perforated walls)

Strap/Blocking Force - For FTAO walls, force transferred from above and below opening to shearwall pier.

-> Due to shearline force in the west-to-east or south-to-north direction

<- Due to shearline force in the east-to-west or north-to-south direction

**MWFRS DEFLECTION (flexible wind design)**

These deflections are used to determine shearwall stiffness for force distribution

| Wall, segment  | W Gp | Dir  | Srf | v plf | b ft  | h ft | Bending |         | Shear Defl in | Vn lbs | Nail slip |         | Hold Defl in | Total Defl in |
|----------------|------|------|-----|-------|-------|------|---------|---------|---------------|--------|-----------|---------|--------------|---------------|
|                |      |      |     |       |       |      | A sq.in | Defl in |               |        | en in     | Defl in |              |               |
| <b>Level 1</b> |      |      |     |       |       |      |         |         |               |        |           |         |              |               |
| <b>Line 1</b>  |      |      |     |       |       |      |         |         |               |        |           |         |              |               |
| 1-2            | 2    | S->N | 1   | 127.8 | 14.50 | 9.00 | 24.8    | .001    | .015          | 64     | .009      | .063    | 0.01         | 0.09          |
|                |      | N->S | 1   | 129.2 | 14.50 | 9.00 | 24.8    | .001    | .015          | 65     | .010      | .065    | 0.02         | 0.10          |
| <b>Line 2</b>  |      |      |     |       |       |      |         |         |               |        |           |         |              |               |
| 2-1            | 2    | S->N | Ext | 141.0 | 12.96 | 9.00 | 16.5    | .002    | .016          | 70     | .011      | .076    | 0.02         | 0.11          |
|                |      | N->S | Ext | 142.5 | 12.96 | 9.00 | 16.5    | .002    | .017          | 71     | .011      | .078    | 0.02         | 0.12          |
| <b>Line A</b>  |      |      |     |       |       |      |         |         |               |        |           |         |              |               |
| A-2            | 1    | Both | 1   | 201.8 | 5.00  | 9.00 | 16.5    | .008    | .023          | 50     | .006      | .041    | 0.27         | 0.34          |
| <b>Line B</b>  |      |      |     |       |       |      |         |         |               |        |           |         |              |               |
| B-2            | 2    | Both | 1   | 113.5 | 9.00  | 9.00 | 16.5    | .003    | .013          | 57     | .008      | .051    | 0.02         | 0.08          |

**Legend:**

Wall, segment – Wall and segment between openings, e.g. B-3,2 = second segment on Wall 3 on Shearline B.

W Gp – Wall design group, refer to Sheathing and Framing Materials tables.

Dir – Force direction.

Srf – Wall surface = Int(erior) or Ext(erior) for perimeter walls, 1 or 2 for interior partitions.

v – ASD shear force per unit distance on wall segment.

Unblocked walls =  $v / C_{ub}$  as per SDPWS 4.3.4.3,  $C_{ub}$  = Unblocked factor from 4.3.5.3, shown in the Shear Results table.

Perforated walls =  $v_{max}$  from Eqn. 4.3-9, as per 4.3.4.2.

FTAO walls = Unit shear force in pier beside opening(s).

b – Wall or segment length.

Segmented wall or FTAO wall segments = Width of wall segment between openings.

Perforated wall = Sum of FHS segments, modified as in 4.3.3.4 per 4.3.4.2.

FTAO wall = Length of wall including openings.

h – Wall height.

FTAO piers = Distance from bottom of opening to top of wall; for end segments, results using that distance and the wall height are averaged.

Defl – Horizontal shear wall deflection due to given term:

Bending =  $8vh^3 / EAb$ ; A = Effective cross sectional area of segment end stud(s), E = stud mod. of elasticity in Framing Materials table

For i studs at one end and j at the other,  $A = 2(i^2j + j^2i) / (i + j)^2 \times$  area of one stud, based on Ex. C4.3.4-3

Shear =  $vh / G_{vtv}$ ;  $G_{vtv}$  = Shear stiffness from C4.3.4, shown in Sheathing Materials table.

Nail slip =  $0.75 h \times en$ ; en from Table C4.2.3D, of form  $aVn^b$  for WSP, varies linearly to published value for other materials.

Vn – ASD shear force per nail along panel edge.

Hold – Anchorage system (hold-down) =  $da \times h / beff$ .

da = Vertical hold-down displacement; refer to Hold-down Displacement table for components.

beff = Effective wall segment length =  $b - (\text{tension stud pack width} + \text{hold-down anchor bolt offset}) - (1/2 \text{ compression stud pack width})$  beff is given in the Shear Wall Dimensions table.

For FTAO walls, hold-down device at end of wall is applied to all segments, as per APA T555.

Total Defl – Deflection from bending + shear + nail slip + hold-down, as per Eqn. 4.3-2.

For FTAO walls, the average of the values for the segments, as per APA T555.

**SERVICEABILITY DEFLECTION (flexible wind design)**

These deflections are used to determine story drift.

| Wall, segment  | W Gp | Dir  | Srf | v plf | b ft  | h ft | Bending |         | Shear Defl in | Vn lbs | Nail slip |         | Hold Defl in | Total Defl in |
|----------------|------|------|-----|-------|-------|------|---------|---------|---------------|--------|-----------|---------|--------------|---------------|
|                |      |      |     |       |       |      | A sq.in | Defl in |               |        | en in     | Defl in |              |               |
| <b>Level 1</b> |      |      |     |       |       |      |         |         |               |        |           |         |              |               |
| <b>Line 1</b>  |      |      |     |       |       |      |         |         |               |        |           |         |              |               |
| 1-2            | 2    | S->N | 1   | 235.9 | 14.50 | 9.00 | 24.8    | .002    | .027          | 118    | .029      | .199    | 0.01         | 0.24          |
|                |      | N->S | 1   | 238.5 | 14.50 | 9.00 | 24.8    | .002    | .028          | 119    | .030      | .203    | 0.02         | 0.26          |
| <b>Line 2</b>  |      |      |     |       |       |      |         |         |               |        |           |         |              |               |
| 2-1            | 2    | S->N | Ext | 260.4 | 12.96 | 9.00 | 16.5    | .004    | .030          | 130    | .035      | .239    | 0.03         | 0.30          |
|                |      | N->S | Ext | 263.2 | 12.96 | 9.00 | 16.5    | .004    | .031          | 132    | .036      | .244    | 0.03         | 0.31          |
| <b>Line A</b>  |      |      |     |       |       |      |         |         |               |        |           |         |              |               |
| A-2            | 1    | Both | 1   | 372.7 | 5.00  | 9.00 | 16.5    | .015    | .043          | 93     | .019      | .128    | 0.32         | 0.50          |
| <b>Line B</b>  |      |      |     |       |       |      |         |         |               |        |           |         |              |               |
| B-2            | 2    | Both | 1   | 209.6 | 9.00  | 9.00 | 16.5    | .005    | .024          | 105    | .024      | .159    | 0.02         | 0.21          |

**Legend:**

Wall, segment – Wall and segment between openings, e.g. B-3,2 = second segment on Wall 3 on Shearline B.

W Gp – Wall design group, refer to Sheathing and Framing Materials tables.

Dir – Force direction.

Srf – Wall surface = Int(erior) or Ext(erior) for perimeter walls, 1 or 2 for interior partitions.

v – Shear force per unit distance on wall segment using  $1.0 W_a$  = wind load based on serviceability wind speeds from ASCE 7 CC.2.2, Figs. CC.2-1 - CC.2-4.

Unblocked walls =  $v / C_{ub}$  as per SDPWS 4.3.4.3,  $C_{ub}$  = Unblocked factor from 4.3.5.3, shown in the Shear Results table.

Perforated walls =  $v_{max}$  from Eqn. 4.3-9, as per 4.3.4.2.

FTAO walls = Unit shear force in pier beside opening(s).

b – Wall or segment length.

Segmented wall or FTAO wall segments = Width of wall segment between openings.

Perforated wall = Sum of FHS segments, modified as in 4.3.3.4 per 4.3.4.2.

FTAO wall = Length of wall including openings.

h – Wall height.

FTAO piers = Distance from bottom of opening to top of wall; for end segments, results using that distance and the wall height are averaged.

Defl – Horizontal shear wall deflection due to given term:

Bending =  $8vh^3 / EAb$ ; A = Effective cross sectional area of segment end stud(s), E = stud mod. of elasticity in Framing Materials table

For i studs at one end and j at the other,  $A = 2(i^2j + j^2i) / (i + j)^2 \times$  area of one stud, based on Ex. C4.3.4-3

Shear =  $vh / Gvtv$ ;  $Gvtv$  = Shear stiffness from C4.3.4, shown in Sheathing Materials table.

Nail slip =  $0.75 h \times en$ ; en from Table C4.2.3D, of form  $aVn^b$  for WSP, varies linearly to published value for other materials.

Vn – Serviceability shear force per nail along panel edge.

Hold – Anchorage system (hold-down) =  $da \times h / beff$ .

da = Vertical hold-down displacement; refer to Hold-down Displacement table for components.

beff = Effective wall segment length =  $b - (\text{tension stud pack width} + \text{hold-down anchor bolt offset}) - (1/2 \text{ compression stud pack width})$

beff is given in the Shear Wall Dimensions table.

For FTAO walls, hold-down device at end of wall is applied to all segments, as per APA T555.

Total Defl – Deflection from bending + shear + nail slip + hold-down, as per Eqn. 4.3-2.

For FTAO walls, the average of the values for the segments, as per APA T555.

**MWFRS HOLD-DOWN DISPLACEMENT (flexible wind design)**

These displacements are used to determine deflections for force distribution

| Wall, segment  | Dir  | Hold-down | Tension force lbs | Vert. Displacement |        |       | Slippage |       | Shrink +Extra in | Comp. force lbs | Crush da in | Total da in | Horz Defl in |
|----------------|------|-----------|-------------------|--------------------|--------|-------|----------|-------|------------------|-----------------|-------------|-------------|--------------|
|                |      |           |                   | Manuf in           | Add in | da in | Vf lbs   | da in |                  |                 |             |             |              |
| <b>Level 1</b> |      |           |                   |                    |        |       |          |       |                  |                 |             |             |              |
| <b>Line 1</b>  |      |           |                   |                    |        |       |          |       |                  |                 |             |             |              |
| 1-2            | S->N | HDU2-SDS  | -5757             | .000               | .000   | 0.000 | -        | -     | .000             | 6618            | 0.01        | 0.01        | 0.01         |
|                | N->S | HDU2-SDS  | -2086             | .000               | .000   | 0.000 | -        | -     | .000             | 12727           | 0.03        | 0.03        | 0.02         |
| <b>Line 2</b>  |      |           |                   |                    |        |       |          |       |                  |                 |             |             |              |
| 2-1            | S->N | HDU2-SDS  | -2134             | .000               | .000   | 0.000 | -        | -     | .000             | 8352            | 0.03        | 0.03        | 0.02         |
|                | N->S | HDU2-SDS  | -2114             | .000               | .000   | 0.000 | -        | -     | .000             | 8372            | 0.03        | 0.03        | 0.02         |
| <b>Line A</b>  |      |           |                   |                    |        |       |          |       |                  |                 |             |             |              |
| A-2            | Both | HDU5-SDS  | 1345              | .027               | .000   | 0.027 | -        | -     | .105             | 2857            | 0.01        | 0.14        | 0.27         |
| <b>Line B</b>  |      |           |                   |                    |        |       |          |       |                  |                 |             |             |              |
| B-2            | Both | HDU2-SDS  | -1620             | .000               | .000   | 0.000 | -        | -     | .000             | 5501            | 0.01        | 0.01        | 0.02         |

**Legend:**

Wall, segment – Wall and segment between openings, e.g. B-3,2 = second segment on Wall 3 on Shearline B

Dir – Force direction

Tens., Comp. force – Accumulated ASD hold-down tension force T and end stud compression force C from overturning, dead loads and wind uplift

da – Vertical displacements due to the following components:

Vert. Displacement – Elongation when slippage calculated separately; displacement when combined elongation/slippage used

Manuf – Using manufacturer's value for anchor bolt length, or no bolt contribution for connector-only elongation

Unless marked with \* = (ASD uplift force / ASD hold-down capacity) x max ASD elongation or displacement

\* - Maximum strength-level elongation or displacement is used. May result in higher than actual displacements for lightly loaded hold-downs, causing the segment to draw less force due to lower than actual stiffness.

Add – Due to longer anchor bolt length than manufacturer's value, or entire bolt length for connector-only elongation =  $TL / (Ab \times Es)$

Ab = bolt cross-sectional area

Es = steel modulus = 29000000 psi

L = Lb – Lh

Lb = Total bolt length shown in Storey Information table

Lh = Manufacturer's anchor bolt length for given displacement/elongation from hold-down database

Slippage – Due to vertical slippage of hold-down fasteners attached to stud(s) when not combined with elongation

Nails = en from SDPWS Table C4.2.3D using values for wood structural panels

Bolts =  $Vf / (270,000 D^{1.5})$  (NDS 11.3.6); D = bolt diameter, Vf = Tension force T / number of fasteners

Shrink + Extra – Wood shrinkage plus extra displacement due to mis-cuts, gaps, etc.

Shrinkage =  $0.002 \times (24\% \text{ fabrication} - 10\% \text{ in-service moisture contents}) \times Ls$

Ls = Length between anchor bolt fasteners subject to perp-to-grain shrinkage; see Storey Information table

Crush – Deformation of bottom plate at compression end of wall segment

=  $0.02'' \times [r / 0.73, r < 0.73; (1 + (r - 0.73) / 0.27), 0.73 < r < 1; 2r^3, r > 1]$

r =  $fcp / Fcp$ ;  $Fcp' = Ct CM Fcp$ ;  $fcp = C / A$ , A = cross sectional area of end studs

Total da – Vert. Displacement + Slippage + Shrink + Crush + Extra

Horz Defl – Anchorage deflection term in SDPWS Eqn. C.4.3.4-1 =  $h / beff \times da$

h = Wall height. For end segments in FTAO walls, h is the average of the wall height and the distance from the bottom of opening to top of wall

beff = Effective wall segment length = b - (tension stud pack width + hold-down anchor bolt offset) - (1/2 compression stud pack width)

h and b are shown in Deflection table, beff in the Shear Wall Dimensions table

**SERVICEABILITY HOLD-DOWN DISPLACEMENT (flexible wind design)**

These displacements are used to determine deflections for story drift

| Wall, segment  | Dir  | Hold-down | Tension force lbs | Vert. Displacement |        |       | Slippage |       | Shrink +Extra in | Comp. force lbs | Crush da in | Total da in | Horz Defl in |
|----------------|------|-----------|-------------------|--------------------|--------|-------|----------|-------|------------------|-----------------|-------------|-------------|--------------|
|                |      |           |                   | Manuf in           | Add in | da in | Vf lbs   | da in |                  |                 |             |             |              |
| <b>Level 1</b> |      |           |                   |                    |        |       |          |       |                  |                 |             |             |              |
| <b>Line 1</b>  |      |           |                   |                    |        |       |          |       |                  |                 |             |             |              |
| 1-2            | S->N | HDU2-SDS  | -10631            | .000               | .000   | 0.000 | -        | -     | .000             | 8197            | 0.01        | 0.01        | 0.01         |
|                | N->S | HDU2-SDS  | -3853             | .000               | .000   | 0.000 | -        | -     | .000             | 14976           | 0.04        | 0.04        | 0.02         |
| <b>Line 2</b>  |      |           |                   |                    |        |       |          |       |                  |                 |             |             |              |
| 2-1            | S->N | HDU2-SDS  | -3940             | .000               | .000   | 0.000 | -        | -     | .000             | 10583           | 0.04        | 0.04        | 0.03         |
|                | N->S | HDU2-SDS  | -3904             | .000               | .000   | 0.000 | -        | -     | .000             | 10619           | 0.04        | 0.04        | 0.03         |
| <b>Line A</b>  |      |           |                   |                    |        |       |          |       |                  |                 |             |             |              |
| A-2            | Both | HDU5-SDS  | 2483              | .051               | .000   | 0.051 | -        | -     | .105             | 4578            | 0.01        | 0.17        | 0.32         |
| <b>Line B</b>  |      |           |                   |                    |        |       |          |       |                  |                 |             |             |              |
| B-2            | Both | HDU2-SDS  | -2991             | .000               | .000   | 0.000 | -        | -     | .000             | 6871            | 0.02        | 0.02        | 0.02         |

**Legend:**

Wall, segment – Wall and segment between openings, e.g. B-3,2 = second segment on Wall 3 on Shearline B

Dir – Force direction

Tens., Comp. force – Accumulated hold-down tension force T and end stud compression force C from overturning, dead loads and wind uplift using load combination D + Wa from ASCE 7 CC.2.2

Wa = wind load based on serviceability wind speeds from ASCE 7 CC.2.2, Figs. CC.2-1 - CC.2-4

da – Vertical displacements due to the following components:

Vert. Displacement – Elongation when slippage calculated separately; displacement when combined elongation/slippage used

Manuf – Using manufacturer's value for anchor bolt length, or no bolt contribution for connector-only elongation

Unless marked with \* = (ASD uplift force / ASD hold-down capacity) x max strength-level elongation or displacement

\* - Maximum strength-level elongation or displacement is used. May result in higher than actual displacements for lightly loaded hold-downs, causing the segment to draw less force due to lower than actual stiffness.

Add – Due to longer anchor bolt length than manufacturer's value, or entire bolt length for connector-only elongation =  $TL / (Ab \times Es)$

Ab = bolt cross-sectional area

Es = steel modulus = 29000000 psi

L = Lb – Lh

Lb = Total bolt length shown in Storey Information table

Lh = Manufacturer's anchor bolt length for given displacement/elongation from hold-down database

Slippage – Due to vertical slippage of hold-down fasteners attached to stud(s) when not combined with elongation

Nails = en from SDPWS Table C4.2.3D using values for wood structural panels

Bolts =  $Vf / (270,000 D^{1.5})$  (NDS 11.3.6); D = bolt diameter, Vf = Tension force T / number of fasteners

Shrink + Extra – Wood shrinkage plus extra displacement due to mis-cuts, gaps, etc.

Shrinkage =  $0.002 \times (24\% \text{ fabrication} - 10\% \text{ in-service moisture contents}) \times Ls$

Ls = Length between anchor bolt fasteners subject to perp-to-grain shrinkage; see Story Information table

Crush – Deformation of bottom plate at compression end of wall segment

=  $0.02'' \times [r / 0.73, r < 0.73; (1 + (r - 0.73) / 0.27), 0.73 < r < 1; 2r^3, r > 1]$

r =  $fcp / Fcp'$ ;  $Fcp' = Ct CM Fcp$ ;  $fcp = C / A$ , A = cross sectional area of end studs

Total da – Vert. Displacement + Slippage + Shrink + Crush + Extra

Horz Defl – Anchorage deflection term in SDPWS Eqn. C.4.3.4-1 =  $h / beff \times da$

h = Wall height. For end segments in FTAO walls, h is the average of the wall height and the distance from the bottom of opening to top of wall

beff = Effective wall segment length = b - (tension stud pack width + hold-down anchor bolt offset) - (1/2 compression stud pack width)

h and b are shown in Deflection table, beff in the Shear Wall Dimensions table

**STORY DRIFT (flexible wind design)**

| Level | Dir   | Wall height<br>ft | Actual Story Drift (in) |      | Allowable Story Drift |             |       |
|-------|-------|-------------------|-------------------------|------|-----------------------|-------------|-------|
|       |       |                   | Max<br>defl             | Line | hs<br>ft              | Drift<br>in | Ratio |
| 1     | N<->S | 9.00              | 0.31                    | 2    | 9.00                  | 1.08        | 0.29  |
|       | E<->W |                   | 0.50                    | A    |                       | 1.08        | 0.47  |

**Legend:**

*Max defl* – Largest deflection for any shearline on level in this direction; refer to Serviceability Deflections table

*Line* – Shearline with largest deflection on level in this direction

*hs* – Story height = Height of walls plus joist depth between this level and the one above.

*Drift* = Allowable story drift on this level = story height / 100

*Ratio* - Proportion of allowable story drift experienced, on this level in this direction.

## Out-of-plane Wind Design

## COMPONENTS AND CLADDING by SHEARLINE

| North-South Shearlines |     |     | Sheathing [psf] |       |           | Fastener Withdrawal [lbs] |           |      |               |               | Service Cond Factors |       |
|------------------------|-----|-----|-----------------|-------|-----------|---------------------------|-----------|------|---------------|---------------|----------------------|-------|
| Line                   | Lev | Grp | Force           | Cap   | Force/Cap | Force End                 | Force Int | Cap  | Force/Cap End | Force/Cap Int | Temp                 | Moist |
| 1                      | 1   | 2   | 15.8            | 178.1 | 0.09      | 21.1                      | 17.1      | 23.4 | 0.90          | 0.73          | 1.00                 | 0.25  |
| 2                      | 1   | 2   | 15.8            | 178.1 | 0.09      | 21.1                      | 17.1      | 23.4 | 0.90          | 0.73          | 1.00                 | 0.25  |
| East-West Shearlines   |     |     | Sheathing [psf] |       |           | Fastener Withdrawal [lbs] |           |      |               |               | Service Cond Factors |       |
| Line                   | Lev | Grp | Force           | Cap   | Force/Cap | Force End                 | Force Int | Cap  | Force/Cap End | Force/Cap Int | Temp                 | Moist |
| A                      | 1   | 2   | 15.8            | 178.1 | 0.09      | 21.1                      | 17.1      | 23.4 | 0.90          | 0.73          | 1.00                 | 0.25  |
| B                      | 1   | 2   | 15.8            | 178.1 | 0.09      | 21.1                      | 17.1      | 23.4 | 0.90          | 0.73          | 1.00                 | 0.25  |

## Legend:

Grp - Wall Design Group ( results for all design groups for rigid, flexible design listed for each wall )

## Sheathing:

Force - C&C end zone exterior pressures using negative (suction) coefficient in ASCE 7 Figure 30.3-1 added to interior pressure using coefficients from Table 26.13-1

Cap - Out-of-plane capacity of exterior sheathing from SDPWS Tables 3.2.1A/B, divided by 1.6 for short-term ASD loads as per 3.2.1. Assumes continuous over 2 spans (table note 3).

## Fastener Withdrawal:

Force - Force tributary to each nail in end zone and interior zone

Cap - Factored withdrawal capacity of individual nail according to NDS 12.2-3



## Flexible Diaphragm Seismic Design

## SEISMIC INFORMATION

| Level | Mass [lbs] | Area [sq.ft] | Story Shear Fx [lbs] |      | Shear Resistance [lbs] |      | Diaphragm Force [lbs] |        |      |        |
|-------|------------|--------------|----------------------|------|------------------------|------|-----------------------|--------|------|--------|
|       |            |              | E-W                  | N-S  | E-W                    | N-S  | E-W                   |        | N-S  |        |
|       |            |              |                      |      |                        |      | Fpx                   | Design | Fpx  | Design |
| 1     | 37713      | 845.3        | 3123                 | 3123 | 4793                   | 7158 | 4060                  | 4060   | 4060 | 4060   |
| All   | 37713      | -            | 4462                 | 4462 | -                      | -    | -                     | -      | -    | -      |

## Legend:

Mass – Sum of all generated and input building masses on level =  $w_x$  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  $\rho$  (rho):**

E-W 1.30, N-S 1.00

Automatically calculated according to ASCE 7 12.3.4.2.

Applies to shearwall design, hold-down forces and the drag strut force component based on shearline forces; does not apply to story drift, out-of-plane force, or the diaphragm force Fpx and the drag strut force component based on it.

**Vertical Earthquake Load  $E_v$** 

$E_v = 0.2 S_d s D$ ;  $S_d s = 0.77$ ;  $E_v = 0.154 D$  unfactored;  $0.108 D$  factored; total dead load factor:  $0.6 - 0.108 = 0.492$  tension,  $1.0 + 0.108 = 1.108$  compression.

## SHEAR RESULTS (flexible seismic design)

| N-S<br>Shearlines | W<br>Gp | For<br>Dir | ASD Shear Force [plf] |          |         | Asp-Cub |     |     | Allowable Shear [plf] |      |   |     | Resp.<br>Ratio |         |
|-------------------|---------|------------|-----------------------|----------|---------|---------|-----|-----|-----------------------|------|---|-----|----------------|---------|
|                   |         |            | v                     | vmax/vft | V [lbs] | Int     | Ext | Int | Ext                   | Co   | C | Cmb |                | V [lbs] |
| <b>Line 1</b>     |         |            |                       |          |         |         |     |     |                       |      |   |     |                |         |
| <b>Level 1</b>    |         |            |                       |          |         |         |     |     |                       |      |   |     |                |         |
| Ln1, Lev1         | 2       | Both       | 110.1                 | 110.1    | 1596    | -       | 1.0 | -   | 261                   | 1.00 |   | 261 | 3780           | 0.42    |
| <b>Line 2</b>     |         |            |                       |          |         |         |     |     |                       |      |   |     |                |         |
| Ln2, Lev1         | 2       | Both       | 105.3                 | 117.9    | 1527    | -       | .89 | -   | 233                   | 1.00 |   | 233 | 3378           | 0.45    |
| E-W<br>Shearlines | W<br>Gp | For<br>Dir | ASD Shear Force [plf] |          |         | Asp-Cub |     |     | Allowable Shear [plf] |      |   |     | Resp.<br>Ratio |         |
|                   |         |            | v                     | vmax/vft | V [lbs] | Int     | Ext | Int | Ext                   | Co   | C | Cmb |                | V [lbs] |
| <b>Line A</b>     |         |            |                       |          |         |         |     |     |                       |      |   |     |                |         |
| <b>Level 1</b>    |         |            |                       |          |         |         |     |     |                       |      |   |     |                |         |
| LnA, Lev1         | -       | Both       | -                     | -        | 2023    | -       | -   | -   | 489                   | -    |   | -   | 2446           | -       |
| Wall A-2          | 1^      | Both       | 404.6                 | -        | 2023    | -       | 1.0 | -   | 489                   | -    |   | 489 | 2446           | 0.83    |
| <b>Line B</b>     |         |            |                       |          |         |         |     |     |                       |      |   |     |                |         |
| LnB, Lev1         | -       | Both       | -                     | -        | 2038    | -       | -   | -   | 261                   | -    |   | -   | 2346           | -       |
| Wall B-2          | 2^      | Both       | 226.4                 | -        | 2038    | -       | 1.0 | -   | 261                   | -    |   | 261 | 2346           | 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  $b_i / FHS$ , where  $b_i$  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<br>Line-Wall | Posit'n | Location [ft] |       | Tensile Hold-down<br>or Compressive Stud Force [lbs] |       |      |       | Hold-down   | Cap<br>[lbs] | Crit<br>Resp. |
|----------------------|---------|---------------|-------|--|-------|------|-------|-------------|--------------|---------------|
|                      |         | X             | Y     | Shear  | Dead  | Ev   | Cmb'd |             |              |               |
| <b>Line 1</b>        |         |               |       |  |       |      |       |             |              |               |
|                      | V Elem  | 0.25          | 0.12  | 0  | 575   | 62   | 637   | Compression |              |               |
| 1-2                  | L End   | 0.50          | 6.13  | -1008  | 11545 | 1243 | 13796 | Compression | 15469        | 0.89          |
| 1-2                  | R End   | 0.50          | 24.38 | -1008  | 5448  | 587  | 7043  | Compression | 15469        | 0.46          |
| 1-1                  | R End   | 0.25          | 24.63 | 0  | 5459  | 588  | 6046  | Compression |              | -             |
| <b>Line 2</b>        |         |               |       |  |       |      |       |             |              |               |
| 2-1                  | L End   | 34.75         | 0.38  | -1504  | 6554  | 706  | 8763  | Compression | 10312        | 0.85          |
| 2-1                  | R End   | 34.75         | 24.63 | -1504  | 6554  | 706  | 8763  | Compression | 10312        | 0.85          |
| <b>Line A</b>        |         |               |       |  |       |      |       |             |              |               |
|                      | V Elem  | 8.21          | 0.25  | 0  | 152   | 16   | 168   | Compression |              |               |
|                      | V Elem  | 10.21         | 0.25  | 0  | 152   | 16   | 168   | Compression |              |               |
| A-1                  | R Op 2  | 16.46         | 0.25  | 0  | 214   | 23   | 237   | Compression |              | -             |
| A-1                  | L Op 3  | 19.38         | 0.25  | 0  | 214   | 23   | 237   | Compression |              | -             |
| A-2                  | L End   | 22.63         | 0.50  | 3833   | 567   | 102  | 3367  | HDU5-SDS    | 5645         | 0.60          |
| A-2                  | L End   | 22.63         | 0.50  | -3833  | 945   | 102  | 4879  | Compression | 10312        | 0.47          |
| A-2                  | R End   | 27.38         | 0.50  | 3833   | 567   | 102  | 3367  | HDU5-SDS    | 5645         | 0.60          |
| A-2                  | R End   | 27.38         | 0.50  | -3833  | 945   | 102  | 4879  | Compression | 10312        | 0.47          |
|                      | V Elem  | 32.62         | 0.25  | 0  | 152   | 16   | 168   | Compression |              |               |
|                      | V Elem  | 34.63         | 0.25  | 0  | 152   | 16   | 168   | Compression |              |               |
| <b>Line B</b>        |         |               |       |  |       |      |       |             |              |               |
| B-1                  | L End   | 0.38          | 24.75 | 0  | -320  | 57   | 263   |             |              |               |
| B-2                  | L End   | 0.63          | 24.50 | -2096  | 4451  | 479  | 7025  | Compression | 10312        | 0.68          |
| B-1                  | L Op 2  | 9.13          | 24.75 | 0  | 15225 | 1639 | 16864 | Compression |              | -             |
| B-2                  | R End   | 9.38          | 24.50 | -2096  | 4451  | 479  | 7025  | Compression | 10312        | 0.68          |
| B-1                  | R Op 2  | 21.38         | 24.75 | 0  | 9594  | 1033 | 10626 | Compression |              | -             |
| B-1                  | L Op 2  | 25.38         | 24.75 | 0  | -1602 | 287  | 1315  |             |              |               |
| B-1                  | R Op 2  | 30.63         | 24.75 | 0  | 2137  | 230  | 2367  | Compression |              | -             |
| B-1                  | R End   | 34.63         | 24.75 | 0  | 1137  | 122  | 1259  | Compression |              | -             |

## 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 =  $V \times h / beff$  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 =  $V \times h / Co$  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 =  $-0.2 Sds \times ASD \text{ factor} \times \text{unfactored } D = 0.179 SDS \times \text{factored } D$ . 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:

HDU5-SDS2.5 for studs with thickness &gt; 0'-3" and depth &gt; 0'-3.5" : Uses 14 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 4.3.6.4.3 for foundation anchor bolt requirements.

## COLLECTOR FORCES (flexible seismic design)

| Level 1<br>Line-<br>Wall | Position on Wall<br>or Opening | Location [ft] |       | Drag Strut<br>Force [lbs] |       | Strap/Blocking<br>Force [lbs] |      |
|--------------------------|--------------------------------|---------------|-------|---------------------------|-------|-------------------------------|------|
|                          |                                | X             | Y     | --->                      | <---  | --->                          | <--- |
| <b>Line 1</b>            |                                |               |       |                           |       |                               |      |
|                          | Shearline force                |               |       | 2075                      | 2075  |                               |      |
| 1-2                      | Left Wall End                  | 0.50          | 6.00  | -487                      | 487   |                               |      |
| 1-2                      | Left Opening 1                 | 0.50          | 16.00 | 97                        | -97   |                               |      |
| 1-2                      | Right Opening 1                | 0.50          | 20.00 | -242                      | 242   |                               |      |
| 1-2                      | Right Wall End                 | 0.50          | 24.50 | 21                        | -21   |                               |      |
| <b>Line 2</b>            |                                |               |       |                           |       |                               |      |
|                          | Shearline force                |               |       | 1985                      | 1985  |                               |      |
| 2-1                      | Left Opening 1                 | 34.75         | 4.25  | 289                       | -289  |                               |      |
| 2-1                      | Right Opening 1                | 34.75         | 9.25  | -260                      | 260   |                               |      |
| 2-1                      | Left Opening 2                 | 34.75         | 17.17 | 312                       | -312  |                               |      |
| 2-1                      | Right Opening 2                | 34.75         | 22.17 | -187                      | 187   |                               |      |
| <b>Line A</b>            |                                |               |       |                           |       |                               |      |
|                          | Shearline force                |               |       | 2023                      | 2023  |                               |      |
| A-2                      | Left Wall End                  | 22.50         | 0.50  | -1305                     | 1305  |                               |      |
| A-2                      | Right Wall End                 | 27.50         | 0.50  | 425                       | -425  |                               |      |
| <b>Line B</b>            |                                |               |       |                           |       |                               |      |
|                          | Shearline force                |               |       | 2038                      | 2038  |                               |      |
| B-2                      | Left Wall End                  | 0.50          | 24.50 | -15                       | 15    |                               |      |
| B-2                      | Right Wall End                 | 9.50          | 24.50 | 1491                      | -1491 |                               |      |

## Legend:

Line-Wall - Shearline and wall number

Position...- Side of opening or wall end that drag strut is attached to

Location - Co-ordinates in Plan View

Drag strut Force - Axial force in transfer element at openings, gaps, or changes in design shear along shearline. + : tension; - : compression.

Based on ASD-factored shearline force shown. For SDC C-F, it is the greater of the design shearline force and the diaphragm force  $F_{px}$ , added to shearline force from story above and to forces transferred from discontinuous shearlines factored by overstrength ( $\omega$ ) as per 12.10.1.1.

Refer to Seismic Information table for diaphragm forces and  $\omega$  factor.

For SDC D-F, if horizontal torsional irregularities 2, 3, or 4 are input, or vertical irregularity 4 detected or input, 25% increase from 12.3.3.4 applied.

For perforated walls, this force is converted to  $v_{max}$  using 4.3.6.4.1.1.

Strap/Blocking Force - For FTAO walls, force transferred from above and below opening to shearwall pier.

-> Due to shearline force in the west-to-east or south-to-north direction

<- Due to shearline force in the east-to-west or north-to-south direction

## DEFLECTION (flexible seismic design)

| Wall, segment  | W Gp | Dir  | Srf | v plf | b ft  | h ft | Bending A sq.in | Defl in | Shear Defl in | Vn lbs | Nail slip en in | Defl in | Hold Defl in | Total Defl in |
|----------------|------|------|-----|-------|-------|------|-----------------|---------|---------------|--------|-----------------|---------|--------------|---------------|
| <b>Level 1</b> |      |      |     |       |       |      |                 |         |               |        |                 |         |              |               |
| <b>Line 1</b>  |      |      |     |       |       |      |                 |         |               |        |                 |         |              |               |
| 1-2            | 2    | S->N | 1   | 157.3 | 14.50 | 9.00 | 24.8            | .002    | .018          | 79     | .014            | .093    | 0.01         | 0.12          |
|                |      | N->S | 1   | 157.3 | 14.50 | 9.00 | 24.8            | .002    | .018          | 79     | .014            | .093    | 0.05         | 0.16          |
| <b>Line 2</b>  |      |      |     |       |       |      |                 |         |               |        |                 |         |              |               |
| 2-1            | 2    | Both | Ext | 168.4 | 12.96 | 9.00 | 16.5            | .003    | .020          | 84     | .016            | .106    | 0.05         | 0.18          |
| <b>Line A</b>  |      |      |     |       |       |      |                 |         |               |        |                 |         |              |               |
| A-2            | 1    | Both | 1   | 444.6 | 5.00  | 9.00 | 16.5            | .018    | .052          | 111    | .026            | .178    | 0.41         | 0.65          |
| <b>Line B</b>  |      |      |     |       |       |      |                 |         |               |        |                 |         |              |               |
| B-2            | 2    | Both | 1   | 248.8 | 9.00  | 9.00 | 16.5            | .006    | .029          | 124    | .033            | .220    | 0.03         | 0.29          |

## Legend:

Wall, segment – Wall and segment between openings, e.g. B-3,2 = second segment on Wall 3 on Shearline B.

W Gp – Wall design group, refer to Sheathing and Framing Materials tables.

Dir – Force direction.

Srf – Wall surface = Int(erior) or Ext(erior) for perimeter walls, 1 or 2 for interior partitions.

v – Unfactored (strength-level) shear force per unit distance on wall segment = ASD force / 0.70, as per ASCE 7 12.8.6.

Unblocked walls =  $v / C_{ub}$  as per SDPWS 4.3.4.3,  $C_{ub}$  = Unblocked factor from 4.3.5.3, shown in the Shear Results table.

Perforated walls =  $v_{max}$  from Eqn. 4.3-9, as per 4.3.4.2.

FTAO walls = Unit shear force in pier beside opening(s).

b – Wall or segment length.

Segmented wall or FTAO wall segments = Width of wall segment between openings.

Perforated wall = Sum of FHS segments, modified as in 4.3.3.4 per 4.3.4.2.

FTAO wall = Length of wall including openings.

h – Wall height.

FTAO piers = Distance from bottom of opening to top of wall; for end segments, results using that distance and the wall height are averaged.

Defl – Horizontal shear wall deflection due to given term:

Bending =  $8vh^3 / EAb$ ; A = Effective cross sectional area of segment end stud(s), E = stud mod. of elasticity in Framing Materials table

For i studs at one end and j at the other,  $A = 2(i^2j + j^2i) / (i + j)^2 \times$  area of one stud, based on Ex. C4.3.4-3

Shear =  $vh / Gvtv$ ;  $Gvtv$  = Shear stiffness from C4.3.4, shown in Sheathing Materials table.

Nail slip =  $0.75 h \times en$ ; en from Table C4.2.3D, of form  $aVn^b$  for WSP, varies linearly to published value for other materials.

Vn – Strength-level shear force per nail along panel edge.

Hold – Anchorage system (hold-down) =  $d_a \times h / beff$ .

$d_a$  = Vertical hold-down displacement; refer to Hold-down Displacement table for components.

$beff$  = Effective wall segment length =  $b - (\text{tension stud pack width} + \text{hold-down anchor bolt offset}) - (1/2 \text{ compression stud pack width})$   
 $beff$  is given in the Shear Wall Dimensions table.

For FTAO walls, hold-down device at end of wall is applied to all segments, as per APA T555.

Total Defl – Deflection from bending + shear + nail slip + hold-down, as per Eqn. 4.3-2.

For FTAO walls, the average of the values for the segments, as per APA T555.

**HOLD-DOWN DISPLACEMENT (flexible seismic design)**

| Wall, segment  | Dir  | Hold-down | Tension force lbs | Vert. Displacement |        |       | Slippage |       | Shrink +Extra in | Comp. force lbs | Crush da in | Total da in | Horz Defl in |
|----------------|------|-----------|-------------------|--------------------|--------|-------|----------|-------|------------------|-----------------|-------------|-------------|--------------|
|                |      |           |                   | Manuf in           | Add in | da in | Vf lbs   | da in |                  |                 |             |             |              |
| <b>Level 1</b> |      |           |                   |                    |        |       |          |       |                  |                 |             |             |              |
| <b>Line 1</b>  |      |           |                   |                    |        |       |          |       |                  |                 |             |             |              |
| 1-2            | S->N | HDU2-SDS  | -7174             | .000               | .000   | 0.000 | -        | -     | .000             | 9906            | 0.02        | 0.02        | 0.01         |
|                | N->S | HDU2-SDS  | -2625             | .000               | .000   | 0.000 | -        | -     | .000             | 19378           | 0.08        | 0.08        | 0.05         |
| <b>Line 2</b>  |      |           |                   |                    |        |       |          |       |                  |                 |             |             |              |
| 2-1            | Both | HDU2-SDS  | -2742             | .000               | .000   | 0.000 | -        | -     | .000             | 12331           | 0.07        | 0.07        | 0.05         |
| <b>Line A</b>  |      |           |                   |                    |        |       |          |       |                  |                 |             |             |              |
| A-2            | Both | HDU5-SDS  | 3507              | .094               | .000   | 0.094 | -        | -     | .105             | 5680            | 0.02        | 0.21        | 0.41         |
| <b>Line B</b>  |      |           |                   |                    |        |       |          |       |                  |                 |             |             |              |
| B-2            | Both | HDU2-SDS  | -1018             | .000               | .000   | 0.000 | -        | -     | .000             | 9218            | 0.03        | 0.03        | 0.03         |

**Legend:**

Wall, segment – Wall and segment between openings, e.g. B-3,2 = second segment on Wall 3 on Shearline B

Dir – Force direction

Tens., Comp. force – Accumulated strength-level hold-down tension force T and end compression force C from overturning, dead loads and vertical earthquake loads

da – Vertical displacements due to the following components:

Vert. Displacement – Elongation when slippage calculated separately; displacement when combined elongation/slippage used

Manuf – Using manufacturer's value for anchor bolt length, or no bolt contribution for connector-only elongation

Unless marked with \* = (ASD uplift force / ASD hold-down capacity) x max strength-level elongation or displacement

\* - Maximum strength-level elongation or displacement is used. May result in higher than actual displacements for lightly loaded hold-downs, causing the segment to draw less force due to lower than actual stiffness.

Add – Due to longer anchor bolt length than manufacturer's value, or entire bolt length for connector-only elongation =  $TL / (Ab \times Es)$

Ab = bolt cross-sectional area

Es = steel modulus = 29000000 psi

L = Lb – Lh

Lb = Total bolt length shown in Storey Information table

Lh = Manufacturer's anchor bolt length for given displacement/elongation from hold-down database

Slippage – Due to vertical slippage of hold-down fasteners attached to stud(s) when not combined with elongation

Nails = en from SDPWS Table C4.2.3D using values for wood structural panels

Bolts =  $Vf / (270,000 D^{1.5})$  (NDS 11.3.6); D = bolt diameter, Vf = Tension force T / number of fasteners

Shrink + Extra – Wood shrinkage plus extra displacement due to mis-cuts, gaps, etc.

Shrinkage =  $0.002 \times (24\% \text{ fabrication} - 10\% \text{ in-service moisture contents}) \times Ls$

Ls = Length between anchor bolt fasteners subject to perp-to-grain shrinkage; see Story Information table

Crush – Deformation of bottom plate at compression end of wall segment

=  $0.02'' \times [r / 0.73, r < 0.73; (1 + (r - 0.73) / 0.27), 0.73 < r < 1; 2r^3, r > 1]$

r =  $fcp / Fcp'$ ;  $Fcp' = Ct \text{ CM } Fcp$ ;  $fcp = C / A$ , A = cross sectional area of end studs

Total da – Vert. Displacement + Slippage + Shrink + Crush + Extra

Horz Defl – Anchorage deflection term in SDPWS Eqn. C.4.3.4-1 =  $h / beff \times da$

h = Wall height. For end segments in FTAO walls, h is the average of the wall height and the distance from the bottom of opening to top of wall

beff = Effective wall segment length = b - (tension stud pack width + hold-down anchor bolt offset) - (1/2 compression stud pack width)

h and b are shown in Deflection table, beff in the Shear Wall Dimensions table

**STORY DRIFT (flexible seismic design)**

| Level | Dir   | Wall height ft | Max dxe | Line | Actual Story Drift (in) |                |            |           | Allowable Story Drift |            |           |              |
|-------|-------|----------------|---------|------|-------------------------|----------------|------------|-----------|-----------------------|------------|-----------|--------------|
|       |       |                |         |      | Max dx                  | Center of Mass | C of M dxe | C of M dx | hsx ft                | Delta a in | Ratio Max | Ratio C of M |
| 1     | N<->S | 9.00           | 0.18    | 2    | 0.71                    | 16.97          | 0.17       | 0.68      | 9.00                  | 2.70       | 0.26      | 0.25         |
|       | E<->W |                | 0.65    | A    | 2.05                    | 12.29          | 0.47       | 1.60      |                       |            | 0.76      | 0.59         |

ASCE 7 Eqn. 12.8-15:  $dx = dxe \times Cd / Ie$

Deflection amplification factor  $Cd$  from Table 12.2-1 = (E-W), 4.0 (N-S)

Importance factor  $Ie = 1.00$

**Legend:**

*Max dxe* – Largest deflection for any shearline on level in this direction; refer to Deflections table

*Line* – Shearline with largest deflection on level in this direction

*hsx* – Story height in ASCE Table 12.12-1 = Height of walls plus joist depth between this level and the one above.

*Max dx* – Largest amplified deflection on level in this direction using ASCE 7 Eq'n 12.8-15

*C of M dxe* - Deflection at the center of mass of this level; from interpolating deflections at adjacent shearlines.

*C of M dx* - Amplified deflection at center of mass using Eq'n 12.8-15. Does not include differences between top and bottom diaphragm deflection.

*Delta a* = Allowable story drift on this level from ASCE 7 Table 12.12-1

*Ratio* - Proportion of allowable story drift experienced, on this level in this direction.





Design Code: IBC 2021/AWC SDPWS 2021

## SEISMIC LOAD GENERATION

ASCE 7-16 12.8 Equivalent Lateral Force Procedure

## Site Information:

Risk Category II - All others

SFRS = Bearing wall structure

Regular

Site class D

S1 = 0.35, (Fv = 1.95)

SS = 0.84, Fa = 1.37

Seismic Design Category D

Ta: Calculated - refer to Equations and to Base Shear table, below

R: Refer to Base Shear table below

Site-specific ground motion analysis from Chapter 21 was used to determine Fa

## Legend:

|  |   |
|--|---|
| V - Total design base shear                    | Cvx - Vertical distribution factor, level x     |
| Vx - Design story shear, level x               | R - Response modification factor                |
| Fx - Lateral force induced in level x          | Ie - Seismic importance factor                  |
| Fpx - Diaphragm design force, level x          | Cu - Coefficient for upper limit on period T    |
| W - Total seismic dead load on structure       | Cs - Seismic design coefficient                 |
| wx - Dead load tributary to story x            | SDS - Design short period spectral acceleration |
| hx - Ceiling height of level x (floor of x+1)  | SD1 - Design 1s spectral response acceleration  |
| hn - Height of structure to mid-roof           | SS - Mapped short period spectral acceleration  |
| Fi,wi,hi,Vi - Fx, etc. summed over levels      | S1 - Mapped 1s spectral response acceleration   |
| Vjx - Design force on shearline j, level x     | Fa - Acceleration-based site coefficient        |
| Vpjax - Diaphragm design shearline force       | Fv - Velocity-based site coefficient            |
| Vdjax - Vert. discontinuous shearline force    | T - Fundamental period of vibration             |
| Vcjax - Collector shearline force              | Tmax - Maximum period of vibration              |
| Fe,Fpe,we - Force,load from mass element e     | Ta - Approximate period of vibration            |
| Fej,Fpej - Portion of Fe,Fpe applied to line j | Omega - Overstrength factor                     |
| SDC - Seismic Design Category                  | SFRS - Seismic force resisting system           |

## Equations:

|  |  |
|--|--|
| Fx = Cvx V                                   | Eqn 12.8-11 (SDC B-F)                      |
| Fx = 0.01 wx                                 | Eqn 1.4-1 (SDC A)                          |
| Fpx = wx SUM(Fi)/SUM(wi), i = x to n         | Eqn 12.10-1                                |
| V = Cs W                                     | Eqn 12.8-1                                 |
| Vx = SUM(Fi), i = x to n                     | Eqn 12.8-13                                |
| Cvx = $hx^k wx / \sum(wi hi^k)$ i = 1 to n   | Eqn 12.8-12                                |
| k = k(T)                                     | Note, 12.8-12                              |
| Cscal = Sds Ie/R                             | Eqn 12.8-2                                 |
| Csmax = Sd1 Ie/(R T)                         | Eqn 12.8-3                                 |
| Csmin = max (0.044 Ie Sds, 0.01)             | Eqn 12.8-5                                 |
| Csmin = 0.5 S1 Ie/R (Sds >= 0.6g)            | Eqn 12.8-6                                 |
| Ta = $Ct hn^{(3/4)}$ , hn in m               | Eqn 12.8-7                                 |
| Ie = Ie(risk category)                       | Table 1.5-2                                |
| Tmax = Ta Cu                                 | 12.8.2                                     |
| Cu = Cu(SD1)                                 | Table 12.8-1                               |
| SDS = 2/3 Fa SS                              | Eqns 11.4-1,4-3                            |
| SD1 = 2/3 Fv S1                              | Eqns 11.4-2,4-4                            |
| Fa = Fa(SS, Site Class)                      | Table 11.4-1                               |
| Fv = Fv(S1, Site Class)                      | Table 11.4-2                               |
| SDC = SDC(SDS, SD1, occupancy)               | Tables 11.6-1,6-2                          |
| Omega = Omega(SFRS)                          | Table 12.2-1                               |
| Fe = Fx we / wx                              | Assumption                                 |
| Fpe = Fpx we / wx                            | Assumption                                 |
| Vjx (flexible diaphragm) = SUM(Fej) + Vj,x+1 | 12.8.4                                     |
| Vjx (rigid diaphragm) =                      | See Torsional Analysis Details,            |
|  | F = Vx, CL = centroid of Fe's and Vj,x+1's |
| Vpjax = Vjx using Fpe, and Omega * Vdj,x+1   | 12.10.1.1                                  |
| Vcjax = Vjx                                  | 12.10.2 (SDC A,B)                          |
| Vcjax = max(Vjx,Vpjax)                       | 12.10.2.1 - Exception (SDC C-F)            |

## User Input and Source:

|                                       |                           |
|---------------------------------------|---------------------------|
| Site Classes A-F                      | Table 20.3-1              |
| Risk Category                         | Table 1.5-1               |
| Fa and Fv for site profile F, maybe E | Site specific study       |
| R (also calculated)                   | Table 12.2-1              |
| T (also calculated using Ta)          | deformational analysis    |
| Irregularities                        | 12.3.2,3; Tables 12.3-1,2 |
| SFRS                                  | Table 12.2-1              |

Total Design Base Shear:

Job #23M-007 749 Palisade

|      |     |         |       |       |        |       |       |       |         |
|------|-----|---------|-------|-------|--------|-------|-------|-------|---------|
| Ie   | SDC | W (lbs) | SDS   | SD1   | Cu     | Tmax  | Ta    | k     |         |
| 1.00 | D   | 37713   | 0.769 | 0.462 | 1.400  | 0.186 | 0.133 | 1.000 |         |
|      | R   | T       | SS    | SDS   | CscalC | Csmax | Csmin | Cs    | V (lbs) |
| N-S  | 6.5 | 0.133   | 0.84  | 0.769 | 0.118  | 0.534 | 0.034 | 0.118 | 4462    |
| E-W  | 6.5 | 0.133   | 0.84  | 0.769 | 0.118  | 0.534 | 0.034 | 0.118 | 4462    |

The first SDS value shown, used for Seismic Design Category, diaphragm design force limits, and out-of-plane forces, is not limited by ASCE 7 12.8.1.3. SDS values shown in lower table are for Cs and Ev calculations and may implement 12.8.1.3.

Manually added or modified seismic loads and forces do not contribute to base shear.

Distribution of Base Shear to Levels:

| Level | hx<br>(ft) | wx<br>(lbs) | hx * wx<br>(ft-lbs) | Cvx  | Fx (lbs) |      | Vx (lbs) |      |
|-------|------------|-------------|---------------------|------|----------|------|----------|------|
|       |            |             |                     |      | N-S      | E-W  | N-S      | E-W  |
| 1     | 9.00       | 37713       | 339417              | 1.00 | 4462     | 4462 | 4462     | 4462 |

Manually added or modified seismic loads and forces are not included in the distribution of base shear.

Unfactored seismic loads for Level 1 -

| Dir. No. | Start | End   | Profile | Magnitude (lbs, plf) |       |
|----------|-------|-------|---------|----------------------|-------|
|          |       |       |         | From                 | To    |
| N<->S 1  | -0.81 | 0.25  | Line    | 85.0                 | 85.0  |
| N<->S 2  | 0.25  | 0.50  | Line    | 100.9                | 100.9 |
| N<->S 3  | 0.25  | 0.25  | Point   | 348                  | 348   |
| N<->S 4  | 0.50  | 9.50  | Line    | 104.1                | 104.1 |
| N<->S 5  | 0.50  | 0.50  | Point   | 59                   | 59    |
| N<->S 6  | 9.50  | 22.50 | Line    | 100.9                | 100.9 |
| N<->S 7  | 22.50 | 27.50 | Line    | 104.1                | 104.1 |
| N<->S 8  | 27.50 | 34.75 | Line    | 100.9                | 100.9 |
| N<->S 9  | 34.75 | 35.81 | Line    | 85.0                 | 85.0  |
| N<->S 10 | 34.75 | 34.75 | Point   | 348                  | 348   |
| W<->E 1  | -1.37 | 0.25  | Line    | 112.7                | 112.7 |
| W<->E 2  | 0.25  | 6.00  | Line    | 128.6                | 139.8 |
| W<->E 3  | 0.25  | 0.25  | Point   | 276                  | 276   |
| W<->E 4  | 0.50  | 0.50  | Point   | 16                   | 16    |
| W<->E 5  | 6.00  | 13.00 | Line    | 143.0                | 156.7 |
| W<->E 6  | 13.00 | 24.50 | Line    | 156.7                | 132.4 |
| W<->E 7  | 24.50 | 24.50 | Point   | 29                   | 29    |
| W<->E 8  | 24.50 | 24.75 | Line    | 129.2                | 128.6 |
| W<->E 9  | 24.75 | 26.25 | Line    | 112.7                | 112.7 |
| W<->E 10 | 24.75 | 24.75 | Point   | 276                  | 276   |

Design Code: IBC 2021/AWC SDPWS 2021

WIND LOAD GENERATION

MWFRS Procedure: ASCE 7-16 Directional (All heights)  
 C&C Procedure: ASCE 7 Ch. 30 Part 1 (h ≤ 60 ft.)

Site Information:

Enclosure = Partially open  
 Internal gust factor Cgi = 2.0  
 Occupancy = Category II - All others  
 Exposure = Exposure C  
 Rigid building - Static analysis  
 Case 2 Loads at 75%  
 Eccentricity N-S loads = 15%, E-W loads = 15%  
 Ground Elevation: = 0 feet

Legend:

|  |                              |
|--|------------------------------|
| p - Design wind pressure (see Equations)                                 | h - Mean roof height         |
| q - Velocity pressure  | z - Height of interest       |
| G - Gust factor  | theta - Roof angle           |
| Cp - External pressure factor  | B - Building width           |
| GCp - Combined exposure and gust factor                                  | L - Building length          |
| GCpi - Internal pressure coefficient                                     | V - Basic wind speed         |
| Kz - Velocity pressure exposure coefficient                              | Ke - Ground elevation factor |
| Kd - Wind directionality factor  | Kzt - Topographic factor     |
| zg - Ground elevation  |                              |
| c, zmin, epsilon-bar, l - Terrain exposure constants used to calculate G |                              |
| hE, zg, alpha - Terrain exposure constants used to calculate K           |                              |

Equations:

MWFRS Pressure Equation:  $p = q * G * Cp$   
 C&C Pressure Equation:  $p = q * (GCp - GCpi)$   
 Other Equations:  $q = 0.00256 * Kz * Kd * Kzt * Ke * V^2$   
 $Ke = e^{(-0.0000362 * zg)}$   
 $Kz = 2.01 * ( \max(z, hE) / zg ) ^ ( 2 / a )$   
 $Gz = \min(0.85, 0.925 * (1 + 5.8 * (c * (\max(0.6 * h, zmin) / 33) ^ (-1/6))) * ((1 / (1 + 0.63 * ((B + h) / (1 * (\max(0.6 * h, zmin) / 33))) ^ (e)))) ^ (0.63))) ^ (1/2))) / (1 + 5.8 * (c * (\max(0.6 * h, zmin) / 33) ^ (-1/6))))$

Data (all loads):

Kd = 0.85, GCpi = 0.18, Ke = 1.000  
 Terrain Exposure Constants:  
 zmin = 15 epsilon-bar = 0.20  
 c = 0.20 l = 500  
 zg = 900 alpha = 9.5  
 hE = 15

Units: ft, lbs, ft/s

MAIN WIND FORCE RESISTING SYSTEM (MWFRS)

MWFRS - Block 1: EW x NS = 34.50 x 24.50 Mean Roof Height = 12.50

| Level | Face  | Direction | p     | q    | GCp   | Cp    | Gz   | z-G  | Kz   | z-K  | Kzt  | z-Kzt | theta | L/B  | h/L  |
|-------|-------|-----------|-------|------|-------|-------|------|------|------|------|------|-------|-------|------|------|
| 1     | North | Windward  | 11.34 | 16.7 | 0.68  | 0.80  | 0.85 | 6.8  | 0.85 | 6.8  | 1.00 | -     | 30.8  | 0.71 | 0.51 |
| 1     | North | Leeward   | -7.09 | 16.7 | -0.43 | -0.50 | 0.85 | 12.5 | 0.85 | 12.5 | 1.00 | -     | 30.8  | 0.71 | 0.51 |
| Roof  | North | Leeward   | -8.50 | 16.7 | -0.51 | -0.60 | 0.85 | 12.5 | 0.85 | 12.5 | 1.00 | -     | 30.8  | 0.71 | 0.51 |
| Roof  | North | Windward  | 3.05  | 16.7 | 0.18  | 0.22  | 0.85 | 12.5 | 0.85 | 12.5 | 1.00 | -     | 30.8  | 0.71 | 0.51 |
| 1     | East  | Windward  | 11.34 | 16.7 | 0.68  | 0.80  | 0.85 | 6.8  | 0.85 | 6.8  | 1.00 | -     | 90.0  | 1.41 | 0.36 |
| 1     | East  | Leeward   | -5.93 | 16.7 | -0.36 | -0.42 | 0.85 | 12.5 | 0.85 | 12.5 | 1.00 | -     | 90.0  | 1.41 | 0.36 |
| 1     | East  | Leeward   | -5.93 | 16.7 | -0.36 | -0.42 | 0.85 | 12.5 | 0.85 | 12.5 | 1.00 | -     | 90.0  | 1.41 | 0.36 |
| 1     | East  | Windward  | 11.34 | 16.7 | 0.68  | 0.80  | 0.85 | 11.1 | 0.85 | 11.1 | 1.00 | -     | 90.0  | 1.41 | 0.36 |
| 1     | East  | Leeward   | -5.93 | 16.7 | -0.36 | -0.42 | 0.85 | 12.5 | 0.85 | 12.5 | 1.00 | -     | 90.0  | 1.41 | 0.36 |
| 1     | East  | Windward  | 11.34 | 16.7 | 0.68  | 0.80  | 0.85 | 11.1 | 0.85 | 11.1 | 1.00 | -     | 90.0  | 1.41 | 0.36 |
| 1     | South | Windward  | 11.34 | 16.7 | 0.68  | 0.80  | 0.85 | 6.8  | 0.85 | 6.8  | 1.00 | -     | 28.8  | 0.71 | 0.51 |
| 1     | South | Leeward   | -7.09 | 16.7 | -0.43 | -0.50 | 0.85 | 12.5 | 0.85 | 12.5 | 1.00 | -     | 28.8  | 0.71 | 0.51 |
| Roof  | South | Leeward   | -8.50 | 16.7 | -0.51 | -0.60 | 0.85 | 12.5 | 0.85 | 12.5 | 1.00 | -     | 28.8  | 0.71 | 0.51 |
| Roof  | South | Windward  | 2.82  | 16.7 | 0.17  | 0.20  | 0.85 | 12.5 | 0.85 | 12.5 | 1.00 | -     | 28.8  | 0.71 | 0.51 |
| 1     | West  | Windward  | 11.34 | 16.7 | 0.68  | 0.80  | 0.85 | 6.8  | 0.85 | 6.8  | 1.00 | -     | 90.0  | 1.41 | 0.36 |
| 1     | West  | Leeward   | -5.93 | 16.7 | -0.36 | -0.42 | 0.85 | 12.5 | 0.85 | 12.5 | 1.00 | -     | 90.0  | 1.41 | 0.36 |
| 1     | West  | Leeward   | -5.93 | 16.7 | -0.36 | -0.42 | 0.85 | 12.5 | 0.85 | 12.5 | 1.00 | -     | 90.0  | 1.41 | 0.36 |
| 1     | West  | Windward  | 11.34 | 16.7 | 0.68  | 0.80  | 0.85 | 11.1 | 0.85 | 11.1 | 1.00 | -     | 90.0  | 1.41 | 0.36 |
| 1     | West  | Leeward   | -5.93 | 16.7 | -0.36 | -0.42 | 0.85 | 12.5 | 0.85 | 12.5 | 1.00 | -     | 90.0  | 1.41 | 0.36 |
| 1     | West  | Windward  | 11.34 | 16.7 | 0.68  | 0.80  | 0.85 | 11.1 | 0.85 | 11.1 | 1.00 | -     | 90.0  | 1.41 | 0.36 |



## PERFORATED SHEARWALL DRAG STRUT FORCE CALCULATION

V - Total shear line force(lbs)  
 Vw - Total force on perforated shear wall(lbs)  
 V / L - Diaphragm shear force(plf)  
 v - Unit shear wall force(plf)  
 $v_{max}$  - Perforated shear wall force =  $Vw / Co / \sum(bi)$  (plf)  
 $\sum(bi)$  - Sum of wall segment lengths adjusted for narrow segments(ft)  
 FHS - Sum of full - height segment lengths on wall(ft)  
 L - Length of shear line, including gaps and openings(ft)  
 Co - perforated wall shear capacity adjustment factor  
 Seg w /  $v_{max}$  - Wall segment for which v is set to  $v_{max}$ .  
 Other v - Force on the other wall segments =  $(Vw - v_{max} * bs) / (FHS - bs)$   
 Drag strut force at - Sum of  $(V / L - v) * di$  along shear line(lbs), where di is the length of segments, openings or gaps. Locations shown are from start of shear line.  
 Critical force - Largest drag strut force at each location derived from setting  $v = v_{max}$  on each segment independently(lbs)

## Shear wall 1-2, Level 1

W->E and S->N seismic design, flexible diaphragm  
 $v_{max} = 143.1$ ,  $V/L = 84.7$ ,  $Co = 1.000$ ,  $FHS = 14.5$ ,  $\sum(bi) = 14.5$   

| Seg w/          | Seg    | Other | Drag strut force at |       |       |       |
|-----------------|--------|-------|---------------------|-------|-------|-------|
| $v_{max}$       | Length | v     | 6.00                | 16.00 | 20.00 | 24.50 |
| 1               | 10.0   | 143.1 | -487                | 97    | -242  | 21    |
| 2               | 4.5    | 143.1 | -487                | 97    | -242  | 21    |
| Critical force: |        |       | -487                | 97    | -242  | 21    |

## Shear wall 1-2, Level 1

W->E and S->N wind design, flexible diaphragm  
 $v_{max} = 127.8$ ,  $V/L = 75.6$ ,  $Co = 1.000$ ,  $FHS = 14.5$ ,  $\sum(bi) = 14.5$   

| Seg w/          | Seg    | Other | Drag strut force at |       |       |       |
|-----------------|--------|-------|---------------------|-------|-------|-------|
| $v_{max}$       | Length | v     | 6.00                | 16.00 | 20.00 | 24.50 |
| 1               | 10.0   | 127.8 | -435                | 87    | -216  | 19    |
| 2               | 4.5    | 127.8 | -435                | 87    | -216  | 19    |
| Critical force: |        |       | -435                | 87    | -216  | 19    |

## Shear wall 1-2, Level 1

E->W and N->S wind design, flexible diaphragm  
 $v_{max} = 129.2$ ,  $V/L = 76.4$ ,  $Co = 1.000$ ,  $FHS = 14.5$ ,  $\sum(bi) = 14.5$   

| Seg w/          | Seg    | Other | Drag strut force at |       |       |       |
|-----------------|--------|-------|---------------------|-------|-------|-------|
| $v_{max}$       | Length | v     | 6.00                | 16.00 | 20.00 | 24.50 |
| 1               | 10.0   | 129.2 | 440                 | -88   | 218   | -19   |
| 2               | 4.5    | 129.2 | 440                 | -88   | 218   | -19   |
| Critical force: |        |       | 440                 | -88   | 218   | -19   |

## Shear wall 1-2, Level 1

E->W and N->S seismic design, flexible diaphragm  
 $v_{max} = 143.1$ ,  $V/L = 84.7$ ,  $Co = 1.000$ ,  $FHS = 14.5$ ,  $\sum(bi) = 14.5$   

| Seg w/          | Seg    | Other | Drag strut force at |       |       |       |
|-----------------|--------|-------|---------------------|-------|-------|-------|
| $v_{max}$       | Length | v     | 6.00                | 16.00 | 20.00 | 24.50 |
| 1               | 10.0   | 143.1 | 487                 | -97   | 242   | -21   |
| 2               | 4.5    | 143.1 | 487                 | -97   | 242   | -21   |
| Critical force: |        |       | 487                 | -97   | 242   | -21   |

## Shear wall 2-1, Level 1

W->E and S->N seismic design, flexible diaphragm  
 $v_{max} = 153.2$ ,  $V/L = 81.0$ ,  $Co = 1.000$ ,  $FHS = 14.5$ ,  $\sum(bi) = 12.96$   

| Seg w/          | Seg    | Other | Drag strut force at |      |       |       |
|-----------------|--------|-------|---------------------|------|-------|-------|
| $v_{max}$       | Length | v     | 4.25                | 9.25 | 17.17 | 22.17 |
| 1               | 4.0    | 130.7 | 289                 | -116 | 277   | -128  |
| 2               | 7.92   | 117.3 | 145                 | -260 | 312   | -94   |
| 3               | 2.58   | 133.4 | 209                 | -196 | 219   | -186  |
| Critical force: |        |       | 289                 | -260 | 312   | -186  |

## Shear wall 2-1, Level 1

W->E and S->N wind design, flexible diaphragm  
 $v_{max} = 141.0$ ,  $V/L = 74.6$ ,  $Co = 1.000$ ,  $FHS = 14.5$ ,  $\sum(bi) = 12.96$   

| Seg w/          | Seg    | Other | Drag strut force at |      |       |       |
|-----------------|--------|-------|---------------------|------|-------|-------|
| $v_{max}$       | Length | v     | 4.25                | 9.25 | 17.17 | 22.17 |
| 1               | 4.0    | 120.3 | 266                 | -107 | 255   | -118  |
| 2               | 7.92   | 107.9 | 133                 | -239 | 287   | -86   |
| 3               | 2.58   | 122.7 | 193                 | -180 | 201   | -172  |
| Critical force: |        |       | 266                 | -239 | 287   | -172  |

Shear wall 2-1, Level 1

E->W and N->S wind design, flexible diaphragm

vmax = 142.5, V/L = 75.4, Co = 1.000, FHS = 14.5, sum (bi) = 12.96

| Seg w/          | Seg    | Other | Drag | strut force at |       |       |  |
|-----------------|--------|-------|------|----------------|-------|-------|--|
| vmax            | Length | v     | 4.25 | 9.25           | 17.17 | 22.17 |  |
| 1               | 4.0    | 121.6 | -269 | 108            | -257  | 119   |  |
| 2               | 7.92   | 109.1 | -135 | 242            | -290  | 87    |  |
| 3               | 2.58   | 124.1 | -195 | 182            | -203  | 174   |  |
| Critical force: |        |       | -269 | 242            | -290  | 174   |  |

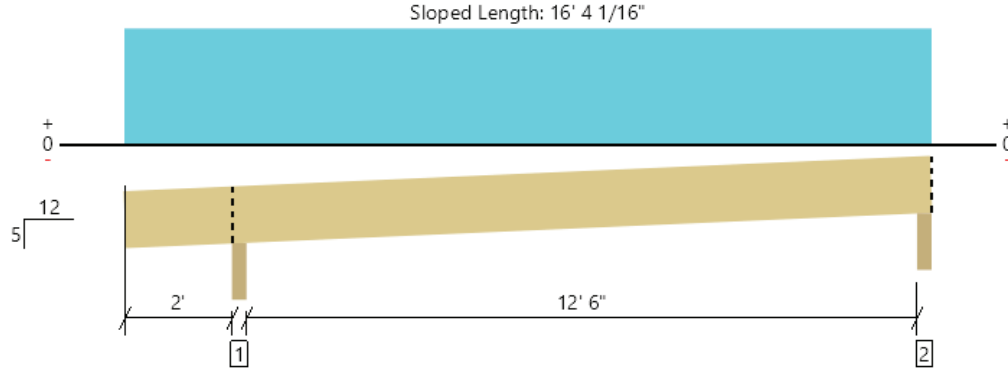
Shear wall 2-1, Level 1

E->W and N->S seismic design, flexible diaphragm

vmax = 153.2, V/L = 81.0, Co = 1.000, FHS = 14.5, sum (bi) = 12.96

| Seg w/          | Seg    | Other | Drag | strut force at |       |       |  |
|-----------------|--------|-------|------|----------------|-------|-------|--|
| vmax            | Length | v     | 4.25 | 9.25           | 17.17 | 22.17 |  |
| 1               | 4.0    | 130.7 | -289 | 116            | -277  | 128   |  |
| 2               | 7.92   | 117.3 | -145 | 260            | -311  | 94    |  |
| 3               | 2.58   | 133.4 | -209 | 196            | -219  | 187   |  |
| Critical force: |        |       | -289 | 260            | -311  | 187   |  |

Level, Roof: Rafter B1  
**1 piece(s) 2 x 8 DF No.2 @ 24" OC**



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

Member Length : 16' 7 1/8"

| Design Results        | Actual @ Location   | Allowed      | Result         | LDF  | Load: Combination (Pattern) |
|-----------------------|---------------------|--------------|----------------|------|-----------------------------|
| Member Reaction (lbs) | 668 @ 2' 1 3/4"     | 3555 (3.50") | Passed (19%)   | --   | 1.0 D + 1.0 Lr (All Spans)  |
| Shear (lbs)           | 449 @ 2' 10 3/16"   | 1631         | Passed (28%)   | 1.25 | 1.0 D + 1.0 Lr (All Spans)  |
| Moment (Ft-lbs)       | 1491 @ 8' 7 3/4"    | 1700         | Passed (88%)   | 1.25 | 1.0 D + 1.0 Lr (Alt Spans)  |
| Live Load Defl. (in)  | 0.351 @ 8' 6 1/2"   | 0.460        | Passed (L/471) | --   | 1.0 D + 1.0 Lr (Alt Spans)  |
| Total Load Defl. (in) | 0.664 @ 8' 6 11/16" | 0.689        | Passed (L/249) | --   | 1.0 D + 1.0 Lr (Alt Spans)  |

System : Roof  
Member Type : Joist  
Building Use : Residential  
Building Code : IBC 2021  
Design Methodology : ASD  
Member Pitch : 5/12

- Deflection criteria: LL (L/360) and TL (L/240).
- Overhang deflection criteria: LL (2L/360) and TL (2L/240).
- Upward deflection on left cantilever exceeds overhang deflection criteria.
- 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.

| Supports               | Bearing Length |           |          | Loads to Supports (lbs) |           |          | Accessories |
|------------------------|----------------|-----------|----------|-------------------------|-----------|----------|-------------|
|                        | Total          | Available | Required | Dead                    | Roof Live | Factored |             |
| 1 - Beveled Plate - DF | 3.50"          | 3.50"     | 1.50"    | 320                     | 348       | 668      | Blocking    |
| 2 - Beveled Plate - DF | 3.50"          | 3.50"     | 1.50"    | 235                     | 259       | 495      | 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) | 16' 4" o/c        |          |

•Maximum allowable bracing intervals based on applied load.

| Vertical Load     | Location (Side) | Spacing | Dead (0.90) | Roof Live (non-snow: 1.25) | Comments     |
|-------------------|-----------------|---------|-------------|----------------------------|--------------|
| 1 - Uniform (PSF) | 0 to 15' 1"     | 24"     | 17.0        | 20.0                       | Default Load |

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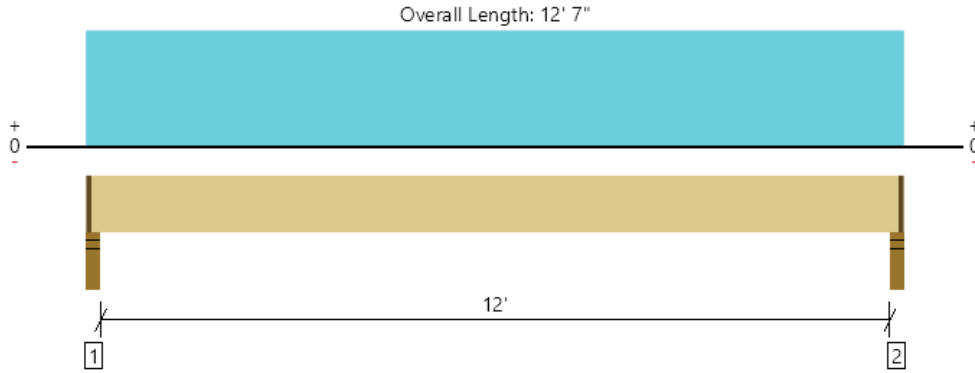
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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

| ForteWEB Software Operator  | Job Notes |
|---|-----------|
| Jeffrey Ford<br>Jackson and Sands<br>(530) 715-7184<br>jeffrey@jacksonandsandsengineering.com |           |



Level, Roof: Joist B2  
**1 piece(s) 2 x 8 DF No.2 @ 24" OC**



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

| Design Results        | Actual @ Location | Allowed      | Result          | LDF  | Load: Combination (Pattern) |
|-----------------------|-------------------|--------------|-----------------|------|-----------------------------|
| Member Reaction (lbs) | 272 @ 2 1/2"      | 1434 (2.25") | Passed (19%)    | --   | 1.0 D + 1.0 Lr (All Spans)  |
| Shear (lbs)           | 237 @ 10 3/4"     | 1631         | Passed (15%)    | 1.25 | 1.0 D + 1.0 Lr (All Spans)  |
| Moment (Ft-lbs)       | 814 @ 6' 3 1/2"   | 1700         | Passed (48%)    | 1.25 | 1.0 D + 1.0 Lr (All Spans)  |
| Live Load Defl. (in)  | 0.129 @ 6' 3 1/2" | 0.304        | Passed (L/999+) | --   | 1.0 D + 1.0 Lr (All Spans)  |
| Total Load Defl. (in) | 0.285 @ 6' 3 1/2" | 0.608        | Passed (L/513)  | --   | 1.0 D + 1.0 Lr (All Spans)  |
| TJ-Pro™ Rating        | N/A               | N/A          | N/A             | --   | N/A                         |

System : Floor  
Member Type : Joist  
Building Use : Residential  
Building Code : IBC 2021  
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                    | Roof Live | Factored |                  |
| 1 - Stud wall - SPF | 3.50"          | 2.25"     | 1.50"    | 151                     | 126       | 277      | 1 1/4" Rim Board |
| 2 - Stud wall - SPF | 3.50"          | 2.25"     | 1.50"    | 151                     | 126       | 277      | 1 1/4" Rim Board |

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

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

•Maximum allowable bracing intervals based on applied load.

| Vertical Load     | Location (Side) | Spacing | Dead (0.90) | Roof Live (non-snow: 1.25) | Comments     |
|-------------------|-----------------|---------|-------------|----------------------------|--------------|
| 1 - Uniform (PSF) | 0 to 12' 7"     | 24"     | 12.0        | 10.0                       | Default Load |

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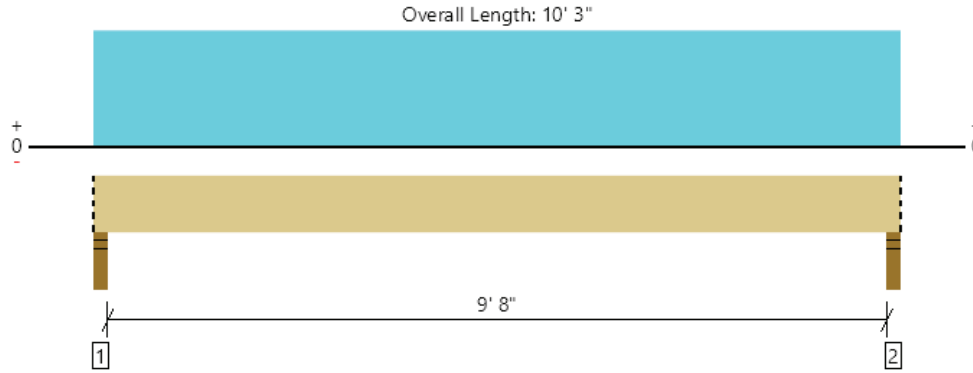
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|---|-----------|
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Level, Int. Drop Beam B3  
**1 piece(s) 4 x 12 DF No.1**



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

| Design Results        | Actual @ Location | Allowed      | Result          | LDF  | Load: Combination (Pattern) |
|-----------------------|-------------------|--------------|-----------------|------|-----------------------------|
| Member Reaction (lbs) | 2027 @ 2"         | 5206 (3.50") | Passed (39%)    | --   | 1.0 D + 1.0 Lr (All Spans)  |
| Shear (lbs)           | 1541 @ 1' 2 3/4"  | 5906         | Passed (26%)    | 1.25 | 1.0 D + 1.0 Lr (All Spans)  |
| Moment (Ft-lbs)       | 4861 @ 5' 1 1/2"  | 8459         | Passed (57%)    | 1.25 | 1.0 D + 1.0 Lr (All Spans)  |
| Live Load Defl. (in)  | 0.059 @ 5' 1 1/2" | 0.331        | Passed (L/999+) | --   | 1.0 D + 1.0 Lr (All Spans)  |
| Total Load Defl. (in) | 0.122 @ 5' 1 1/2" | 0.496        | Passed (L/976)  | --   | 1.0 D + 1.0 Lr (All Spans)  |

System : Floor  
Member Type : Drop Beam  
Building Use : Residential  
Building Code : IBC 2021  
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                    | Roof Live | Factored |             |
| 1 - Stud wall - SPF | 3.50"          | 3.50"     | 1.50"    | 1040                    | 987       | 2027     | Blocking    |
| 2 - Stud wall - SPF | 3.50"          | 3.50"     | 1.50"    | 1040                    | 987       | 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)    | 10' 3" o/c        |          |
| Bottom Edge (Lu) | 10' 3" o/c        |          |

•Maximum allowable bracing intervals based on applied load.

| Vertical Loads        | Location (Side)     | Tributary Width | Dead (0.90) | Roof Live (non-snow: 1.25) | Comments                                |
|-----------------------|---------------------|-----------------|-------------|----------------------------|---|
| 0 - Self Weight (PLF) | 0 to 10' 3"         | N/A             | 10.0        | --                         |   |
| 1 - Uniform (PLF)     | 0 to 10' 3" (Front) | N/A             | 117.5       | 129.5                      | Linked from: Roof: Rafter B1, Support 2 |
| 2 - Uniform (PLF)     | 0 to 10' 3" (Top)   | N/A             | 75.5        | 63.0                       | Linked from: Roof: Joist B2, Support 1  |

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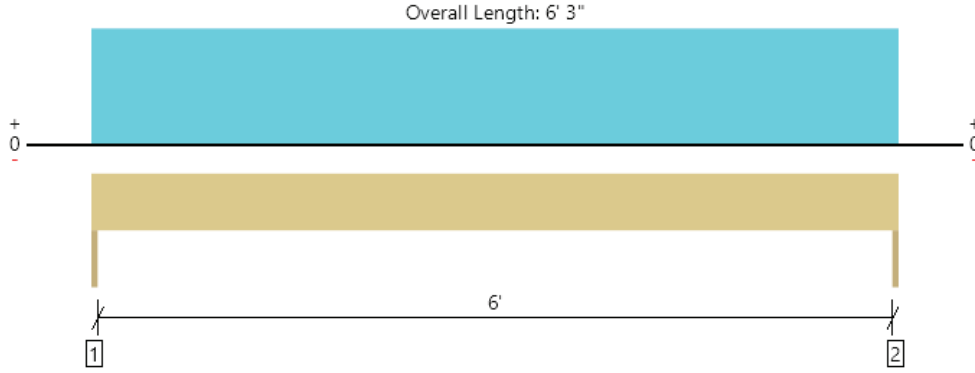
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| Jeffrey Ford<br>Jackson and Sands<br>(530) 715-7184<br>jeffrey@jacksonandsandsengineering.com |           |



Level, Typ. Header B4  
**1 piece(s) 6 x 8 DF No.2**



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

| Design Results        | Actual @ Location | Allowed      | Result          | LDF  | Load: Combination (Pattern) |
|-----------------------|-------------------|--------------|-----------------|------|-----------------------------|
| Member Reaction (lbs) | 1509 @ 0          | 5156 (1.50") | Passed (29%)    | --   | 1.0 D + 1.0 Lr (All Spans)  |
| Shear (lbs)           | 1147 @ 9"         | 5844         | Passed (20%)    | 1.25 | 1.0 D + 1.0 Lr (All Spans)  |
| Moment (Ft-lbs)       | 2358 @ 3' 1 1/2"  | 4028         | Passed (59%)    | 1.25 | 1.0 D + 1.0 Lr (All Spans)  |
| Live Load Defl. (in)  | 0.032 @ 3' 1 1/2" | 0.156        | Passed (L/999+) | --   | 1.0 D + 1.0 Lr (All Spans)  |
| Total Load Defl. (in) | 0.066 @ 3' 1 1/2" | 0.313        | Passed (L/999+) | --   | 1.0 D + 1.0 Lr (All Spans)  |

System : Wall  
Member Type : Header  
Building Use : Residential  
Building Code : IBC 2021  
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 | Factored |             |
| 1 - Trimmer - SPF | 1.50"          | 1.50"     | 1.50"    | 769                     | 741       | 1509     | None        |
| 2 - Trimmer - SPF | 1.50"          | 1.50"     | 1.50"    | 769                     | 741       | 1509     | None        |

| Lateral Bracing  | Bracing Intervals | Comments |
|------------------|-------------------|----------|
| Top Edge (Lu)    | 6' 3" o/c         |          |
| Bottom Edge (Lu) | 6' 3" o/c         |          |

•Maximum allowable bracing intervals based on applied load.

| Vertical Loads        | Location   | Tributary Width | Dead (0.90) | Roof Live (non-snow: 1.25) | Comments                                |
|-----------------------|------------|-----------------|-------------|----------------------------|---|
| 0 - Self Weight (PLF) | 0 to 6' 3" | N/A             | 10.4        | --                         |   |
| 1 - Uniform (PLF)     | 0 to 6' 3" | N/A             | 160.0       | 174.0                      | Linked from: Roof: Rafter B1, Support 1 |
| 2 - Uniform (PLF)     | 0 to 6' 3" | N/A             | 75.5        | 63.0                       | Linked from: Roof: Joist B2, Support 1  |

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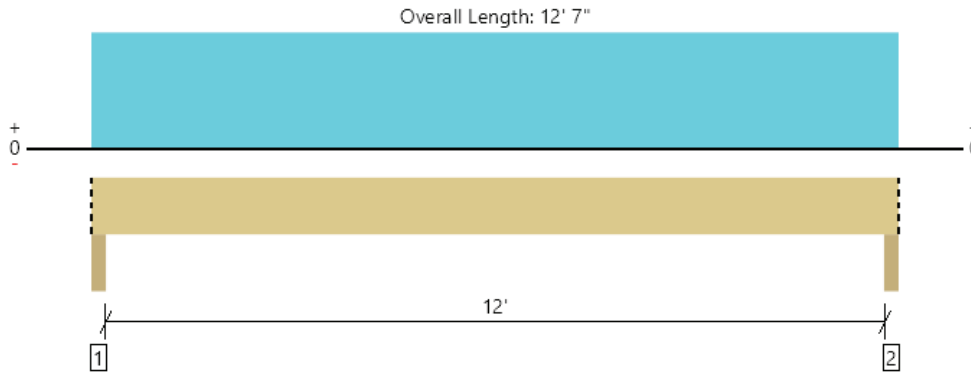
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Level, Porch: Beam B5  
**1 piece(s) 6 x 10 DF No.2**



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

| Design Results        | Actual @ Location | Allowed       | Result         | LDF  | Load: Combination (Pattern) |
|-----------------------|-------------------|---------------|----------------|------|-----------------------------|
| Member Reaction (lbs) | 2185 @ 2"         | 12031 (3.50") | Passed (18%)   | --   | 1.0 D + 1.0 Lr (All Spans)  |
| Shear (lbs)           | 1809 @ 1' 1"      | 7402          | Passed (24%)   | 1.25 | 1.0 D + 1.0 Lr (All Spans)  |
| Moment (Ft-lbs)       | 6513 @ 6' 3 1/2"  | 7540          | Passed (86%)   | 1.25 | 1.0 D + 1.0 Lr (All Spans)  |
| Live Load Defl. (in)  | 0.173 @ 6' 3 1/2" | 0.306         | Passed (L/852) | --   | 1.0 D + 1.0 Lr (All Spans)  |
| Total Load Defl. (in) | 0.344 @ 6' 3 1/2" | 0.613         | Passed (L/427) | --   | 1.0 D + 1.0 Lr (All Spans)  |

System : Floor  
 Member Type : Drop Beam  
 Building Use : Residential  
 Building Code : IBC 2021  
 Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Lumber grading provisions must be extended over the length of the member per NDS 4.2.5.5.
- Applicable calculations are based on NDS.

| Supports         | Bearing Length |           |          | Loads to Supports (lbs) |           |          | Accessories |
|------------------|----------------|-----------|----------|-------------------------|-----------|----------|-------------|
|                  | Total          | Available | Required | Dead                    | Roof Live | Factored |             |
| 1 - Column - SPF | 3.50"          | 3.50"     | 1.50"    | 1090                    | 1095      | 2185     | Blocking    |
| 2 - Column - SPF | 3.50"          | 3.50"     | 1.50"    | 1090                    | 1095      | 2185     | 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' 7" o/c        |          |
| Bottom Edge (Lu) | 12' 7" o/c        |          |

•Maximum allowable bracing intervals based on applied load.

| Vertical Loads        | Location (Side)     | Tributary Width | Dead (0.90) | Roof Live (non-snow: 1.25) | Comments                                |
|-----------------------|---------------------|-----------------|-------------|----------------------------|---|
| 0 - Self Weight (PLF) | 0 to 12' 7"         | N/A             | 13.2        | --                         |   |
| 1 - Uniform (PLF)     | 0 to 12' 7" (Front) | N/A             | 160.0       | 174.0                      | Linked from: Roof: Rafter B1, Support 1 |

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**General Footing**

Project File: 23M-007 Orland ADU's.ec6

LIC# : KW-06012341, Build:20.23.2.14

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**DESCRIPTION:** F1, Cont. Ftg.

**Code References**

Calculations per ACI 318-19, IBC 2021, ASCE 7-16  
 Load Combinations Used : ASCE 7-16

**General Information**

**Material Properties**

|   |   |             |
|---|---|-------------|
| f <sub>c</sub> : Concrete 28 day strength | = | 2.50 ksi    |
| f <sub>y</sub> : Rebar Yield              | = | 60.0 ksi    |
| E <sub>c</sub> : Concrete Elastic Modulus | = | 3,122.0 ksi |
| Concrete Density                          | = | 145.0 pcf   |
| φ Values Flexure                          | = | 0.90        |
| Shear                                     | = | 0.750       |

**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      |

**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      |

**Increases based on footing depth**

|  |   |           |
|--|---|-----------|
| Footing base depth below soil surface                              | = | ft        |
| Allow press. increase per foot of depth when footing base is below | = | ksf<br>ft |

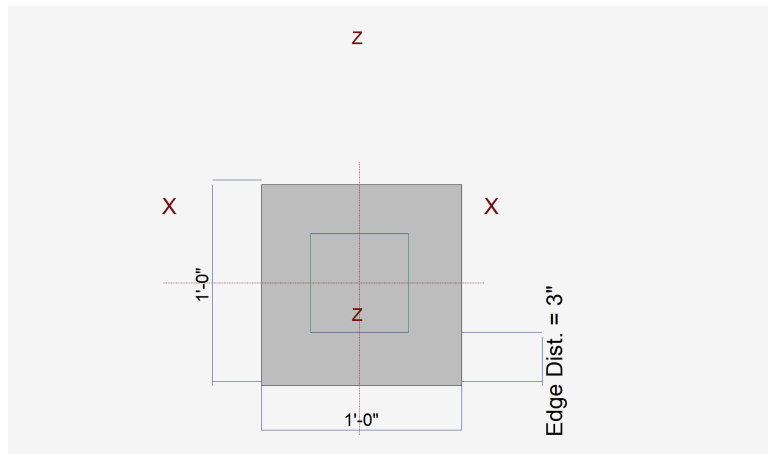
**Increases based on footing plan dimension**

|   |   |           |
|---|---|-----------|
| Allowable pressure increase per foot of depth when max. length or width is greater than | = | ksf<br>ft |
|---|---|-----------|

**Dimensions**

|                             |   |         |
|-----------------------------|---|---------|
| Width parallel to X-X Axis  | = | 1.0 ft  |
| Length parallel to Z-Z Axis | = | 1.0 ft  |
| Footing Thickness           | = | 12.0 in |

|  |   |        |
|--|---|--------|
| Pedestal dimensions...                                       | = | in     |
| 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 |



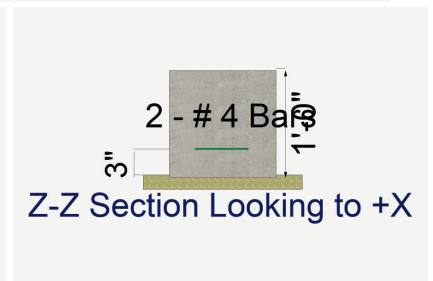
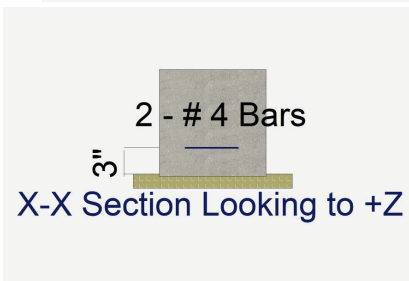
**Reinforcing**

|                           |   |     |
|---------------------------|---|-----|
| Bars parallel to X-X Axis | = |     |
| Number of Bars            | = | 2.0 |
| Reinforcing Bar Size      | = | # 4 |

|                           |   |     |
|---------------------------|---|-----|
| Bars parallel to Z-Z Axis | = |     |
| Number of Bars            | = | 2.0 |
| 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 | L <sub>r</sub> | L     | S | W   | E | H    |
|-----------------|---|----------------|-------|---|-----|---|------|
| P : Column Load | = | 0.310          | 0.360 |   | 0.0 |   | k    |
| OB : Overburden | = |                |       |   |     |   | ksf  |
| M-xx            | = |                |       |   |     |   | k-ft |
| M-zz            | = |                |       |   |     |   | k-ft |
| V-x             | = |                |       |   |     |   | k    |
| V-z             | = |                |       |   |     |   | k    |

**General Footing**

Project File: 23M-007 Orland ADU's.ec6

LIC# : KW-06012341, Build:20.23.2.14

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**DESCRIPTION:** F1, Cont. Ftg.

**DESIGN SUMMARY**

**Design OK**

|      | Min. Ratio | Item              | Applied        | Capacity       | Governing Load Combination |
|------|------------|-------------------|----------------|----------------|----------------------------|
| PASS | 0.5433     | Soil Bearing      | 0.8150 ksf     | 1.50 ksf       | +D+Lr 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 | 0.007718   | Z Flexure (+X)    | 0.1185 k-ft/ft | 15.353 k-ft/ft | +1.20D+1.60Lr              |
| PASS | 0.007718   | Z Flexure (-X)    | 0.1185 k-ft/ft | 15.353 k-ft/ft | +1.20D+1.60Lr              |
| PASS | 0.007718   | X Flexure (+Z)    | 0.1185 k-ft/ft | 15.353 k-ft/ft | +1.20D+1.60Lr              |
| PASS | 0.007718   | X Flexure (-Z)    | 0.1185 k-ft/ft | 15.353 k-ft/ft | +1.20D+1.60Lr              |
| PASS | n/a        | 1-way Shear (+X)  | 0.0 psi        | 75.0 psi       | n/a                        |
| PASS | 0.0        | 1-way Shear (-X)  | 0.0 psi        | 0.0 psi        | n/a                        |
| PASS | n/a        | 1-way Shear (+Z)  | 0.0 psi        | 75.0 psi       | n/a                        |
| PASS | n/a        | 1-way Shear (-Z)  | 0.0 psi        | 75.0 psi       | n/a                        |
| PASS | n/a        | 2-way Punching    | 1.236 psi      | 75.0 psi       | +1.20D+1.60Lr              |

**Detailed Results**

**Soil Bearing**

| Rotation Axis & Load Combination... | Gross Allowable | Xecc      |     | Actual Soil Bearing Stress @ Location |         |          |           | Actual / Allow Ratio |
|-------------------------------------|-----------------|-----------|-----|---------------------------------------|---------|----------|-----------|----------------------|
|                                     |                 | Zecc (in) |     | Bottom, -Z                            | Top, +Z | Left, -X | Right, +X |                      |
| X-X, D Only                         | 1.50            | n/a       | 0.0 | 0.4550                                | 0.4550  | n/a      | n/a       | 0.303                |
| X-X, +D+Lr                          | 1.50            | n/a       | 0.0 | 0.8150                                | 0.8150  | n/a      | n/a       | 0.543                |
| X-X, +D+0.750Lr                     | 1.50            | n/a       | 0.0 | 0.7250                                | 0.7250  | n/a      | n/a       | 0.483                |
| X-X, +0.60D                         | 1.50            | n/a       | 0.0 | 0.2730                                | 0.2730  | n/a      | n/a       | 0.182                |
| Z-Z, D Only                         | 1.50            | 0.0       | n/a | n/a                                   | n/a     | 0.4550   | 0.4550    | 0.303                |
| Z-Z, +D+Lr                          | 1.50            | 0.0       | n/a | n/a                                   | n/a     | 0.8150   | 0.8150    | 0.543                |
| Z-Z, +D+0.750Lr                     | 1.50            | 0.0       | n/a | n/a                                   | n/a     | 0.7250   | 0.7250    | 0.483                |
| Z-Z, +0.60D                         | 1.50            | 0.0       | n/a | n/a                                   | n/a     | 0.2730   | 0.2730    | 0.182                |

**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                     | 0.05425 | +Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +1.40D                     | 0.05425 | -Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +1.20D+0.50Lr              | 0.0690  | +Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +1.20D+0.50Lr              | 0.0690  | -Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +1.20D                     | 0.04650 | +Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +1.20D                     | 0.04650 | -Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +1.20D+1.60Lr              | 0.1185  | +Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +1.20D+1.60Lr              | 0.1185  | -Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +0.90D                     | 0.03488 | +Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +0.90D                     | 0.03488 | -Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| Z-Z, +1.40D                     | 0.05425 | -X   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| Z-Z, +1.40D                     | 0.05425 | +X   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| Z-Z, +1.20D+0.50Lr              | 0.0690  | -X   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| Z-Z, +1.20D+0.50Lr              | 0.0690  | +X   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| Z-Z, +1.20D                     | 0.04650 | -X   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| Z-Z, +1.20D                     | 0.04650 | +X   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| Z-Z, +1.20D+1.60Lr              | 0.1185  | -X   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |

**General Footing**

Project File: 23M-007 Orland ADU's.ec6

LIC# : KW-06012341, Build:20.23.2.14

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**DESCRIPTION:** F1, Cont. Ftg.

**Footing Flexure**

| Flexure Axis & Load Combination | Mu<br>k-ft | Side | Tension<br>Surface | As Req'd<br>in^2 | Gvrn. As<br>in^2 | Actual As<br>in^2 | Phi*Mn<br>k-ft | Status |
|---------------------------------|------------|------|--------------------|------------------|------------------|-------------------|----------------|--------|
| Z-Z, +1.20D+1.60Lr              | 0.1185     | +X   | Bottom             | 0.2592           | AsMin            | 0.40              | 15.353         | OK     |
| Z-Z, +0.90D                     | 0.03488    | -X   | Bottom             | 0.2592           | AsMin            | 0.40              | 15.353         | OK     |
| Z-Z, +0.90D                     | 0.03488    | +X   | Bottom             | 0.2592           | AsMin            | 0.40              | 15.353         | OK     |

**One Way Shear**

| Load Combination... | Vu @ -X  | Vu @ +X  | Vu @ -Z  | Vu @ +Z  | Vu:Max   | Phi Vn    | Vu / Phi*Vn | Status |
|---------------------|----------|----------|----------|----------|----------|-----------|-------------|--------|
| +1.40D              | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 75.00 psi | 0.00        | OK     |
| +1.20D+0.50Lr       | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 75.00 psi | 0.00        | OK     |
| +1.20D              | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 75.00 psi | 0.00        | OK     |
| +1.20D+1.60Lr       | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 75.00 psi | 0.00        | OK     |
| +0.90D              | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 75.00 psi | 0.00        | OK     |

**Two-Way "Punching" Shear**

| Load Combination... | Vu       | Phi*Vn    | Vu / Phi*Vn | Status |
|---------------------|----------|-----------|-------------|--------|
| +1.40D              | 0.57 psi | 150.00psi | 0.003772    | OK     |
| +1.20D+0.50Lr       | 0.72 psi | 150.00psi | 0.004798    | OK     |
| +1.20D              | 0.49 psi | 150.00psi | 0.003233    | OK     |
| +1.20D+1.60Lr       | 1.24 psi | 150.00psi | 0.008239    | OK     |
| +0.90D              | 0.36 psi | 150.00psi | 0.002425    | OK     |

All units k

**General Footing**

Project File: 23M-007 Orland ADU's.ec6

LIC# : KW-06012341, Build:20.23.2.14

Jackson & Sands Engineering

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**DESCRIPTION:** F2, Int. Beam Ftg.

**Code References**

Calculations per ACI 318-19, IBC 2021, ASCE 7-16  
 Load Combinations Used : ASCE 7-16

**General Information**

**Material Properties**

|   |   |             |
|---|---|-------------|
| f <sub>c</sub> : Concrete 28 day strength | = | 2.50 ksi    |
| f <sub>y</sub> : Rebar Yield              | = | 60.0 ksi    |
| E <sub>c</sub> : Concrete Elastic Modulus | = | 3,122.0 ksi |
| Concrete Density                          | = | 145.0 pcf   |
| φ Values Flexure                          | = | 0.90        |
| Shear                                     | = | 0.750       |

**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      |

**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      |

**Increases based on footing depth**

|  |   |           |
|--|---|-----------|
| Footing base depth below soil surface                              | = | ft        |
| Allow press. increase per foot of depth when footing base is below | = | ksf<br>ft |

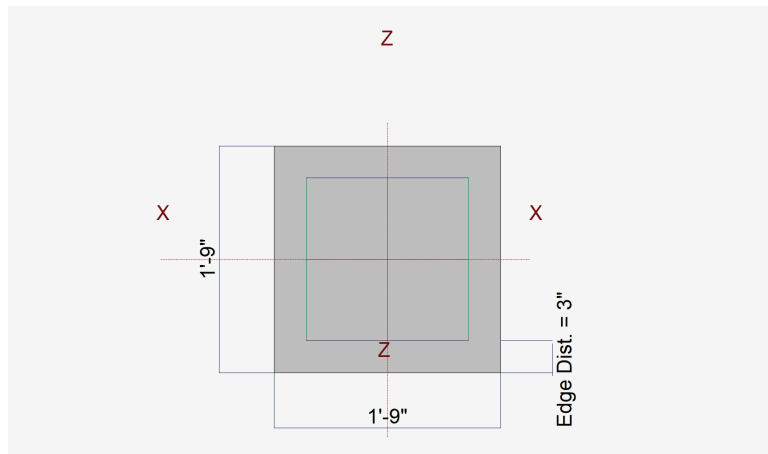
**Increases based on footing plan dimension**

|   |   |           |
|---|---|-----------|
| Allowable pressure increase per foot of depth when max. length or width is greater than | = | ksf<br>ft |
|---|---|-----------|

**Dimensions**

|                             |   |          |
|-----------------------------|---|----------|
| Width parallel to X-X Axis  | = | 1.750 ft |
| Length parallel to Z-Z Axis | = | 1.750 ft |
| Footing Thickness           | = | 12.0 in  |

|  |   |        |
|--|---|--------|
| Pedestal dimensions...                                       | = | in     |
| 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 |



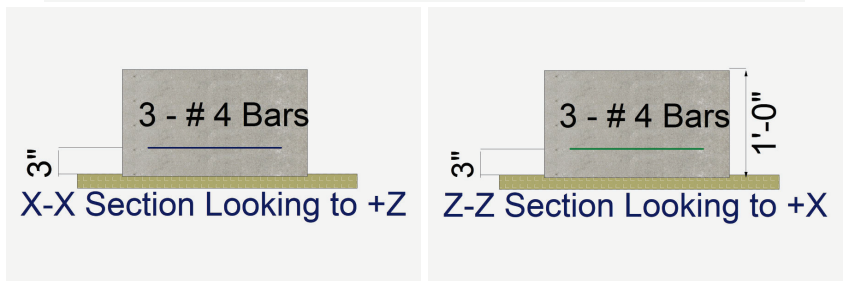
**Reinforcing**

|                           |   |     |
|---------------------------|---|-----|
| Bars parallel to X-X Axis | = |     |
| Number of Bars            | = | 3.0 |
| Reinforcing Bar Size      | = | # 4 |

|                           |   |     |
|---------------------------|---|-----|
| Bars parallel to Z-Z Axis | = |     |
| Number of Bars            | = | 3.0 |
| 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 | L <sub>r</sub> | L    | S    | W   | E | H |      |
|-----------------|---|----------------|------|------|-----|---|---|------|
| P : Column Load | = | 1.50           | 1.40 | 1.60 | 0.0 |   |   | k    |
| OB : Overburden | = |                |      |      |     |   |   | ksf  |
| M-xx            | = |                |      |      |     |   |   | k-ft |
| M-zz            | = |                |      |      |     |   |   | k-ft |
| V-x             | = |                |      |      |     |   |   | k    |
| V-z             | = |                |      |      |     |   |   | k    |

**General Footing**

Project File: 23M-007 Orland ADU's.ec6

LIC# : KW-06012341, Build:20.23.2.14

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**DESCRIPTION: F2, Int. Beam Ftg.**

**DESIGN SUMMARY**

**Design OK**

|      | Min. Ratio | Item              | Applied        | Capacity       | Governing Load Combination       |
|------|------------|-------------------|----------------|----------------|----------------------------------|
| PASS | 0.9127     | Soil Bearing      | 1.369 ksf      | 1.50 ksf       | +D+0.750Lr+0.750L 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 | 0.05315    | Z Flexure (+X)    | 0.7050 k-ft/ft | 13.263 k-ft/ft | +1.20D+1.60Lr+L                  |
| PASS | 0.05315    | Z Flexure (-X)    | 0.7050 k-ft/ft | 13.263 k-ft/ft | +1.20D+1.60Lr+L                  |
| PASS | 0.05315    | X Flexure (+Z)    | 0.7050 k-ft/ft | 13.263 k-ft/ft | +1.20D+1.60Lr+L                  |
| PASS | 0.05315    | X Flexure (-Z)    | 0.7050 k-ft/ft | 13.263 k-ft/ft | +1.20D+1.60Lr+L                  |
| PASS | 0.02785    | 1-way Shear (+X)  | 2.089 psi      | 75.0 psi       | +1.20D+1.60Lr+L                  |
| PASS | 0.02785    | 1-way Shear (-X)  | 2.089 psi      | 75.0 psi       | +1.20D+1.60Lr+L                  |
| PASS | 0.02785    | 1-way Shear (+Z)  | 2.089 psi      | 75.0 psi       | +1.20D+1.60Lr+L                  |
| PASS | 0.02785    | 1-way Shear (-Z)  | 2.089 psi      | 75.0 psi       | +1.20D+1.60Lr+L                  |
| PASS | 0.09558    | 2-way Punching    | 14.337 psi     | 150.0 psi      | +1.20D+1.60Lr+L                  |

**Detailed Results**

**Soil Bearing**

| Rotation Axis & Load Combination... | Gross Allowable | Xecc | Zecc (in) | Actual Soil Bearing Stress @ Location |         |          |           | Actual / Allow Ratio |
|-------------------------------------|-----------------|------|-----------|---------------------------------------|---------|----------|-----------|----------------------|
|                                     |                 |      |           | Bottom, -Z                            | Top, +Z | Left, -X | Right, +X |                      |
| X-X, D Only                         | 1.50            | n/a  | 0.0       | 0.6348                                | 0.6348  | n/a      | n/a       | 0.423                |
| X-X, +D+L                           | 1.50            | n/a  | 0.0       | 1.157                                 | 1.157   | n/a      | n/a       | 0.771                |
| X-X, +D+Lr                          | 1.50            | n/a  | 0.0       | 1.092                                 | 1.092   | n/a      | n/a       | 0.728                |
| X-X, +D+0.750Lr+0.750L              | 1.50            | n/a  | 0.0       | 1.369                                 | 1.369   | n/a      | n/a       | 0.913                |
| X-X, +D+0.750L                      | 1.50            | n/a  | 0.0       | 1.027                                 | 1.027   | n/a      | n/a       | 0.685                |
| X-X, +0.60D                         | 1.50            | n/a  | 0.0       | 0.3809                                | 0.3809  | n/a      | n/a       | 0.254                |
| Z-Z, D Only                         | 1.50            | 0.0  | n/a       | n/a                                   | n/a     | 0.6348   | 0.6348    | 0.423                |
| Z-Z, +D+L                           | 1.50            | 0.0  | n/a       | n/a                                   | n/a     | 1.157    | 1.157     | 0.771                |
| Z-Z, +D+Lr                          | 1.50            | 0.0  | n/a       | n/a                                   | n/a     | 1.092    | 1.092     | 0.728                |
| Z-Z, +D+0.750Lr+0.750L              | 1.50            | 0.0  | n/a       | n/a                                   | n/a     | 1.369    | 1.369     | 0.913                |
| Z-Z, +D+0.750L                      | 1.50            | 0.0  | n/a       | n/a                                   | n/a     | 1.027    | 1.027     | 0.685                |
| Z-Z, +0.60D                         | 1.50            | 0.0  | n/a       | n/a                                   | n/a     | 0.3809   | 0.3809    | 0.254                |

**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                     | 0.2625  | +Z   | Bottom          | 0.2592        | AsMin         | 0.3429         | 13.263      | OK     |
| X-X, +1.40D                     | 0.2625  | -Z   | Bottom          | 0.2592        | AsMin         | 0.3429         | 13.263      | OK     |
| X-X, +1.20D+0.50Lr+1.60L        | 0.6325  | +Z   | Bottom          | 0.2592        | AsMin         | 0.3429         | 13.263      | OK     |
| X-X, +1.20D+0.50Lr+1.60L        | 0.6325  | -Z   | Bottom          | 0.2592        | AsMin         | 0.3429         | 13.263      | OK     |
| X-X, +1.20D+1.60L               | 0.5450  | +Z   | Bottom          | 0.2592        | AsMin         | 0.3429         | 13.263      | OK     |
| X-X, +1.20D+1.60L               | 0.5450  | -Z   | Bottom          | 0.2592        | AsMin         | 0.3429         | 13.263      | OK     |
| X-X, +1.20D+1.60Lr+L            | 0.7050  | +Z   | Bottom          | 0.2592        | AsMin         | 0.3429         | 13.263      | OK     |
| X-X, +1.20D+1.60Lr+L            | 0.7050  | -Z   | Bottom          | 0.2592        | AsMin         | 0.3429         | 13.263      | OK     |
| X-X, +1.20D+1.60Lr              | 0.5050  | +Z   | Bottom          | 0.2592        | AsMin         | 0.3429         | 13.263      | OK     |
| X-X, +1.20D+1.60Lr              | 0.5050  | -Z   | Bottom          | 0.2592        | AsMin         | 0.3429         | 13.263      | OK     |
| X-X, +1.20D+L                   | 0.4250  | +Z   | Bottom          | 0.2592        | AsMin         | 0.3429         | 13.263      | OK     |
| X-X, +1.20D+L                   | 0.4250  | -Z   | Bottom          | 0.2592        | AsMin         | 0.3429         | 13.263      | OK     |
| X-X, +1.20D                     | 0.2250  | +Z   | Bottom          | 0.2592        | AsMin         | 0.3429         | 13.263      | OK     |



**General Footing**

Project File: 23M-007 Orland ADU's.ec6

LIC# : KW-06012341, Build:20.23.2.14

Jackson & Sands Engineering

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**DESCRIPTION: F2, Int. Beam Ftg.**

**Footing Flexure**

| Flexure Axis & Load Combination | Mu<br>k-ft | Side | Tension<br>Surface | As Req'd<br>in^2 | Gvrn. As<br>in^2 | Actual As<br>in^2 | Phi*Mn<br>k-ft | Status |
|---------------------------------|------------|------|--------------------|------------------|------------------|-------------------|----------------|--------|
| X-X, +1.20D                     | 0.2250     | -Z   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| X-X, +1.20D+0.50Lr+L            | 0.5125     | +Z   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| X-X, +1.20D+0.50Lr+L            | 0.5125     | -Z   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| X-X, +0.90D                     | 0.1688     | +Z   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| X-X, +0.90D                     | 0.1688     | -Z   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +1.40D                     | 0.2625     | -X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +1.40D                     | 0.2625     | +X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +1.20D+0.50Lr+1.60L        | 0.6325     | -X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +1.20D+0.50Lr+1.60L        | 0.6325     | +X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +1.20D+1.60L               | 0.5450     | -X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +1.20D+1.60L               | 0.5450     | +X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +1.20D+1.60Lr+L            | 0.7050     | -X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +1.20D+1.60Lr+L            | 0.7050     | +X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +1.20D+1.60Lr              | 0.5050     | -X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +1.20D+1.60Lr              | 0.5050     | +X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +1.20D+L                   | 0.4250     | -X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +1.20D+L                   | 0.4250     | +X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +1.20D                     | 0.2250     | -X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +1.20D                     | 0.2250     | +X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +1.20D+0.50Lr+L            | 0.5125     | -X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +1.20D+0.50Lr+L            | 0.5125     | +X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +0.90D                     | 0.1688     | -X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |
| Z-Z, +0.90D                     | 0.1688     | +X   | Bottom             | 0.2592           | AsMin            | 0.3429            | 13.263         | OK     |

**One Way Shear**

| Load Combination... | Vu @ -X  | Vu @ +X  | Vu @ -Z  | Vu @ +Z  | Vu:Max   | Phi Vn    | Vu / Phi*Vn | Status |
|---------------------|----------|----------|----------|----------|----------|-----------|-------------|--------|
| +1.40D              | 0.78 psi | 0.78 psi | 0.78 psi | 0.78 psi | 0.78 psi | 75.00 psi | 0.01        | OK     |
| +1.20D+0.50Lr+1.60L | 1.87 psi | 1.87 psi | 1.87 psi | 1.87 psi | 1.87 psi | 75.00 psi | 0.02        | OK     |
| +1.20D+1.60L        | 1.62 psi | 1.62 psi | 1.62 psi | 1.62 psi | 1.62 psi | 75.00 psi | 0.02        | OK     |
| +1.20D+1.60Lr+L     | 2.09 psi | 2.09 psi | 2.09 psi | 2.09 psi | 2.09 psi | 75.00 psi | 0.03        | OK     |
| +1.20D+1.60Lr       | 1.50 psi | 1.50 psi | 1.50 psi | 1.50 psi | 1.50 psi | 75.00 psi | 0.02        | OK     |
| +1.20D+L            | 1.26 psi | 1.26 psi | 1.26 psi | 1.26 psi | 1.26 psi | 75.00 psi | 0.02        | OK     |
| +1.20D              | 0.67 psi | 0.67 psi | 0.67 psi | 0.67 psi | 0.67 psi | 75.00 psi | 0.01        | OK     |
| +1.20D+0.50Lr+L     | 1.52 psi | 1.52 psi | 1.52 psi | 1.52 psi | 1.52 psi | 75.00 psi | 0.02        | OK     |
| +0.90D              | 0.50 psi | 0.50 psi | 0.50 psi | 0.50 psi | 0.50 psi | 75.00 psi | 0.01        | OK     |

**Two-Way "Punching" Shear**

All units k

| Load Combination... | Vu        | Phi*Vn    | Vu / Phi*Vn | Status |
|---------------------|-----------|-----------|-------------|--------|
| +1.40D              | 5.34 psi  | 150.00psi | 0.03559     | OK     |
| +1.20D+0.50Lr+1.60L | 12.86 psi | 150.00psi | 0.08575     | OK     |
| +1.20D+1.60L        | 11.08 psi | 150.00psi | 0.07389     | OK     |
| +1.20D+1.60Lr+L     | 14.34 psi | 150.00psi | 0.09558     | OK     |
| +1.20D+1.60Lr       | 10.27 psi | 150.00psi | 0.06846     | OK     |
| +1.20D+L            | 8.64 psi  | 150.00psi | 0.05762     | OK     |
| +1.20D              | 4.58 psi  | 150.00psi | 0.0305      | OK     |
| +1.20D+0.50Lr+L     | 10.42 psi | 150.00psi | 0.06948     | OK     |
| +0.90D              | 3.43 psi  | 150.00psi | 0.02288     | OK     |

**General Footing**

Project File: 23M-007 Orland ADU's.ec6

LIC# : KW-06012341, Build:20.23.2.14

Jackson & Sands Engineering

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**DESCRIPTION:** F3, Front Porch Pier

**Code References**

Calculations per ACI 318-19, IBC 2021, ASCE 7-16  
 Load Combinations Used : ASCE 7-16

**General Information**

**Material Properties**

|   |   |             |
|---|---|-------------|
| f <sub>c</sub> : Concrete 28 day strength | = | 2.50 ksi    |
| f <sub>y</sub> : Rebar Yield              | = | 60.0 ksi    |
| E <sub>c</sub> : Concrete Elastic Modulus | = | 3,122.0 ksi |
| Concrete Density                          | = | 145.0 pcf   |
| φ Values Flexure                          | = | 0.90        |
| Shear                                     | = | 0.750       |

**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      |

**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      |

**Increases based on footing Depth**

|  |   |           |
|--|---|-----------|
| Footing base depth below soil surface                              | = | ft        |
| Allow press. increase per foot of depth when footing base is below | = | ksf<br>ft |

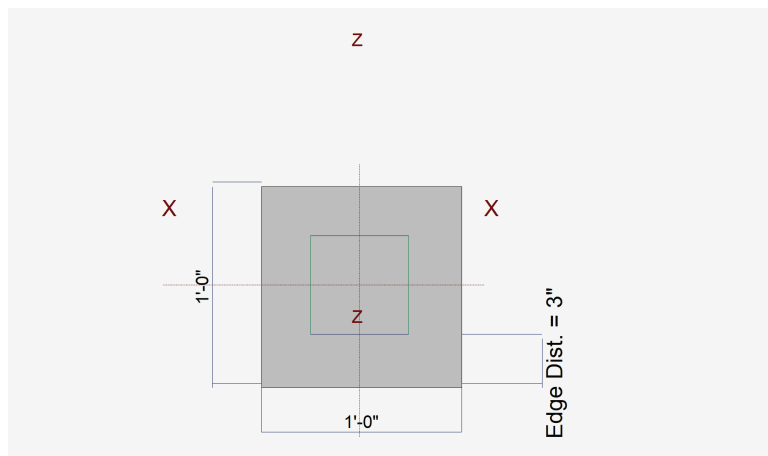
**Increases based on footing plan dimension**

|   |   |           |
|---|---|-----------|
| Allowable pressure increase per foot of depth when max. length or width is greater than | = | ksf<br>ft |
|---|---|-----------|

**Dimensions**

|                             |   |         |
|-----------------------------|---|---------|
| Width parallel to X-X Axis  | = | 1.0 ft  |
| Length parallel to Z-Z Axis | = | 1.0 ft  |
| Footing Thickness           | = | 12.0 in |

|  |   |        |
|--|---|--------|
| Pedestal dimensions...                                       | = | in     |
| 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 |



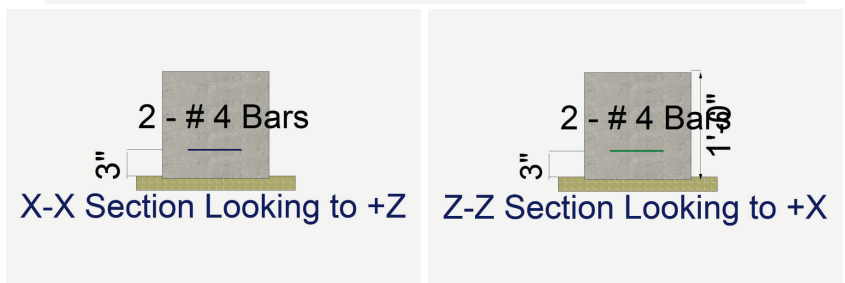
**Reinforcing**

|                           |   |     |
|---------------------------|---|-----|
| Bars parallel to X-X Axis | = |     |
| Number of Bars            | = | 2.0 |
| Reinforcing Bar Size      | = | # 4 |

|                           |   |     |
|---------------------------|---|-----|
| Bars parallel to Z-Z Axis | = |     |
| Number of Bars            | = | 2.0 |
| 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 | L <sub>r</sub> | L      | S | W   | E | H    |
|-----------------|---|----------------|--------|---|-----|---|------|
| P : Column Load | = | 0.3720         | 0.3910 |   | 0.0 |   | k    |
| OB : Overburden | = |                |        |   |     |   | ksf  |
| M-xx            | = |                |        |   |     |   | k-ft |
| M-zz            | = |                |        |   |     |   | k-ft |
| V-x             | = |                |        |   |     |   | k    |
| V-z             | = |                |        |   |     |   | k    |

**General Footing**

Project File: 23M-007 Orland ADU's.ec6

LIC# : KW-06012341, Build:20.23.2.14

Jackson & Sands Engineering

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**DESCRIPTION:** F3, Front Porch Pier

**DESIGN SUMMARY**

**Design OK**

|      | Min. Ratio | Item              | Applied        | Capacity       | Governing Load Combination |
|------|------------|-------------------|----------------|----------------|----------------------------|
| PASS | 0.6053     | Soil Bearing      | 0.9080 ksf     | 1.50 ksf       | +D+Lr 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 | 0.008728   | Z Flexure (+X)    | 0.1340 k-ft/ft | 15.353 k-ft/ft | +1.20D+1.60Lr              |
| PASS | 0.008728   | Z Flexure (-X)    | 0.1340 k-ft/ft | 15.353 k-ft/ft | +1.20D+1.60Lr              |
| PASS | 0.008728   | X Flexure (+Z)    | 0.1340 k-ft/ft | 15.353 k-ft/ft | +1.20D+1.60Lr              |
| PASS | 0.008728   | X Flexure (-Z)    | 0.1340 k-ft/ft | 15.353 k-ft/ft | +1.20D+1.60Lr              |
| PASS | n/a        | 1-way Shear (+X)  | 0.0 psi        | 75.0 psi       | n/a                        |
| PASS | 0.0        | 1-way Shear (-X)  | 0.0 psi        | 0.0 psi        | n/a                        |
| PASS | n/a        | 1-way Shear (+Z)  | 0.0 psi        | 75.0 psi       | n/a                        |
| PASS | n/a        | 1-way Shear (-Z)  | 0.0 psi        | 75.0 psi       | n/a                        |
| PASS | n/a        | 2-way Punching    | 1.398 psi      | 75.0 psi       | +1.20D+1.60Lr              |

**Detailed Results**

**Soil Bearing**

| Rotation Axis & Load Combination... | Gross Allowable | Xecc      |     | Actual Soil Bearing Stress @ Location |         |          |           | Actual / Allow Ratio |
|-------------------------------------|-----------------|-----------|-----|---------------------------------------|---------|----------|-----------|----------------------|
|                                     |                 | Zecc (in) |     | Bottom, -Z                            | Top, +Z | Left, -X | Right, +X |                      |
| X-X, D Only                         | 1.50            | n/a       | 0.0 | 0.5170                                | 0.5170  | n/a      | n/a       | 0.345                |
| X-X, +D+Lr                          | 1.50            | n/a       | 0.0 | 0.9080                                | 0.9080  | n/a      | n/a       | 0.605                |
| X-X, +D+0.750Lr                     | 1.50            | n/a       | 0.0 | 0.8103                                | 0.8103  | n/a      | n/a       | 0.540                |
| X-X, +0.60D                         | 1.50            | n/a       | 0.0 | 0.3102                                | 0.3102  | n/a      | n/a       | 0.207                |
| Z-Z, D Only                         | 1.50            | 0.0       | n/a | n/a                                   | n/a     | 0.5170   | 0.5170    | 0.345                |
| Z-Z, +D+Lr                          | 1.50            | 0.0       | n/a | n/a                                   | n/a     | 0.9080   | 0.9080    | 0.605                |
| Z-Z, +D+0.750Lr                     | 1.50            | 0.0       | n/a | n/a                                   | n/a     | 0.8103   | 0.8103    | 0.540                |
| Z-Z, +0.60D                         | 1.50            | 0.0       | n/a | n/a                                   | n/a     | 0.3102   | 0.3102    | 0.207                |

**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                     | 0.06510 | +Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +1.40D                     | 0.06510 | -Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +1.20D+0.50Lr              | 0.08024 | +Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +1.20D+0.50Lr              | 0.08024 | -Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +1.20D                     | 0.05580 | +Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +1.20D                     | 0.05580 | -Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +1.20D+1.60Lr              | 0.1340  | +Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +1.20D+1.60Lr              | 0.1340  | -Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +0.90D                     | 0.04185 | +Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| X-X, +0.90D                     | 0.04185 | -Z   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| Z-Z, +1.40D                     | 0.06510 | -X   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| Z-Z, +1.40D                     | 0.06510 | +X   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| Z-Z, +1.20D+0.50Lr              | 0.08024 | -X   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| Z-Z, +1.20D+0.50Lr              | 0.08024 | +X   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| Z-Z, +1.20D                     | 0.05580 | -X   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| Z-Z, +1.20D                     | 0.05580 | +X   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |
| Z-Z, +1.20D+1.60Lr              | 0.1340  | -X   | Bottom          | 0.2592        | AsMin         | 0.40           | 15.353      | OK     |

**General Footing**

Project File: 23M-007 Orland ADU's.ec6

LIC# : KW-06012341, Build:20.23.2.14

Jackson & Sands Engineering

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**DESCRIPTION: F3, Front Porch Pier**

**Footing Flexure**

| Flexure Axis & Load Combination | Mu<br>k-ft | Side | Tension<br>Surface | As Req'd<br>in^2 | Gvrn. As<br>in^2 | Actual As<br>in^2 | Phi*Mn<br>k-ft | Status |
|---------------------------------|------------|------|--------------------|------------------|------------------|-------------------|----------------|--------|
| Z-Z, +1.20D+1.60Lr              | 0.1340     | +X   | Bottom             | 0.2592           | AsMin            | 0.40              | 15.353         | OK     |
| Z-Z, +0.90D                     | 0.04185    | -X   | Bottom             | 0.2592           | AsMin            | 0.40              | 15.353         | OK     |
| Z-Z, +0.90D                     | 0.04185    | +X   | Bottom             | 0.2592           | AsMin            | 0.40              | 15.353         | OK     |

**One Way Shear**

| Load Combination... | Vu @ -X  | Vu @ +X  | Vu @ -Z  | Vu @ +Z  | Vu:Max   | Phi Vn    | Vu / Phi*Vn | Status |
|---------------------|----------|----------|----------|----------|----------|-----------|-------------|--------|
| +1.40D              | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 75.00 psi | 0.00        | OK     |
| +1.20D+0.50Lr       | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 75.00 psi | 0.00        | OK     |
| +1.20D              | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 75.00 psi | 0.00        | OK     |
| +1.20D+1.60Lr       | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 75.00 psi | 0.00        | OK     |
| +0.90D              | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 0.00 psi | 75.00 psi | 0.00        | OK     |

**Two-Way "Punching" Shear**

| Load Combination... | Vu       | Phi*Vn    | Vu / Phi*Vn | Status |
|---------------------|----------|-----------|-------------|--------|
| +1.40D              | 0.68 psi | 150.00psi | 0.004526    | OK     |
| +1.20D+0.50Lr       | 0.84 psi | 150.00psi | 0.005579    | OK     |
| +1.20D              | 0.58 psi | 150.00psi | 0.00388     | OK     |
| +1.20D+1.60Lr       | 1.40 psi | 150.00psi | 0.009317    | OK     |
| +0.90D              | 0.44 psi | 150.00psi | 0.00291     | OK     |

All units k