QUANTUM
CONSULTING ENGINEERS

July 26, 2018

**SUPPLEMENTAL STRUCTURAL CALCULATIONS**
(Permit Corrections #1)

**LEE-BOYLE RESIDENCE**
4150 Boulevard Place
Mercer Island, WA 98040

Quantum Job Number: 19052.01

*Prepared for:*
STUART SILK ARCHITECTS
2400 N. 45th Street
Seattle, WA 98103

*Prepared by:*
QUANTUM CONSULTING ENGINEERS
1511 Third Avenue, Suite 323
Seattle, WA 98101
TEL 206.957.3900
FAX 206.957.3901

SANDRO K. KODAMA
STATE OF WASHINGTON
36613
STRUCTURAL ENGINEER
PROFESSIONAL ENGINEER

QUANTUM | CONSULTING ENGINEERS

LEE-BOYLE RESIDENCE
4150 78TH. AVE SE
MERCER ISLAND, WA

QUANTUM JOB NUMBER: 19052.01

# INDEX

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# STRUCTURAL DESIGN CRITERIA

LEE-BOYLE RESIDENCE
4150 78TH. AVE SE
MERCER ISLAND, WA

QUANTUM JOB NUMBER: 19052.01

CODE CRITERIA:

BUILDING CODE........2015 INTERNATIONAL BUILDING CODE
BUILDING DEPARTMENT........CITY OF MERCER ISLAND
WIND CRITERIA........110 MPH; EXPOSURE "C"
........RISK CATEGORY = II
........$K_{ZT}$= 1.00

SEISMIC ZONE........SDC = D
........SITE CLASS = D
........R = 6.5
........$I_E$ = 1.0
........$S_S$ = 1.411, $S_1$ = 0.543
........$S_{DS}$ = 0.941, $S_{D1}$ = 0.543
SNOW LOAD........~~25 PSF~~ 30 PSF
DECK LIVE LOAD........60 PSF
LIVE LOAD........40 PSF
PHOTOVOLTAIC SOLAR PANEL DEAD LOAD........5 PSF

SOILS CRITERIA:

ALLOWABLE BEARING PRESSURE........2,500 PSF
MINIMUM FOOTING WIDTH........CONTINUOUS: 18" MIN., ISOLATED: 24" MIN.
FROST DEPTH........18" MIN.
LATERAL EARTH PRESSURE (RESTRAINED/UNRESTRAINED)........55 PCF /35 PCF
SEISMIC SURCHARGE PRESSURE........6H PSF
TRAFFIC SURCHARGE PRESSURE (PASSENGER VEHICLE)........70 PSF
PASSIVE SOIL PRESSURE........300 PCF
COEFFICIENT OF FRICTION........0.40 PCF

MATERIALS CRITERIA:

CONCRETE (28 DAY STRENGTH):

FOUNDATION/S.O.G........F'C=2,500 PSI

REINFORCING STEEL:

GRADE 60 (#5 BAR OR LARGER)........FY=60,000 PSI
GRADE 40 (#4 BAR)........FY=40,000 PSI

WOOD FRAMING:

2X, 3X, & 4X FRAMING MBRS........HF#2 OR DF#2
6X FRAMING MBRS........DF#1
PARALLAM BEAMS........2.2E WS PARALLAM PSL
LSL MEMBERS – BEAMS & HEADERS........1.55E LSL
WOOD SHTG........APA RATED

**LEE-BOYLE RESIDENCE**
4150 78$^{TH}$. AVE SE
MERCER ISLAND, WA

QUANTUM JOB NUMBER: 19052.01

# GRAVITY DESIGN

# Concrete Beam

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**Lic. # : KW-06005835** **Licensee : QUANTUM CONSULTING ENGINEERS**

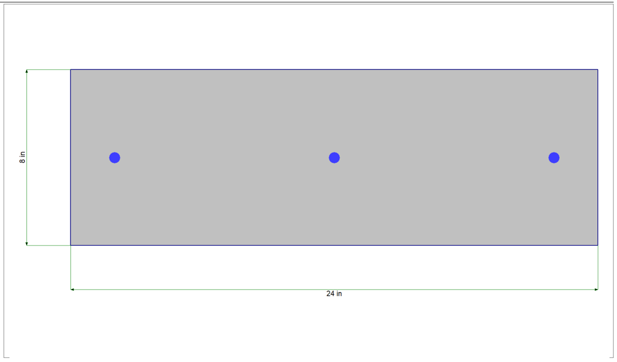
Description : Detail 12/S3.1 Retaining Wall at Crawl Space

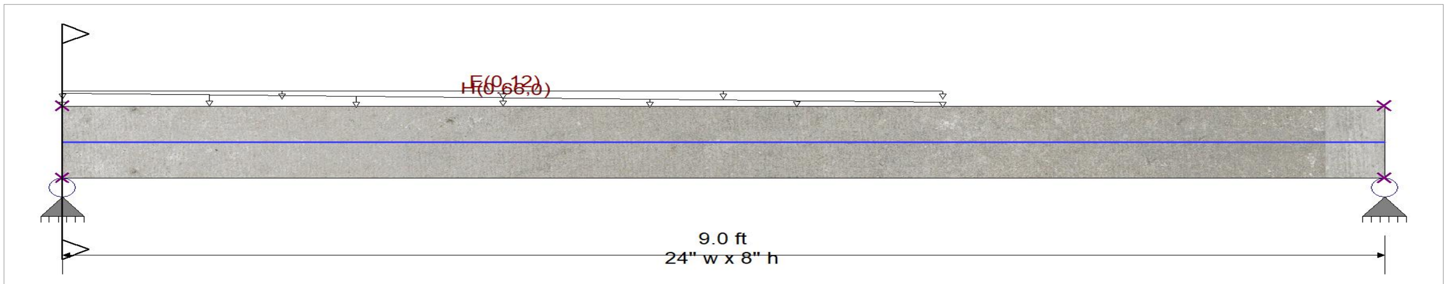
## *CODE REFERENCES*

Calculations per ACI 318-14, IBC 2015, CBC 2016, ASCE 7-10
Load Combination Set : ASCE 7-10

## Material Properties

| | | | | | | |
|---|---|---|---|---|---|---|
| f'c | = | 2.50 ksi | $\phi$ Phi Values | Flexure : | | 0.90 |
| fr = $f'c^{1/2}$ * 7.50 | = | 375.0 psi | | Shear : | | 0.750 |
| $\psi$ Density | = | 145.0 pcf | $\beta_1$ | | = | 0.850 |
| $\lambda$ LtWt Factor | = | 1.0 | | | | |
| Elastic Modulus | = | 2,850.0 ksi | Fy - Stirrups | | | 40.0 ksi |
| fy - Main Rebar | = | 40.0 ksi | E - Stirrups | | = | 29,000.0 ksi |
| E - Main Rebar | = | 29,000.0 ksi | Stirrup Bar Size # | | | 3 |
| | | | Number of Resisting Legs Per Stirrup = | | | 1 |




## Cross Section & Reinforcing Details

Rectangular Section, Width = 24.0 in, Height = 8.0 in
Span #1 Reinforcing....
3-#4 at 4.0 in from Top, from 0.0 to 9.0 ft in this span

## Applied Loads

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

Load for Span Number 1
Varying Uniform Load : H= 0.330->0.0 ksf, Extent = 0.0 -->> 6.0 ft, Trib Width = 2.0 ft, (Soil Load)

Uniform Load : E = 0.060 ksf, Extent = 0.0 -->> 6.0 ft, Tributary Width = 2.0 ft, (EQ)

## *DESIGN SUMMARY*

**Design OK**

| | | |
|---|---|---|
| Maximum Bending Stress Ratio = | **0.644** : 1 | |
| Section used for this span | **Typical Section** | |
| Mu : Applied | 4.366 | k-ft |
| Mn * Phi : Allowable | 6.776 | k-ft |
| Location of maximum on span | 3.344 | ft |
| Span # where maximum occurs | Span # 1 | |

| Maximum Deflection | | | |
|---|---|---|---|
| Max Downward Transient Deflection | 0.005 in | Ratio = | 23594 >=360. |
| Max Upward Transient Deflection | 0.000 in | Ratio = | 0 <360.0 |
| Max Downward Total Deflection | 0.013 in | Ratio = | 8284 >=180. |
| Max Upward Total Deflection | 0.000 in | Ratio = | 0 <180.0 |

## Vertical Reactions

Support notation : Far left is #1

| Load Combination | Support 1 | Support 2 |
|---|---|---|
| Overall MAXimum | 1.876 | 0.608 |
| Overall MINimum | 0.480 | 0.240 |
| H Only | 1.540 | 0.440 |
| +0.70E+H | 1.876 | 0.608 |
| +0.5250E+H | 1.792 | 0.566 |
| +0.60H | 0.924 | 0.264 |
| +0.70E+0.60H | 1.260 | 0.432 |
| E Only | 0.480 | 0.240 |

Wall is designed as a 2'-0" wide section of wall.
Top Reaction = [0.44 k + 0.7 (0.24 k)] / 2'-0"
Top Reaction = 0.3 klf or 0.4 k / joist @ 16" o.c.

10d Nail Capacity = 102 lb
Nails Req'd = 400 lb / 102 lb = 3.92 --> Provide (4) Nails Min.

# Concrete Beam





Description : Detail 12/S3.1 Retaining Wall at Crawl Space

## Overall Maximum Deflections

| Load Combination | Span | Max. "-" Defl (in) | Location in Span (ft) | Load Combination | Max. "+" Defl (in) | Location in Span (ft) |
|---|---|---|---|---|---|---|
| +0.70E+H | 1 | 0.0130 | 4.205 | | 0.0000 | 0.000 |

# Fastener Spacing in Weyerhaeuser Engineered Lumber Products

This technical bulletin provides fastener spacing and placement information for Weyerhaeuser engineered lumber products. It is intended to supplement what is included in Weyerhaeuser's code evaluation reports and product literature. Specifically, the document provides recommended on-center spacing and minimum end distances for fasteners in continuous patterns (i.e. diaphragm nailing). These guidelines do not apply to conditions including joist hangers, straps, and nailing of TJI® joists at bearing locations or other localized nailing applications. As with any connection in wood or wood based material, avoiding unacceptable splitting often dictates fastener spacing and placement. The recommendations given in the following tables are based on preventing splitting that propagates from fastener to fastener within the connection. Splitting can be reduced by installing nails at slight angles and by using staggered or offset patterns.

The following tables provide general guidelines for fastener spacing as well as information relevant to determining the capacity of fastener connections. For additional information regarding TJI® joists, reference *Specifier's Guide for TJI® Joists* (TJ-4000 \ Canada-East (s-Series): TJ-4510 \ Canada-West: TJ-4500). For additional information regarding structural composite lumber, reference *Specifier's Guide for Trus Joist® Beams, Headers, and Columns* (TJ-9000 \ Pacific Coast and Northwest: TJ-9020 \ Canada-East: TJ-9500 \ Canada-West: TJ-9505). For other applications, see *Attaching Fire Sprinkler Components to Weyerhaeuser Engineered Wood Products* (TB-203). If closer on-center spacing patterns are required, please consult your Weyerhaeuser representative.

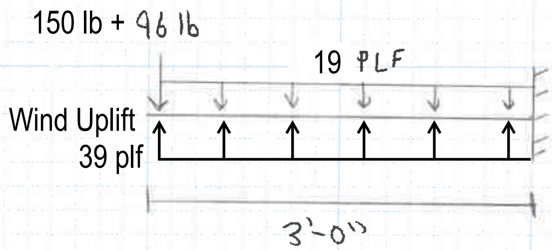
**TABLE 1: TJI® JOISTS, RIM JOISTS, AND BLOCKING PANELS[1][2][3][4]**

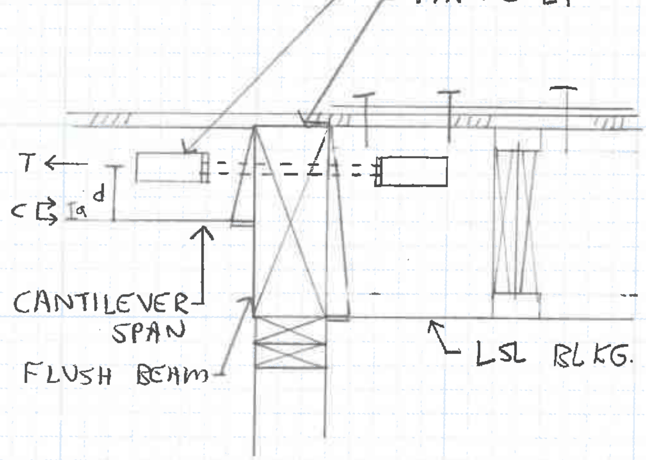
| Nail Size[5] | | Nails into Wide Face of Flange[6] | | | | Nails into Narrow Edge of Flange[7] | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | TJI® Joist Series | | | | TJI® Joist Series | | | |
| | | 110 \ 210 \ 230 | | 360 \ 560 \ 560D \ s31 \ s33 \ s47 | | 110 \ 210 \ 230 | | 360 \ 560 \ 560D \ s31 \ s33 \ s47 | |
| | | On-Center Spacing | Min. End Distance | On-Center Spacing | Min. End Distance | On-Center Spacing | Min. End Distance | On-Center Spacing | Min. End Distance |
| **6d (2″) common & 8d (2 ½″) box** | [0.113″] | 4″ | 2 ½″ | 3″ | 2″ | 6″ | 6″ | 3″ | 4″ |
| **8d (2 ½″) common** | [0.131″] | 4″ | 2 ½″ | 3″ | 2″ | 6″ | 6″ | 6″ | 6″ |
| **8d (1 ½″) N8 or NA11[8]** | [0.131″] | 3″ | 2 ½″ | 3″ | 2″ | 6″ | 6″ | 6″ | 6″ |
| **10d (3″) box** | [0.128″] | 4″ | 3″ | 3″ | 2″ | 6″ | 6″ | 5″ | 5″ |
| **12d (3 ¼″) box** | [0.128″] | 4″ | 3″ | 3″ | 2″ | 6″ | 6″ | 5″ | 5″ |
| **10d (3″) common** | [0.148″] | 4″ | 4 ½″ | 4″ | 3″ | 6″ | 6″ | 6″ | 6″ |
| **12d (3 ¼″) common** | [0.148″] | 4″ | 4 ½″ | 4″ | 3″ | 6″ | 6″ | 6″ | 6″ |
| **10d (1 ½″) N10 or NA9D[8]** | [0.148″] | 3″ | 4 ½″ | 3″ | 3″ | 6″ | 6″ | 6″ | 6″ |
| **16d (3 ½″) box** | [0.135″] | 4″ | 4 ½″ | 4″ | 3″ | 6″ | 6″ | 6″ | 6″ |
| **16d (3 ¼″) sinker** | [0.148″] | 4″ | 4 ½″ | 4″ | 3″ | 6″ | 6″ | 6″ | 6″ |
| **16d (3 ½″) common** | [0.162″] | 6″ | 6″ | 6″ | 4″ | Not Recommended | | | |
| **Framing Angles: A34, A35, LTP4, LTP5, MP34, MPA1, MPA1F, and MP4F** | | N/A | | N/A | | Not Recommended | | | |

[1] Fastener spacings in this table may be used for wood screws provided the lengths and root diameters are less than or equal to the nail sizes listed in the table. Always use screws intended for structural assembly of wood structures. Drywall screws should never be used since they tend to be brittle and may easily break.
[2] Includes attachment of the bottom flange of TJI® rim joists and blocking panels to the wall plate below.
[3] Recommended edge distance is ½″ for TJI® 110 joists and ⅝″ for all other TJI® joist series (does not apply to diaphragm construction, see note 6).
[4] Maximum spacing of nails should not exceed lateral stability requirements. See applicable literature.
[5] Length of nail shown in parentheses ( ); diameter of nail shown in brackets [ ].
[6] One row of nails permitted (two at abutting panel edges) for diaphragms. Stagger nails when using 4″ on-center spacing or less and maintain ⅜″ joist and panel edge distance. For other applications, multiple rows of fasteners are permitted if the rows are offset at least ½″ and staggered.
[7] One (1) row of nails only.
[8] Nail spacing values shown are intended for use with only light-gauge steel straps. Multiple rows of nails must be offset at least ½″ and staggered.

# CANTILEVER FLOOR

- CANTILEVER SPAN = 3'-0"
- FLOOR Dead Load + GLAZING + 1/2 of 300 lb concentrated load. (Rim Board distributes)
- 16" O.C. SPACING




V = 19 PLF (3'-0") + 96 lb + 150 lb
V = 303 lb USE LUS HGR.

M = 246 lb (3') + 19 PLF $(3')^2/2$
M = 824 lb-ft = 9882 lb-in

USE DTT2Z HD w/ 1/2" Ø BOLT

$T_{ALL}$ = 1800 lb / 1.6
$T_{ALL}$ = 1125 lb

a = 1125 lb (2) / (1.5" ( 900 PSI)) 1.25 ($F_{c\perp}$ LSL, $C_b$)
a = 1.33" 1/3 a = 0.44"

$d_{req'd}$ = ( 9882 lb-in / 1125 lb ) + 0.44"
$d_{req'd}$ = 9.22"

- LOCATE DTT2Z CTR'D 2" DOWN FROM SHEATHING

JOIST DEPTH REQ'D = 9.22" + 2" = 11.22" USE 2 × 12 MIN.

$V_{UPLIFT}$ = 0.6 (39 plf - 19 plf) (3'-0")
$V_{UPLIFT}$ = 36 lb LUS HGR. OK for uplift

$M_{UPLIFT}$ = 0.6 (39 plf - 19 plf) $(3'\text{-}0")^2$ / 2 - 0.6(96 lb (3'-0"))
$M_{UPLIFT}$ = -119 lb-ft Dead load is sufficient to resist wind uplift, no additional attachment required.

<u>Blocking Design</u>

Use (2) bays of blocking attached to adjacent joists with A35 clips. Blocking will transfer overturning forces to joists.

V = 9882 lb-in / (3 (12.5"))
V = 275 lb = 206 plf Use A35 clip @ blocking to joist connection.

Apply 206 plf load to joists in this area, see calcs. Use 1 3/4" x 14" LVL joists. Note MSTA49 strap distributes tension from first bay to other bays, capacity = 2020 lb / 1.6 = 1264 lb > 1125 lb OK.

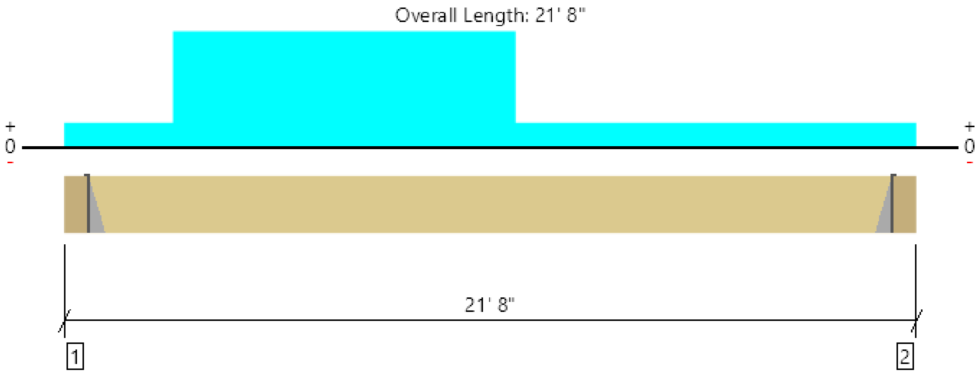
FORTE WEB

MEMBER REPORT

PASSED

Upper Level, UJ2: Master Bed

1 piece(s) 1 3/4" x 14" 2.0E Microllam® LVL @ 16" OC




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

| Design Results | Actual @ Location | Allowed | Result | LDF | Load: Combination (Pattern) |
|---|---|---|---|---|---|
| Member Reaction (lbs) | 2000 @ 5 1/2" | 2000 (1.52") | Passed (100%) | -- | 1.0 D + 1.0 L (All Spans) |
| Shear (lbs) | 1914 @ 1' 7 1/2" | 4655 | Passed (41%) | 1.00 | 1.0 D + 1.0 L (All Spans) |
| Moment (Ft-lbs) | 10281 @ 9' 2 15/16" | 12614 | Passed (82%) | 1.00 | 1.0 D + 1.0 L (All Spans) |
| Live Load Defl. (in) | 0.268 @ 10' 10" | 0.519 | Passed (L/928) | -- | 1.0 D + 1.0 L (All Spans) |
| Total Load Defl. (in) | 0.916 @ 10' 5" | 1.038 | Passed (L/272) | -- | 1.0 D + 1.0 L (All Spans) |
| TJ-Pro™ Rating | 48 | 45 | Passed | -- | -- |

System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Top Edge Bracing (Lu): Top compression edge must be braced at 4' o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 20' 9" o/c unless detailed otherwise.
- A 4% increase in the moment capacity has been added to account for repetitive member usage.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: None.

| Supports | Bearing Length | | | Loads to Supports (lbs) | | | Accessories |
|---|---|---|---|---|---|---|---|
| | Total | Available | Required | Dead | Floor Live | Total | |
| 1 - Hanger on 14" HF beam | 5.50" | Hanger[1] | 1.52" | 1455 | 578 | 2033 | See note [1] |
| 2 - Hanger on 14" HF beam | 5.50" | Hanger[1] | 1.50" | 798 | 578 | 1376 | See note [1] |

- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

**Connector: Simpson Strong-Tie**

| Support | Model | Seat Length | Top Fasteners | Face Fasteners | Member Fasteners | Accessories |
|---|---|---|---|---|---|---|
| 1 - Top Mount Hanger | LBV1.81/14 | 3.00" | 6-10d | 4-10d | 2-10dx1.5 | |
| 2 - Top Mount Hanger | ITS1.81/14 | 2.00" | 4-16d | 4-16d | 4-10dx1.5 | |

| Vertical Loads | Location (Side) | Spacing | Dead (0.90) | Floor Live (1.00) | Comments |
|---|---|---|---|---|---|
| 1 - Uniform (PSF) | 0 to 21' 8" | 16" | 15.0 | 40.0 | Residential - Living Areas |
| 2 - Uniform (PLF) | 2' 8" to 11' 6" | N/A | 206.0 | - | |

**Weyerhaeuser Notes**



| ForteWEB Software Operator | Job Notes |
|---|---|
| Travis Michaud<br>QCE<br>(603) 953-3921<br>tmichaud@quantumce.com | |

7/16/2019 7:55:32 PM UTC

ForteWEB v2.1, Engine: V7.3.2.309, Data: V7.2.0.2

File Name: 19052.01 - Lee-Boyle_Imported

STAIRWAY WALL WIND LOAD

USE VB12 WEAK AXIS CAPACITY TO SUPPORT WIND LOAD ABOVE AND BELOW STAIRWAY

PER FORTE A 5 1/4" x 14" PSL IS REQ'D.

END REACTIONS VERT. = 4167 lb
HORZ. = 1001 lb

USE A HUCQ HANGER VERT CAPACITY @ $C_d = 1.0$ IS 5185 lb

VERT $V_c$ = 4167 lb / (1.6 (5185 lb))
= 0.48

HORIZONTAL CAPACITY OF FACESCREWS (8) 1/4" x 2 1/2" SDS
V = 8 (1.6)(390 lb)
V = 4992 lb

HORIZ $V_c$ = 1001 lb / 4992 lb
= 0.20

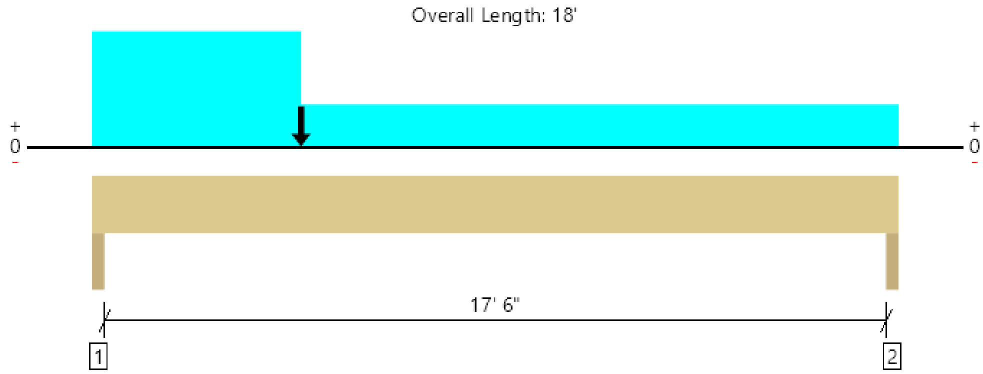
SCREW COMBINED $V_c$ = 0.68 ≤ 1.0 OK

QUANTUM | CONSULTING ENGINEERS
1511 THIRD AVENUE
SUITE 323
SEATTLE, WA 98101
TEL 206.957.3900
FAX 206.957.3901
www.quantumce.com

| | | |
|---|---|---|
| LEE BOYLE | 5/22 | 19052.01 |
| project | date | project no. |
| | TVM | |
| | designer | sheet |
| STUART SILK ARCHITECTS | | G - 6 |
| client | checked by | |

PASSED

Upper Level, UB12: Stair Header
1 piece(s) 5 1/4" x 14" 2.0E Parallam® PSL




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) | 4166 @ 1 1/2" | 9844 (3.00") | Passed (42%) | -- | 1.0 D + 1.0 L (All Spans) |
| Shear (lbs) | 3642 @ 1' 5" | 14210 | Passed (26%) | 1.00 | 1.0 D + 1.0 L (All Spans) |
| Moment (Ft-lbs) | 14896 @ 4' 8" | 40743 | Passed (37%) | 1.00 | 1.0 D + 1.0 L (All Spans) |
| Vert Live Load Defl. (in) | 0.161 @ 8' 2 9/16" | 0.444 | Passed (L/999+) | -- | 1.0 D + 1.0 L (All Spans) |
| Vert Total Load Defl. (in) | 0.344 @ 8' 5" | 0.887 | Passed (L/619) | -- | 1.0 D + 1.0 L (All Spans) |
| Lat Member Reaction (lbs) | 1068 @ 17' 10 1/2" | N/A | Passed (N/A) | 1.60 | 1.0 D + 0.6 W |
| Lat Shear (lbs) | 1001 @ 8 1/4" | 16464 | Passed (6%) | 1.60 | 1.0 D + 0.6 W |
| Lat Moment (Ft-lbs) | 4740 @ mid-span | 24908 | Passed (19%) | 1.60 | 1.0 D + 0.6 W |
| Lat Deflection (in) | 0.563 @ mid-span | 1.775 | Passed (L/379) | -- | 1.0 D + 0.6 W |
| Bi-Axial Bending | 0.37 | 1.00 | Passed (37%) | 1.60 | 1.0 D + 0.45 W + 0.75 L + 0.75 Lr |

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Lateral deflection criteria: Wind (L/120)

| Supports | Bearing Length | | | Loads to Supports (lbs) | | | Accessories |
|---|---|---|---|---|---|---|---|
| | Total | Available | Required | Dead | Floor Live | Total | |
| 1 - Trimmer - HF | 3.00" | 3.00" | 1.50" | 2013 | 2154 | 4167 | None |
| 2 - Trimmer - HF | 3.00" | 3.00" | 1.50" | 1292 | 845 | 2137 | None |

Lateral Connections

| Supports | Plate Size | Plate Material | Connector | Type/Model | Quantity | Nailing |
|---|---|---|---|---|---|---|
| Left | 2X | Hem Fir | | N/A | N/A | N/A |
| Right | 2X | Hem Fir | | N/A | N/A | N/A |

| Vertical Loads | Location (Side) | Tributary Width | Dead (0.90) | Floor Live (1.00) | Comments |
|---|---|---|---|---|---|
| 0 - Self Weight (PLF) | 0 to 18' | N/A | 23.0 | -- | |
| 1 - Uniform (PSF) | 0 to 4' 8" | 5' | 15.0 | 40.0 | Residential - Living Areas |
| 2 - Uniform (PSF) | 4' 8" to 18' | 1' | 15.0 | 40.0 | Residential - Living Areas |
| 3 - Uniform (PSF) | 0 to 18' | 9' | 8.0 | - | Window ABV |
| 4 - Point (lb) | 4' 8" | N/A | 1045 | 1532 | Linked from: UB11: Stair, Support 1 |

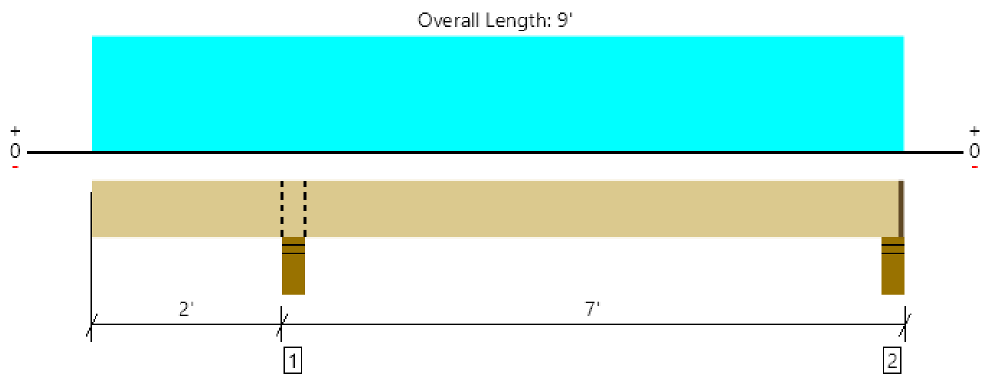
| Lateral Load | Location | Tributary Width | Wind (1.60) | Comments |
|---|---|---|---|---|
| 1 - Uniform (PSF) | Full Length | 10' | 20.1 | Wind Load |

- ASCE/SEI 7 Sec. 30.4: Exposure Category (B), Mean Roof Height (33'), Topographic Factor (1.0), Wind Directionality Factor (0.85), Basic Wind Speed (110), Risk Category(II), Effective Wind Area determined using full member span and trib. width.
- IBC Table 1604.3, footnote f: Deflection checks are performed using 42% of this lateral wind load.

| ForteWEB Software Operator | Job Notes |
|---|---|
| Travis Michaud<br>QCE<br>(603) 953-3921<br>tmichaud@quantumce.com | |

Main Level, MJ3: Terrace

1 piece(s) 2 x 8 Douglas Fir-Larch No. 2 @ 16" OC




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

| Design Results | Actual @ Location | Allowed | Result | LDF | Load: Combination (Pattern) |
|---|---|---|---|---|---|
| Member Reaction (lbs) | 582 @ 2' 2 3/4" | 3341 (5.50") | Passed (17%) | -- | 1.0 D + 1.0 L (All Spans) |
| Shear (lbs) | 275 @ 3' 3/4" | 1305 | Passed (21%) | 1.00 | 1.0 D + 1.0 L (All Spans) |
| Moment (Ft-lbs) | 487 @ 5' 6 1/16" | 1360 | Passed (36%) | 1.00 | 1.0 D + 1.0 L (Alt Spans) |
| Live Load Defl. (in) | 0.040 @ 5' 5 1/8" | 0.160 | Passed (L/999+) | -- | 1.0 D + 1.0 L (Alt Spans) |
| Total Load Defl. (in) | 0.047 @ 5' 5 1/2" | 0.320 | Passed (L/999+) | -- | 1.0 D + 1.0 L (Alt Spans) |
| TJ-Pro™ Rating | N/A | N/A | -- | -- | -- |

System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Overhang deflection criteria: LL (2L/480) and TL (2L/240).
- Top Edge Bracing (Lu): Top compression edge must be braced at 8' 11" o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 8' 11" o/c unless detailed otherwise.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.
- Applicable calculations are based on NDS.
- No composite action between deck and joist was considered in analysis.

| Supports | Bearing Length | | | Loads to Supports (lbs) | | | Accessories |
|---|---|---|---|---|---|---|---|
| | Total | Available | Required | Dead | Floor Live | Total | |
| 1 - Stud wall - HF | 5.50" | 5.50" | 1.50" | 116 | 465 | 581 | Blocking |
| 2 - Stud wall - HF | 5.50" | 4.25" | 1.50" | 64 | 286/-23 | 350/-23 | 1 1/4" Rim Board |

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

| Vertical Load | Location (Side) | Spacing | Dead (0.90) | Floor Live (1.00) | Comments |
|---|---|---|---|---|---|
| 1 - Uniform (PSF) | 0 to 9' | 16" | 15.0 | 60.0 | Residential - Living Areas |

## Weyerhaeuser Notes

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

Weyerhaeuser  SUSTAINABLE FORESTRY INITIATIVE

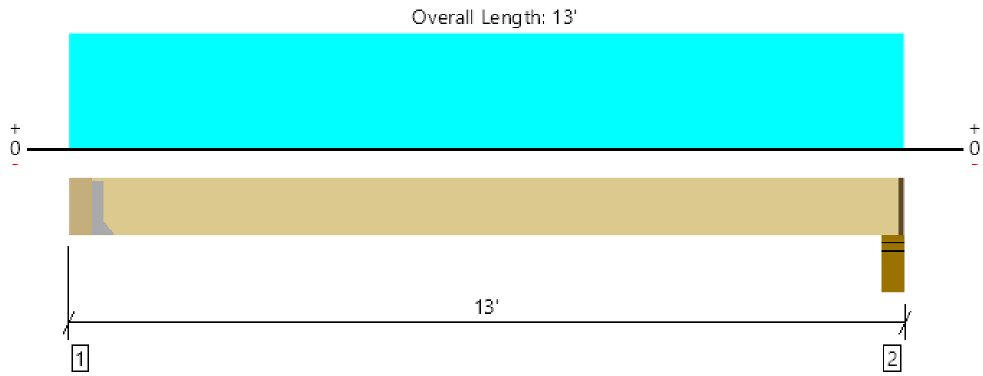
| ForteWEB Software Operator | Job Notes |
|---|---|
| Travis Michaud<br>QCE<br>(603) 953-3921<br>tmichaud@quantumce.com | |

MEMBER REPORT

PASSED

Main Level, MJ4: Terrace

1 piece(s) 4 x 8 Douglas Fir-Larch No. 2 @ 16" OC




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

| Design Results | Actual @ Location | Allowed | Result | LDF | Load: Combination (Pattern) |
|---|---|---|---|---|---|
| Member Reaction (lbs) | 608 @ 5 1/2" | 3281 (1.50") | Passed (19%) | -- | 1.0 D + 1.0 L (All Spans) |
| Shear (lbs) | 548 @ 1' 3/4" | 3045 | Passed (18%) | 1.00 | 1.0 D + 1.0 L (All Spans) |
| Moment (Ft-lbs) | 1850 @ 6' 6 1/2" | 3438 | Passed (54%) | 1.00 | 1.0 D + 1.0 L (All Spans) |
| Live Load Defl. (in) | 0.222 @ 6' 6 1/2" | 0.304 | Passed (L/658) | -- | 1.0 D + 1.0 L (All Spans) |
| Total Load Defl. (in) | 0.277 @ 6' 6 1/2" | 0.608 | Passed (L/527) | -- | 1.0 D + 1.0 L (All Spans) |
| TJ-Pro™ Rating | N/A | N/A | -- | -- | -- |

System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Top Edge Bracing (Lu): Top compression edge must be braced at 12' 5" o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 12' 5" o/c unless detailed otherwise.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.
- Applicable calculations are based on NDS.
- No composite action between deck and joist was considered in analysis.

| Supports | Bearing Length | | | Loads to Supports (lbs) | | | Accessories |
|---|---|---|---|---|---|---|---|
| | Total | Available | Required | Dead | Floor Live | Total | |
| 1 - Hanger on 7 1/4" HF beam | 5.50" | Hanger[1] | 1.50" | 131 | 523 | 654 | See note [1] |
| 2 - Stud wall - HF | 5.50" | 4.25" | 1.50" | 129 | 517 | 646 | 1 1/4" Rim Board |

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

| Connector: Simpson Strong-Tie | | | | | | |
|---|---|---|---|---|---|---|
| Support | Model | Seat Length | Top Fasteners | Face Fasteners | Member Fasteners | Accessories |
| 1 - Face Mount Hanger | LUS46 | 2.00" | N/A | 4-10d | 4-10d | |

| Vertical Load | Location (Side) | Spacing | Dead (0.90) | Floor Live (1.00) | Comments |
|---|---|---|---|---|---|
| 1 - Uniform (PSF) | 0 to 13' | 16" | 15.0 | 60.0 | Residential - Living Areas |

## Weyerhaeuser Notes



Weyerhaeuser

SUSTAINABLE FORESTRY INITIATIVE

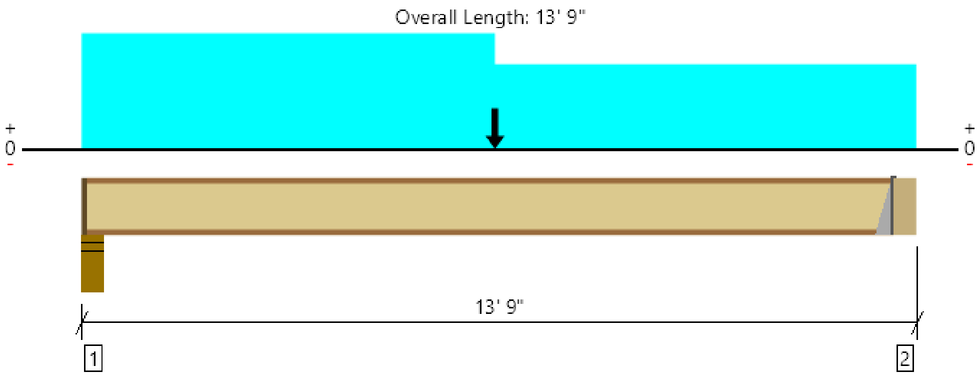
| ForteWEB Software Operator | Job Notes |
|---|---|
| Travis Michaud<br>QCE<br>(603) 953-3921<br>tmichaud@quantumce.com | |

FORTE WEB

MEMBER REPORT

**PASSED**

## Upper Level, UJ3: Master Bath
## 1 piece(s) 9 1/2" TJI® 230 @ 16" OC




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

| Design Results | Actual @ Location | Allowed | Result | LDF | Load: Combination (Pattern) |
|---|---|---|---|---|---|
| Member Reaction (lbs) | 574 @ 13' 3 1/2" | 1060 (1.75") | Passed (54%) | 1.00 | 1.0 D + 1.0 L (All Spans) |
| Shear (lbs) | 649 @ 5 1/2" | 1330 | Passed (49%) | 1.00 | 1.0 D + 1.0 L (All Spans) |
| Moment (Ft-lbs) | 2158 @ 6' 11 5/16" | 3330 | Passed (65%) | 1.00 | 1.0 D + 1.0 L (All Spans) |
| Live Load Defl. (in) | 0.197 @ 6' 8 3/4" | 0.323 | Passed (L/785) | -- | 1.0 D + 1.0 L (All Spans) |
| Total Load Defl. (in) | 0.296 @ 6' 9 1/4" | 0.646 | Passed (L/524) | -- | 1.0 D + 1.0 L (All Spans) |
| TJ-Pro™ Rating | 49 | 45 | Passed | -- | -- |

System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Top Edge Bracing (Lu): Top compression edge must be braced at 5' 1" o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 13' 2" o/c unless detailed otherwise.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: 1/2" Gypsum ceiling.

| Supports | Bearing Length | | | Loads to Supports (lbs) | | | Accessories |
|---|---|---|---|---|---|---|---|
| | Total | Available | Required | Dead | Floor Live | Total | |
| 1 - Stud wall - HF | 5.50" | 4.25" | 1.75" | 189 | 506 | 695 | 1 1/4" Rim Board |
| 2 - Hanger on 9 1/2" LSL beam | 5.50" | Hanger[1] | 1.75" / - [2] | 193 | 414 | 607 | See note [1] |

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

**Connector: Simpson Strong-Tie**

| Support | Model | Seat Length | Top Fasteners | Face Fasteners | Member Fasteners | Accessories |
|---|---|---|---|---|---|---|
| 2 - Top Mount Hanger | ITS2.37/9.5 | 2.00" | 4-10d | 2-10d | 2-Strong-Grip | |

| Vertical Loads | Location (Side) | Spacing | Dead (0.90) | Floor Live (1.00) | Comments |
|---|---|---|---|---|---|
| 1 - Uniform (PSF) | 0 to 13' 9" | 16" | 15.0 | 40.0 | Residential - Living Areas |
| 2 - Uniform (PSF) | 0 to 7' | 16" | - | 20.0 | Terrace Surcharge |
| 3 - Point (PLF) | 7' | 16" | 80.0 | - | Wall |

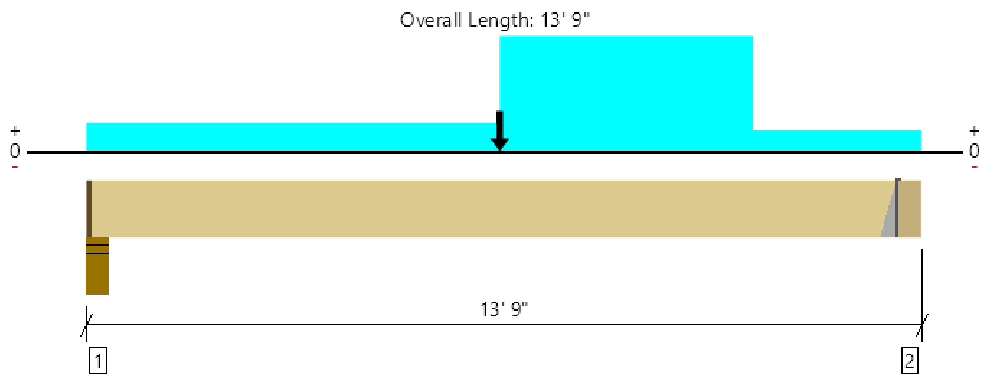
**Weyerhaeuser Notes**



| ForteWEB Software Operator | Job Notes |
|---|---|
| Travis Michaud<br>QCE<br>(603) 953-3921<br>tmichaud@quantumce.com | |

Upper Level, UJ3: Master Bath (Tub)

Current Solution: 1 piece(s) 4 x 10 Douglas Fir-Larch No. 1 @ 16" OC




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

| Design Results | Actual @ Location | Allowed | Result | LDF | Load: Combination (Pattern) |
|---|---|---|---|---|---|
| Member Reaction (lbs) | 1241 @ 13' 3 1/2" | 3281 (1.50") | Passed (38%) | -- | 1.0 D + 1.0 L (All Spans) |
| Shear (lbs) | 1185 @ 12' 6 1/4" | 3885 | Passed (30%) | 1.00 | 1.0 D + 1.0 L (All Spans) |
| Moment (Ft-lbs) | 4434 @ 7' 8 3/16" | 5740 | Passed (77%) | 1.00 | 1.0 D + 1.0 L (All Spans) |
| Live Load Defl. (in) | 0.270 @ 7' 1 1/16" | 0.323 | Passed (L/575) | -- | 1.0 D + 1.0 L (All Spans) |
| Total Load Defl. (in) | 0.322 @ 7' 9/16" | 0.646 | Passed (L/481) | -- | 1.0 D + 1.0 L (All Spans) |
| TJ-Pro™ Rating | N/A | N/A | -- | -- | -- |

System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

All Product Solutions

| Depth | Series | Plies | Spacing | **TJ-Pro™ Rating** | Wood Volume |
|---|---|---|---|---|---|
| 9 1/4" | 4 x Douglas Fir-Larch No. 1 | 1 | 16" | na | 3.44 |

The purpose of this report is for product comparison only. Load and support information necessary for professional design review is not displayed here. Please print an individual Member Report for submittal purposes.

| ForteWEB Software Operator | Job Notes |
|---|---|
| Travis Michaud<br>QCE<br>(603) 953-3921<br>tmichaud@quantumce.com | |

Project Title: Lee-Boyle Residence
Engineer: TVM
Project ID: 19052.01
Project Descr: Stuart Silk Arch.

# Wood Beam

File = M:\Stuart Silk\19052.01_Lee-Boyle Residence\Calculations\Gravity Design\Calcs.ec6 .


**Lic. # : KW-06005835** **Licensee : QUANTUM CONSULTING ENGINEERS**

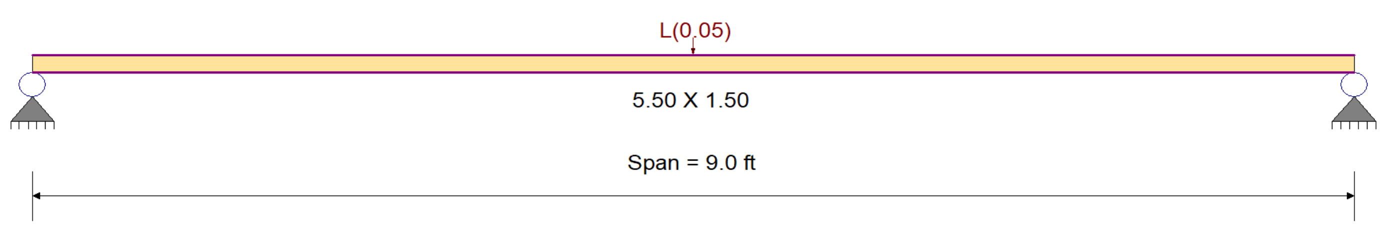
Description : Slat Railing - 50 lbs @ Mid Height

## CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
Load Combination Set : ASCE 7-10

## Material Properties

| | | | | | |
|---|---|---|---|---|---|
| Analysis Method : | Allowable Stress Design | Fb + | 700 psi | *E : Modulus of Elasticity* | |
| Load Combination : | ASCE 7-10 | Fb - | 700 psi | Ebend- xx | 1000 ksi |
| | | Fc - Prll | 650 psi | Eminbend - xx | 370 ksi |
| Wood Species | : Western Cedars | Fc - Perp | 425 psi | | |
| Wood Grade | : No.2 | Fv | 155 psi | | |
| | | Ft | 425 psi | Density | 22.47 pcf |
| Beam Bracing | : Completely Unbraced | | | | |




## Applied Loads

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

Point Load : L = 0.050 k @ 4.50 ft, (Railing)

## DESIGN SUMMARY

**Design OK**

| | | | | | |
|---|---|---|---|---|---|
| Maximum Bending Stress Ratio | = | 0.407 : 1 | Maximum Shear Stress Ratio | = | 0.015 : 1 |
| Section used for this span | | 5.50 X 1.50 | Section used for this span | | 5.50 X 1.50 |
| fb : Actual | = | 654.55 psi | fv : Actual | = | 4.55 psi |
| FB : Allowable | = | 1,610.00 psi | Fv : Allowable | = | 310.00 psi |
| Load Combination | | +D+L+H | Load Combination | | +D+L+H |
| Location of maximum on span | = | 4.500 ft | Location of maximum on span | = | 0.000 ft |
| Span # where maximum occurs | = | Span # 1 | Span # where maximum occurs | = | Span # 1 |

Maximum Deflection

| | | | |
|---|---|---|---|
| Max Downward Transient Deflection | 0.898 in | Ratio = | 120 >=120 |
| Max Upward Transient Deflection | 0.000 in | Ratio = | 0 <120 |
| Max Downward Total Deflection | 0.898 in | Ratio = | 120 >=120 |
| Max Upward Total Deflection | 0.000 in | Ratio = | 0 <120 |

## Maximum Forces & Stresses for Load Combinations

| Load Combination | | Max Stress Ratios | | | | | | | | | Moment Values | | | Shear Values | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Segment Length | Span # | M | V | $C_d$ | $C_{F/V}$ | $C_i$ | $C_r$ | $C_m$ | $C_t$ | $C_L$ | M | fb | F'b | V | fv | F'v |
| +D+L+H | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 9.0 ft | 1 | 0.407 | 0.015 | 2.00 | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.11 | 654.55 | 1610.00 | 0.03 | 4.55 | 310.00 |

## Overall Maximum Deflections

| Load Combination | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|---|---|---|---|---|---|---|
| L Only | 1 | 0.8977 | 4.500 | | 0.0000 | 0.000 |

## Vertical Reactions

Support notation : Far left is #1 Values in KIPS

| Load Combination | Support 1 | Support 2 |
|---|---|---|
| Overall MAXimum | 0.025 | 0.025 |
| Overall MINimum | 0.025 | 0.025 |
| +D+H | | |

# Wood Beam



Description : Slat Railing - 50 lbs @ Mid Height

## Vertical Reactions

Support notation : Far left is #1 Values in KIPS

| Load Combination | Support 1 | Support 2 |
|---|---|---|
| +D+L+H | 0.025 | 0.025 |
| +D+Lr+H | | |
| +D+S+H | | |
| +D+0.750Lr+0.750L+H | 0.019 | 0.019 |
| +D+0.750L+0.750S+H | 0.019 | 0.019 |
| +D+0.60W+H | | |
| +D+0.70E+H | | |
| +D+0.750Lr+0.750L+0.450W+H | 0.019 | 0.019 |
| +D+0.750L+0.750S+0.450W+H | 0.019 | 0.019 |
| +D+0.750L+0.750S+0.5250E+H | 0.019 | 0.019 |
| +0.60D+0.60W+0.60H | | |
| +0.60D+0.70E+0.60H | | |
| D Only | | |
| Lr Only | | |
| L Only | 0.025 | 0.025 |
| S Only | | |
| W Only | | |
| E Only | | |
| H Only | | |

**Slats are spaced at 4" o.c.**
**Slat Space = 4" - 1.5" = 2.5"**

**Slate Deflection = 0.89"**

**Total Opening Size = 2.5" + 0.89" = 3.39" < 4" OK**

**LEE-BOYLE RESIDENCE**
4150 78$^{TH}$. AVE SE
MERCER ISLAND, WA

QUANTUM JOB NUMBER: 19052.01

# LATERAL DESIGN

# Seismic Base Shear for the Equivalent Lateral Force Procedure

Per IBC 2015 & ASCE 7-10

Structure: **Main house wood light framed bearing walls**
Address: **4150 78th Ave. SE, Mercer Island, WA**
Latitude: **47.5717** Longitude: **-122.2351**

**Structure Classification**

Risk Category : **II** per ASCE Table 1.5-1

Seismic Force-Resisting System: **Light-Framed Wood Walls Sheathed with Structural Panels**

| | | |
|---|---|---|
| R: | **6 1/2** | per ASCE Table 12.2-1 |
| $W_o$: | **2 1/2** | per ASCE Table 12.2-1 |
| $C_d$: | **4** | per ASCE Table 12.2-1 |
| $h_n$ (ft): | **31.30** | height above the base to the highest level of the structure |

**Site Ground Motion**

| | | | | |
|---|---|---|---|---|
| Reg. Structure 5 Stories or Less: | **Yes** | Ss (max) = 1.5 Per ASCE 12.8.1.3 | | |
| $S_1$ (g-sec): | **0.54** | $S_S$ (g-sec): | **1.41** | |
| Site Class: | **D** | **Assumed Value** | | per ASCE Table 20.3-1 |
| $S_{D1}$ (g-sec): | **0.54** | $S_{DS}$ (g-sec): | **0.94** | per ASCE 11.4.4 |
| Seismic Design Category: | **D** | per ASCE 11.6 | | |
| $I_E$: | **1.00** | per ASCE Table 1.5-2 | | |

**Fundamental Period per ASCE 12.8.2**

| | | |
|---|---|---|
| Period Method: | **Approximate Fundamental Period** | |
| Structure Type: | **All Other Structural Systems** | |
| $T_L$ (sec): | **6.00** | ASCE Figures 22-12 through 22-16 |
| Ta (sec): | 0.26 | Ct * hnx per ASCE Eq. 12.8-7 |
| $T_{use}$ (sec): | **0.26** | ˉ <= TL |

**Equivalent Lateral Force Procedure Design Base Shear per ASCE 12.8**

| | | |
|---|---|---|
| $C_s$: | 0.14 | $= S_{DS} / (R/I_E)$ per ASCE Eq. 12.8-2 |
| $C_{s\text{-}max}$: | 0.32 | $= S_{D1} / (T_a * R/I_E)$ for $T <= T_L$ per ASCE Eq. 12.8-3 |
| $C_{s\text{-}max}$: | 7 | $= S_{D1} * T_L / (T_a^2 * R/I_E)$ for $T > T_L$ per ASCE Eq. 12.8-4 |
| $C_{s\text{-}min}$: | 0.04 | per ASCE Eq. 12.8-5 |
| $C_{s\text{-}min}$: | -- | $= 0.5S_1 / (R/I_E)$ for $S_1$ => 0.6g per ASCE Eq. 12.8-6 |
| $C_{s\text{-}use}$: | 0.145 | |

**V : 0.145 W = $C_{s\text{-}use}$ * W per ASCE Eq. 12.8-1**

| | | | |
|---|---|---|---|
| **Quantum Consulting Engineers LLC**<br>1511 Third Avenue, Suite 323<br>Seattle, WA 98101 | Project: Lee-Boyle Res.<br>Client: Stuart Silk | Date: 7/24/19<br>Designer: MDA<br>Checked By: | Job No: 19052.01<br>Sheet: 1 |

# Vert. Distribution of Seismic Forces for the Equiv. Lateral Force Procedure

Per IBC 2015 & ASCE 7-10

Structure: **Main house wood light framed bearing walls**

**Seismic Parameters**

| | | |
|---|---|---|
| $I_E$: | 1.00 | per ASCE Table 1.5-2 |
| $S_{DS}$ (g-sec): | 0.94 | per ASCE 11.4.4 |
| Period (Sec): | 0.26 | per ASCE 12.8.2.1 |
| k: | 1.00 | per ASCE 12.8.3 |

**Vertical Distribution of Seismic Forces per ASCE 12.8.3**

$F_x = C_{vx}V$ per ASCE Eq. 12.8-11

$C_{vx} = (w_x h_x^k)/(Sw_i h_i^k)$ per ASCE Eq. 12.8-12

| Level | $h_x$ (ft) | $w_x$ (k) | % of $W_{total}$ | $w_x * h_x^k$ | $C_{vx}$ (%) | $F_x$ (k) | $V_x$ (k) |
|---|---|---|---|---|---|---|---|
| **Roof** | **30.70** | **60.50** | 46.6% | 1857.35 | 55.8% | **10.49** | |
| **Upper** | **21.20** | **69.40** | 53.4% | 1471.28 | 44.2% | **8.31** | **10.49** |
| | | | | | | | **18.81** |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

| | | | |
|---|---|---|---|
| Total WT (k): | 129.90 | Sum: | 3328.63 |
| $C_{s\text{-}use}$: | 0.145 | | |
| V (k): | **18.81** | per ASCE 12.8.1 | |

**Vertical Distribution of Seismic Diaphragm Forces per ASCE 12.10.1.1**

$F_{px} = (SF_i/Sw_i) * w_{px}$ per ASCE Eq 12.10-1

$F_{px\text{-}max} = 0.4*S_{DS}*I_E*w_{px}$ per per ASCE 12.10.1.1

$F_{px\text{-}min} = 0.2*S_{DS}*I_E*w_{px}$ per per ASCE 12.10.1.1

| Level | $w_{px}$ (k) | $\Sigma w_i$ (k) | $F_x$ (k) | $\Sigma F_i$ (k) | $F_{px}$ (k) | Notes |
|---|---|---|---|---|---|---|
| Roof | 60.50 | 60.50 | 10.49 | 10.49 | **11.39** | **= Fp-min** |
| Upper | 69.40 | 129.90 | 8.31 | 18.81 | **13.06** | **= Fp-min** |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

# V - Seismic Shear Wall Calcs.

→ Roof

a) Generals (N-S) Direction

$l_1 = 21.3'$ ; $B_1 = 13.5'$ ; $V_E = 10.5^k$

$l_2 = 29.3'$ ; $B_2 = 22.7'$ ; $LT = 154.9'$

$l_3 = 37.6'$ ; $B_3 = 17.4'$

$l_4 = 28.2'$ ; $B_4 = 8.2'$

$l_5 = 29.3'$ ; $B_5 = 14.7'$

$l_6 = 9.2'$ ; $B_6 = 4.3'$

b) (N-S) Direction Tributary Area Calcs

$W_{E1} = [10.5^k * (21.3'/154.9')]/13.5' = 0.107\ k/ft$

$W_{E2} = [10.5^k * (29.3'/154.9')]/22.7' = 0.087\ k/ft$

$W_{E3} = [10.5^k * (37.6'/154.9')]/17.4' = 0.147\ k/ft$

$W_{E4} = [10.5^k * (28.2'/154.9')]/8.2' = 0.233\ k/ft$

$W_{E5} = [10.5^k * (29.3'/154.9')]/14.7' = 0.135\ k/ft$

$W_{E6} = [10.5^k * (9.2'/154.9')]/4.3' = 0.145\ k/ft$

$A_{T2} = (W_{E1} * 13.5') + (W_{E2} * 22.7') + (W_{E3} * 8.1')$

$A_{T5} = (W_{E3} * 9.3') + (W_{E4} * 8.2') + (W_{E5} * 14.7') + (W_{E6} * 4.3')$

c) Generals (E-W) Direction

$l_7 = 26.3'$ ; $B_7 = 8.2'$ ; $V_E = 10.5^k$

$l_8 = 62.8'$ ; $B_8 = 13.0'$ ; $LT = 262.2\ Ft$

$l_9 = 75.8'$ ; $B_9 = 7.2'$

$l_{10} = 75.0'$ ; $B_{10} = 9.2'$

$l_{11} = 13.5'$ ; $B_{11} = 5.0'$

$l_{12} = 8.8'$ ; $B_{12} = 2.7'$

D) (E-W) Direction tributary Area Calcs

$W_{E7} = [10.5^k * (66.3'/262.2')] / 8.2' = 0.130\ ^k/ft$

$W_{E8} = [10.5^k * (62.8'/262.2')] / 13.0' = 0.193\ ^k/ft$

$W_{E9} = [10.5^k * (75.8'/262.2')] / 7.2' = 0.422\ ^k/ft$

$W_{E10} = [10.5^k * (75.0'/262.2')] / 9.2' = 0.326\ ^k/ft$

$W_{E11} = [10.5^k * (13.5'/262.2')] / 5.0' = 0.108\ ^k/ft$

$W_{E12} = [10.5^k * (8.8'/262.2')] / 2.7' = 0.131\ ^k/ft.$

$A_{TA} = (W_{E7} * 8.2')$ ; $A_{TB} = (W_{E12} * 2.7') + (W_{E8} * 13.0') + (W_{E9} * 1.7')$

$A_{TE} = (W_{E9} * 5.5') + (W_{E10} * 9.2')$ ; $A_{TF} = (W_{E11} * 5.0')$

E) (N-S) Direction shear wall summary – (Seismic Roof)

| Wall Grid | Length (ft) | $V_E$ (k) LRFD |
|---|---|---|
| 2 | 21 | 4.6 |
| 5 | 16.4 | 5.9 |
| | | $10.5^k$ |

F) (E-W) Direction shear wall summary – (seismic - Roof)

| Wall Grid | Length (ft) | $V_E$ (k) LRFD |
|---|---|---|
| A | 14.2 | 1.1 |
| B | 11.5 | 3.6 |
| E | 3.7 | 5.6 |
| F | 13.5 | 0.5 |
| | | $10.5^k$ |

→ Upper Floor.

a) Generals (N-S) Direction

$l_1 = 21.3'$ ; $B_1 = 13.5'$ ; $V_E = 8.3^k$

$l_2 = 29.3'$ ; $B_2 = 22.7'$ ; $L_T = 154.9'$

$l_3 = 37.6'$ ; $B_3 = 17.4'$

$l_4 = 28.2'$ ; $B_4 = 8.2'$

$l_5 = 29.3'$ ; $B_5 = 14.7'$

$l_6 = 9.2'$ ; $B_6 = 4.3'$

b) (N-S) Direction tributary Area Calcs

$w_{E1} = [8.3^k * (21.3'/154.9')]/13.5' = 0.085\ ^k/ft$

$w_{E2} = [8.3^k * (29.3'/154.9')]/22.7' = 0.069\ ^k/ft$

$w_{E3} = [8.3^k * (37.6'/154.9')]/17.4' = 0.116\ ^k/ft$

$w_{E4} = [8.3^k * (28.2'/154.9')]/8.2' = 0.184\ ^k/ft$

$w_{E5} = [8.3^k * (29.3'/154.9')]/14.7' = 0.107\ ^k/ft$

$w_{E6} = [8.3^k * (9.2'/154.9')]/4.3' = 0.115\ ^k/ft$

$A_{T1} = (w_{E1} * 6.8')$ $\quad A_{T2} = (w_{E1} * 6.7') + (w_{E2} * 11.4')$

$A_{T3} = (w_{E2} * 11.3') + (w_{E3} * 12.8')$

$A_{T4} = (w_{E3} * 4.6') + (w_{E4} * 8.0') + (w_{E5} * 7.3')$

$A_{T5} = (w_{E5} * 7.4') + (w_{E6} * 4.3')$

c) Generals (E-W) Direction

$l_7 = 26.3'$ ; $B_7 = 8.2'$ ; $V_E = 8.3^k$

$l_8 = 62.8'$ ; $B_8 = 13.8'$ ; $L_T = 262.2$ ft

$l_9 = 75.8'$ ; $B_9 = 6.3'$

$l_{10} = 75.0'$ ; $B_{10} = 9.2'$

$l_{11} = 13.5'$ ; $B_{11} = 5.0'$

$l_{12} = 8.8'$ ; $B_{12} = 2.7'$

D) (E-W) Direction Tributary Area Calcs

$W_{E7} = [8.3^k * (26.3'/262.2')] / 8.2 = 0.109^k/ft$

$W_{E8} = [8.3^k * (62.8'/262.2')] / 13.8' = 0.150^k/ft$

$W_{E9} = [8.3^k * (75.8'/262.2')] / 6.2' = 0.39^k/ft$

$W_{E10} = [8.3^k * (75.0'/262.2')] / 9.2' = 0.26^k/ft$

$W_{E11} = [8.3^k * (13.5'/262.2')] / 5.0' = 0.086^k/ft$

$W_{E12} = [8.3^k * (8.8'/262.2')] / 2.7' = 0.022^k/ft$

$A_{TE} = (W_{E7} * 8.2') + (W_{E12} * 2.7') + (W_{E9} * 6.2') + (W_{E10} * 9.2') + (W_{E8} * 13.8)$

$A_{TF} = (W_{E11} * 5.0')$

E) (N-S) Direction shear wall summary - (Seismic upper)

| Wall Grid | Length (ft) | $V_E$ (k) LRFD |
|---|---|---|
| 1 | 15.7 | 0.6 |
| 2 | 6.9 | 1.4 |
| 3 | 12.0 | 2.3 |
| 4 | 13.8 | 2.7 |
| 5 | 16.4 | 1.3 |
| | | $8.3^k$ |

F) (E-W) Direction shear wall summary - (Seismic upper)

| Wall Grid | Length (ft) | $V_E$ (k) LRFD |
|---|---|---|
| E | 30.9 | 7.8 |
| F | 13.5 | 0.5 |
| | | $8.3^k$ |

# LIGHT FRAMED WOOD SHEATHED PANEL SHEAR WALL DESIGN
Per IBC 2015, ASCE 7-10, SDPWS 2015 & NDS 2015

Structure: **Lee-Boyle Residence**
Floor Level: **Roof (N-S)**

**Sds =** **0.941**
**Depth of Floor Framing & Plates (Clearspan) at Interstory (in) =** **17.50**

**Shear Wall Line Information**

| SW Mark | | $L_{SW}$ (ft) | $h_{SW}$ (ft) | $h_{SW}/L_{SW}$ | Wall Framing Species | Specific Gravity G | Interstory of Base? |
|---|---|---|---|---|---|---|---|
| **SW GRID** | | **0.00** | - | - | - | - | - |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| **SW GRID** | **2** | **21.00** | - | - | - | - | - |
| SW Segment | 2.10 | 16.00 | 9.00 | 0.56 | DF #2 | 0.50 | Interstory |
| SW Segment | 2.20 | 5.00 | 9.00 | 1.80 | DF #2 | 0.50 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| **SW GRID** | | **0.00** | - | - | - | - | - |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| **SW GRID** | **5** | **16.40** | - | - | - | - | - |
| SW Segment | 5.10 | 10.40 | 9.00 | 0.87 | DF #2 | 0.50 | Interstory |
| SW Segment | 5.20 | 6.00 | 9.00 | 1.50 | DF #2 | 0.50 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |

**Shear Wall Loads and Summary**

| SW Mark | | EQ (lb) Wall (ULT) | Wind (lb) Wall (ULT) | Wall DL (lb) Wall | Wall DL (lb) End 1 | Wall DL (lb) End 2 | Shear Wall Type | MIN. # of End Studs | Holdown |
|---|---|---|---|---|---|---|---|---|---|
| **SW GRID** | | | | - | - | - | - | - | - |
| SW Segment | | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No HD** |
| SW Segment | | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No HD** |
| SW Segment | | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No HD** |
| SW Segment | | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No HD** |
| SW Segment | | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No HD** |
| **SW GRID** | **2** | 4600 | 7150 | | | | - | - | - |
| SW Segment | 2.10 | 3505 | 5448 | 404 | | | **SW-6** | **2** | **(2) CS16 (3410)** |
| SW Segment | 2.20 | 1095 | 1702 | 126 | | | **SW-6** | **2** | **(2) CS16 (3410)** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| **SW GRID** | | | | | | | - | - | - |
| SW Segment | | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No HD** |
| SW Segment | | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No HD** |
| SW Segment | | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No HD** |
| SW Segment | | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No HD** |
| SW Segment | | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No HD** |
| **SW GRID** | **5** | 5900 | 7150 | | | | - | - | - |
| SW Segment | 5.10 | 3741 | 4534 | 263 | | | **SW-4** | **2** | **CMSTC16 (4585)** |
| SW Segment | 5.20 | 2159 | 2616 | 152 | | | **SW-4** | **2** | **(2) CS16 (3410)** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **HDU2 (3075DF,2215HF)** |

## LIGHT FRAMED WOOD SHEATHED PANEL SHEAR WALL DESIGN

Per IBC 2015, ASCE 7-10, SDPWS 2015 & NDS 2015

Structure: **Lee-Boyle Residence**
Floor Level: **Roof (N-S)**

**Shear Wall Schedule (LRFD)** $\phi_D$ = 0.8

| Shear Wall Type | Sheathing Grade, Sheathing Thickness, & Nail Size | Panel Edge Nail Spacing (in) | Nominal Seismic SW Capacity (plf) | LRFD Seismic SW Capacity (plf) | Sheathing Shear Stiffness, $G_a$ (lb/in) |
|---|---|---|---|---|---|
| SW-6 | APA Rated, 15/32", 8d Common | 6 | 520 | 416 | 10 |
| SW-4 | APA Rated, 15/32", 8d Common | 4 | 760 | 608 | 13 |
| SW-3 | APA Rated, 15/32", 8d Common | 3 | 980 | 784 | 15 |
| SW-2 | APA Rated, 15/32", 8d Common | 2 | 1280 | 1024 | 20 |
| 2SW-4 | APA Rated, 15/32", 8d Common | 4 | 1520 | 1216 | 26 |
| 2SW-3 | APA Rated, 15/32", 8d Common | 3 | 1960 | 1568 | 30 |
| 2SW-2 | APA Rated, 15/32", 8d Common | 2 | 2560 | 2048 | 40 |

**Determine Shear Wall Type (LRFD)**

| SW Segment Mark | Seismic Shear (plf) | Seismic & Wind Aspect Ratio Reduction | Adjusted Seismic Shear (plf) | Wind Shear (plf) | Adjusted Wind Shear (plf) | Req'd Shear (plf) | Shear Wall Type | Shear Wall Capacity (plf) | Check |
|---|---|---|---|---|---|---|---|---|---|
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| 2.10 | 219 | 1.00 | 219 | 340 | 243 | 243 | SW-6 | 416 | OK |
| 2.20 | 219 | 1.00 | 219 | 340 | 243 | 243 | SW-6 | 416 | OK |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| 5.10 | 360 | 1.00 | 360 | 436 | 311 | 360 | SW-4 | 608 | OK |
| 5.20 | 360 | 1.00 | 360 | 436 | 311 | 360 | SW-4 | 608 | OK |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |

**Determine Shear Wall Overturning Moment Lever Arm**

| SW Segment Mark | Wall Length Lever Arm (ft) | Calculated Lever Arm (ft) | % Different | Override Wall Length | User Input $M_{OT}$ Lever Arm (ft) |
|---|---|---|---|---|---|
| | 0.00 | #VALUE! | #VALUE! | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| 2.10 | 16.00 | 15.79 | 1.32% | Yes | 13.80 |
| 2.20 | 5.00 | 4.79 | 4.35% | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| 5.10 | 10.40 | 10.19 | 2.04% | Yes | 7.00 |
| 5.20 | 6.00 | 5.79 | 3.60% | Yes | 5.00 |
| | | | | No | |
| | | | | No | |
| | | | | No | |

# LIGHT FRAMED WOOD SHEATHED PANEL SHEAR WALL DESIGN

Per IBC 2015, ASCE 7-10, SDPWS 2015 & NDS 2015

Structure: **Lee-Boyle Residence**
Floor Level: **Roof (N-S)**

**Shear Wall End Axial Load (ASD)**

| SW Segment Mark | Seismic Tension (lb) | ASD Seismic Tension Above (lb) | Seismic Tension Total (lb) | Wind Tension (lb) | ASD Wind Tension Above (lb) | Wind Tension Total (lb) | End 1 Dead (lb) | End 2 Dead (lb) |
|---|---|---|---|---|---|---|---|---|
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| 2.10 | 1600 | 0 | 1600 | 2132 | 0 | 2132 | 202 | 202 |
| 2.20 | 1380 | 0 | 1380 | 1839 | 0 | 1839 | 63 | 63 |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| 5.10 | 3367 | 0 | 3367 | 3498 | 0 | 3498 | 132 | 132 |
| 5.20 | 2720 | 0 | 2720 | 2825 | 0 | 2825 | 76 | 76 |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |

**Determine Required Holdown (ASD)**

| SW Segment Mark | Wind End 1 Eq. 16-15 | End 1 Eq. 16-16 | End 2 Eq. 16-15 | End 2 Eq. 16-16 | Controlling Ten. Load (lb) | Holdown | Holdown Capacity (lb) | Status |
|---|---|---|---|---|---|---|---|---|
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| 2.10 | -2010 | -1505 | -2010 | -1505 | -2010 | (2) CS16 (3410) | -3410 | OK |
| 2.20 | -1801 | -1350 | -1801 | -1350 | -1801 | (2) CS16 (3410) | -3410 | OK |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| 5.10 | -3419 | -3306 | -3419 | -3306 | -3419 | CMSTC16 (4585) | -4585 | OK |
| 5.20 | -2780 | -2684 | -2780 | -2684 | -2780 | (2) CS16 (3410) | -3410 | OK |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | HDU2 (3075DF,2215HF) | | |

# LIGHT FRAMED WOOD SHEATHED PANEL SHEAR WALL DESIGN

Per IBC 2015, ASCE 7-10, SDPWS 2015 & NDS 2015

Structure: **Lee-Boyle Residence**
Floor Level: **Upper (N-S)**

**Sds =** **0.941**
**Depth of Floor Framing & Plates (Clearspan) at Interstory (in) =** **17.50**

**Shear Wall Line Information**

| SW Mark | | $L_{SW}$ (ft) | $h_{SW}$ (ft) | $h_{SW}/L_{SW}$ | Wall Framing Species | Specific Gravity G | Interstory of Base? |
|---|---|---|---|---|---|---|---|
| **SW GRID** | **1** | **15.70** | - | - | - | - | - |
| SW Segment | 1.10 | 15.70 | 9.50 | 0.61 | DF #2 | 0.50 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| **SW GRID** | **2** | **7.00** | - | - | - | - | - |
| SW Segment | 2.10 | 7.00 | 9.50 | 1.36 | DF #2 | 0.50 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| **SW GRID** | **3** | **12.00** | - | - | - | - | - |
| SW Segment | 3.10 | 12.00 | 9.50 | 0.79 | DF #2 | 0.50 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| **SW GRID** | **5** | **16.40** | - | - | - | - | - |
| SW Segment | 5.10 | 16.40 | 9.50 | 0.58 | DF #2 | 0.50 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |

**Shear Wall Loads and Summary**

| SW Mark | | EQ (lb) Wall (ULT) | Wind (lb) Wall (ULT) | Wall DL (lb) Wall | Wall DL (lb) End 1 | Wall DL (lb) End 2 | Shear Wall Type | MIN. # of End Studs | Holdown |
|---|---|---|---|---|---|---|---|---|---|
| **SW GRID** | **1** | 600 | 3500 | - | - | - | - | - | - |
| SW Segment | 1.10 | 600 | 3500 | 3117 | | | **SW-6** | **2** | **HDU2 (3075DF,2215HF)** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| **SW GRID** | **2** | 6000 | 9150 | | | | - | - | - |
| SW Segment | 2.10 | 6000 | 9150 | 1499 | | | **SW-2** | **4** | **HDU11 (4) Studs (9335DF, 6865HF)** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No Strap** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No Strap** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No Strap** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No Strap** |
| **SW GRID** | **3** | 2300 | 6700 | | | | - | - | - |
| SW Segment | 3.10 | 2300 | 6700 | 1151 | | | **SW-4** | **2** | **HDU8 (6765DF, 4870HF)** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No Strap** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No Strap** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No Strap** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No Strap** |
| **SW GRID** | **5** | 7200 | 9950 | | | | - | - | - |
| SW Segment | 5.10 | 7200 | 9950 | 4100 | | | **SW-3** | **4** | **HDU11 (4) Studs (9335DF, 6865HF)** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No Strap** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No Strap** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No Strap** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No Strap** |

# LIGHT FRAMED WOOD SHEATHED PANEL SHEAR WALL DESIGN

Per IBC 2015, ASCE 7-10, SDPWS 2015 & NDS 2015

Structure: **Lee-Boyle Residence**
Floor Level: **Upper (N-S)**

**Shear Wall Schedule (LRFD)** $\phi_D$ = 0.8

| Shear Wall Type | Sheathing Grade, Sheathing Thickness, & Nail Size | Panel Edge Nail Spacing (in) | Nominal Seismic SW Capacity (plf) | LRFD Seismic SW Capacity (plf) | Sheathing Shear Stiffness, $G_a$ (lb/in) |
|---|---|---|---|---|---|
| SW-6 | APA Rated, 15/32", 8d Common | 6 | 520 | 416 | 10 |
| SW-4 | APA Rated, 15/32", 8d Common | 4 | 760 | 608 | 13 |
| SW-3 | APA Rated, 15/32", 8d Common | 3 | 980 | 784 | 15 |
| SW-2 | APA Rated, 15/32", 8d Common | 2 | 1280 | 1024 | 20 |
| 2SW-4 | APA Rated, 15/32", 8d Common | 4 | 1520 | 1216 | 26 |
| 2SW-3 | APA Rated, 15/32", 8d Common | 3 | 1960 | 1568 | 30 |
| 2SW-2 | APA Rated, 15/32", 8d Common | 2 | 2560 | 2048 | 40 |

**Determine Shear Wall Type (LRFD)**

| SW Segment Mark | Seismic Shear (plf) | Seismic & Wind Aspect Ratio Reduction | Adjusted Seismic Shear (plf) | Wind Shear (plf) | Adjusted Wind Shear (plf) | Req'd Shear (plf) | Shear Wall Type | Shear Wall Capacity (plf) | Check |
|---|---|---|---|---|---|---|---|---|---|
| 1.10 | 38 | 1.00 | 38 | 223 | 159 | 159 | SW-6 | 416 | OK |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| 2.10 | 857 | 1.00 | 857 | 1307 | 934 | 934 | SW-2 | 1024 | OK |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| 3.10 | 192 | 1.00 | 192 | 558 | 399 | 399 | SW-4 | 608 | OK |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| 5.10 | 439 | 1.00 | 439 | 607 | 433 | 439 | SW-3 | 784 | OK |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |

**Determine Shear Wall Overturning Moment Lever Arm**

| SW Segment Mark | Wall Length Lever Arm (ft) | Calculated Lever Arm (ft) | % Different | Override Wall Length | User Input $M_{OT}$ Lever Arm (ft) |
|---|---|---|---|---|---|
| 1.10 | 15.70 | 15.22 | 3.18% | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| 2.10 | 7.00 | 6.26 | 11.81% | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| 3.10 | 12.00 | 11.51 | 4.25% | Yes | 8.50 |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| 5.10 | 16.40 | 15.66 | 4.72% | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |

## LIGHT FRAMED WOOD SHEATHED PANEL SHEAR WALL DESIGN

Per IBC 2015, ASCE 7-10, SDPWS 2015 & NDS 2015

Structure: **Lee-Boyle Residence**
Floor Level: **Upper (N-S)**

**Shear Wall End Axial Load (ASD)**

| SW Segment Mark | Seismic Tension (lb) | ASD Seismic Tension Above (lb) | Seismic Tension Total (lb) | Wind Tension (lb) | ASD Wind Tension Above (lb) | Wind Tension Total (lb) | End 1 Dead (lb) | End 2 Dead (lb) |
|---|---|---|---|---|---|---|---|---|
| 1.10 | 254 | 0 | 254 | 1271 | 0 | 1271 | 1559 | 1559 |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| 2.10 | 5700 | 1380 | 7080 | 7451 | 1839 | 9290 | 750 | 750 |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| 3.10 | 1799 | 0 | 1799 | 4493 | 0 | 4493 | 576 | 576 |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| 5.10 | 2920 | 6087 | 9007 | 3458 | 6323 | 9781 | 2050 | 2050 |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |

**Determine Required Holdown (ASD)**

| SW Segment Mark | Wind End 1 Eq. 16-15 | End 1 Eq. 16-16 | End 2 Eq. 16-15 | End 2 Eq. 16-16 | Controlling Ten. Load (lb) | Holdown | Holdown Capacity (lb) | Status |
|---|---|---|---|---|---|---|---|---|
| 1.10 | -336 | 476 | -336 | 476 | -336 | HDU2 (3075DF,2215HF) | -3075 | OK |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| 2.10 | -8840 | -6729 | -8840 | -6729 | -8840 | HDU11 (4) Studs (9335DF, 6865H | -9335 | OK |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
| 3.10 | -4148 | -1530 | -4148 | -1530 | -4148 | HDU8 (6765DF, 4870HF) | -6765 | OK |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
| 5.10 | -8551 | -8047 | -8551 | -8047 | -8551 | HDU11 (4) Studs (9335DF, 6865H | -9335 | OK |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |

# LIGHT FRAMED WOOD SHEATHED PANEL SHEAR WALL DESIGN

Per IBC 2015, ASCE 7-10, SDPWS 2015 & NDS 2015

Structure: **Lee-Boyle Residence**
Floor Level: **Upper (N-S)**

**Sds =** **0.941**
**Depth of Floor Framing & Plates (Clearspan) at Interstory (in) =** **17.50**

**Shear Wall Line Information**

| SW Mark | $L_{SW}$ (ft) | $h_{SW}$ (ft) | $h_{SW}/L_{SW}$ | Wall Framing Species | Specific Gravity G | Interstory of Base? |
|---|---|---|---|---|---|---|
| **SW GRID 4** | **13.80** | - | - | - | - | - |
| SW Segment 4.10 | 13.80 | 9.50 | 0.69 | DF #2 | 0.50 | Base |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| **SW GRID** | **0.00** | - | - | - | - | - |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| **SW GRID** | **0.00** | - | - | - | - | - |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| **SW GRID** | **0.00** | - | - | - | - | - |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |

**Shear Wall Loads and Summary**

| SW Mark | EQ (lb) Wall (ULT) | Wind (lb) Wall (ULT) | Wall DL (lb) Wall | Wall DL (lb) End 1 | Wall DL (lb) End 2 | Shear Wall Type | MIN. # of End Studs | Holdown |
|---|---|---|---|---|---|---|---|---|
| **SW GRID 4** | 2700 | 4900 | - | - | - | - | - | - |
| SW Segment 4.10 | 2700 | 4900 | 1376 | | | **SW-6** | **2** | **HDU2 (3075DF,2215HF)** |
| SW Segment | 0 | 0 | | | | **2SW-2** | | **No Strap** |
| SW Segment | 0 | 0 | | | | **2SW-2** | | **No Strap** |
| SW Segment | 0 | 0 | | | | **2SW-2** | | **No Strap** |
| SW Segment | 0 | 0 | | | | **2SW-2** | | **No Strap** |
| **SW GRID** | | | | | | - | - | - |
| SW Segment | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No Strap** |
| SW Segment | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No Strap** |
| SW Segment | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No Strap** |
| SW Segment | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No Strap** |
| SW Segment | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No Strap** |
| **SW GRID** | | | | | | - | - | - |
| SW Segment | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No Strap** |
| SW Segment | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No Strap** |
| SW Segment | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No Strap** |
| SW Segment | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No Strap** |
| SW Segment | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No Strap** |
| **SW GRID** | | | | | | - | - | - |
| SW Segment | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No Strap** |
| SW Segment | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No Strap** |
| SW Segment | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No Strap** |
| SW Segment | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No Strap** |
| SW Segment | #DIV/0! | #DIV/0! | | | | **2SW-2** | | **No Strap** |

# LIGHT FRAMED WOOD SHEATHED PANEL SHEAR WALL DESIGN

Per IBC 2015, ASCE 7-10, SDPWS 2015 & NDS 2015

Structure: **Lee-Boyle Residence**
Floor Level: **Upper (N-S)**

**Shear Wall Schedule (LRFD)** $\phi_D$ = 0.8

| Shear Wall Type | Sheathing Grade, Sheathing Thickness, & Nail Size | Panel Edge Nail Spacing (in) | Nominal Seismic SW Capacity (plf) | LRFD Seismic SW Capacity (plf) | Sheathing Shear Stiffness, $G_a$ (lb/in) |
|---|---|---|---|---|---|
| SW-6 | APA Rated, 15/32", 8d Common | 6 | 520 | 416 | 10 |
| SW-4 | APA Rated, 15/32", 8d Common | 4 | 760 | 608 | 13 |
| SW-3 | APA Rated, 15/32", 8d Common | 3 | 980 | 784 | 15 |
| SW-2 | APA Rated, 15/32", 8d Common | 2 | 1280 | 1024 | 20 |
| 2SW-4 | APA Rated, 15/32", 8d Common | 4 | 1520 | 1216 | 26 |
| 2SW-3 | APA Rated, 15/32", 8d Common | 3 | 1960 | 1568 | 30 |
| 2SW-2 | APA Rated, 15/32", 8d Common | 2 | 2560 | 2048 | 40 |

**Determine Shear Wall Type (LRFD)**

| SW Segment Mark | Seismic Shear (plf) | Seismic & Wind Aspect Ratio Reduction | Adjusted Seismic Shear (plf) | Wind Shear (plf) | Adjusted Wind Shear (plf) | Req'd Shear (plf) | Shear Wall Type | Shear Wall Capacity (plf) | Check |
|---|---|---|---|---|---|---|---|---|---|
| 4.10 | 196 | 1.00 | 196 | 355 | 254 | 254 | SW-6 | 416 | OK |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |

**Determine Shear Wall Overturning Moment Lever Arm**

| SW Segment Mark | Wall Length Lever Arm (ft) | Calculated Lever Arm (ft) | % Different | Override Wall Length | User Input $M_{OT}$ Lever Arm (ft) |
|---|---|---|---|---|---|
| 4.10 | 13.80 | 13.32 | 3.64% | Yes | 11.80 |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |

## LIGHT FRAMED WOOD SHEATHED PANEL SHEAR WALL DESIGN

Per IBC 2015, ASCE 7-10, SDPWS 2015 & NDS 2015

Structure: **Lee-Boyle Residence**
Floor Level: **Upper (N-S)**

**Shear Wall End Axial Load (ASD)**

| SW Segment Mark | Seismic Tension (lb) | ASD Seismic Tension Above (lb) | Seismic Tension Total (lb) | Wind Tension (lb) | ASD Wind Tension Above (lb) | Wind Tension Total (lb) | End 1 Dead (lb) | End 2 Dead (lb) |
|---|---|---|---|---|---|---|---|---|
| 4.10 | 1522 | 0 | 1522 | 2367 | 0 | 2367 | 688 | 688 |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
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| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |

**Determine Required Holdown (ASD)**

| SW Segment Mark | Wind End 1 Eq. 16-15 | End 1 Eq. 16-16 | End 2 Eq. 16-15 | End 2 Eq. 16-16 | Controlling Ten. Load (lb) | Holdown | Holdown Capacity (lb) | Status |
|---|---|---|---|---|---|---|---|---|
| 4.10 | -1954 | -1199 | -1954 | -1199 | -1954 | HDU2 (3075DF,2215HF) | -3075 | OK |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
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| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |

# LIGHT FRAMED WOOD SHEATHED PANEL SHEAR WALL DESIGN

Per IBC 2015, ASCE 7-10, SDPWS 2015 & NDS 2015

Structure: **Lee-Boyle Residence**
Floor Level: **Roof (E-W)**

**Sds =** **0.941**
**Depth of Floor Framing & Plates (Clearspan) at Interstory (in) =** **17.50**

**Shear Wall Line Information**

| SW Mark | | $L_{SW}$ (ft) | $h_{SW}$ (ft) | $h_{SW}/L_{SW}$ | Wall Framing Species | Specific Gravity G | Interstory of Base? |
|---|---|---|---|---|---|---|---|
| **SW GRID** | **A** | **14.20** | - | - | - | - | - |
| SW Segment | A.1 | 14.20 | 9.00 | 0.63 | DF #2 | 0.50 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| **SW GRID** | **B** | **11.50** | - | - | - | - | - |
| SW Segment | B.1 | 6.30 | 9.00 | 1.43 | DF #2 | 0.50 | Interstory |
| SW Segment | B.2 | 5.20 | 9.00 | 1.73 | DF #2 | 0.50 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| **SW GRID** | **E** | **42.20** | - | - | - | - | - |
| SW Segment | E.1 | 6.50 | 9.00 | 1.38 | DF #2 | 0.50 | Interstory |
| SW Segment | E.2 | 14.00 | 9.00 | 0.64 | DF #2 | 0.50 | Interstory |
| SW Segment | E.3 | 21.70 | 9.00 | 0.41 | DF #2 | 0.50 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| **SW GRID** | **F** | **13.50** | - | - | - | - | - |
| SW Segment | F.1 | 13.50 | 9.00 | 0.67 | DF #2 | 0.50 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Base |

**Shear Wall Loads and Summary**

| SW Mark | | EQ (lb) Wall (ULT) | Wind (lb) Wall (ULT) | Wall DL (lb) Wall | Wall DL (lb) End 1 | Wall DL (lb) End 2 | Shear Wall Type | MIN. # of End Studs | Holdown |
|---|---|---|---|---|---|---|---|---|---|
| **SW GRID** | **A** | 1100 | 1500 | - | - | - | - | - | - |
| SW Segment | A.1 | 1100 | 1500 | 1534 | 1187 | 1187 | **SW-6** | **2** | **CS16 (1705)** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| **SW GRID** | **B** | 3600 | 2900 | | | | - | - | - |
| SW Segment | B.1 | 1972 | 1589 | 1646 | | | **SW-6** | **2** | **CS16 (1705)** |
| SW Segment | B.2 | 1628 | 1311 | 968 | | | **SW-6** | **2** | **CS16 (1705)** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| **SW GRID** | **E** | 5300 | 2900 | | | | - | - | - |
| SW Segment | E.1 | 816 | 447 | 1698 | | | **SW-6** | **2** | **CS16 (1705)** |
| SW Segment | E.2 | 1758 | 962 | 2299 | | | **SW-6** | **2** | **CS16 (1705)** |
| SW Segment | E.3 | 2725 | 1491 | 2585 | | | **SW-6** | **2** | **CS16 (1705)** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| **SW GRID** | **F** | 500 | 1000 | | | | - | - | - |
| SW Segment | F.1 | 500 | 1000 | 2668 | | | **SW-6** | **2** | **CS16 (1705)** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |
| SW Segment | | 0 | 0 | | | | **2SW-2** | | **No HD** |

# LIGHT FRAMED WOOD SHEATHED PANEL SHEAR WALL DESIGN

Per IBC 2015, ASCE 7-10, SDPWS 2015 & NDS 2015

Structure: **Lee-Boyle Residence**
Floor Level: **Roof (E-W)**

**Shear Wall Schedule (LRFD)** $\phi_D$ = 0.8

| Shear Wall Type | Sheathing Grade, Sheathing Thickness, & Nail Size | Panel Edge Nail Spacing (in) | Nominal Seismic SW Capacity (plf) | LRFD Seismic SW Capacity (plf) | Sheathing Shear Stiffness, $G_a$ (lb/in) |
|---|---|---|---|---|---|
| SW-6 | APA Rated, 15/32", 8d Common | 6 | 520 | 416 | 10 |
| SW-4 | APA Rated, 15/32", 8d Common | 4 | 760 | 608 | 13 |
| SW-3 | APA Rated, 15/32", 8d Common | 3 | 980 | 784 | 15 |
| SW-2 | APA Rated, 15/32", 8d Common | 2 | 1280 | 1024 | 20 |
| 2SW-4 | APA Rated, 15/32", 8d Common | 4 | 1520 | 1216 | 26 |
| 2SW-3 | APA Rated, 15/32", 8d Common | 3 | 1960 | 1568 | 30 |
| 2SW-2 | APA Rated, 15/32", 8d Common | 2 | 2560 | 2048 | 40 |

**Determine Shear Wall Type (LRFD)**

| SW Segment Mark | Seismic Shear (plf) | Seismic & Wind Aspect Ratio Reduction | Adjusted Seismic Shear (plf) | Wind Shear (plf) | Adjusted Wind Shear (plf) | Req'd Shear (plf) | Shear Wall Type | Shear Wall Capacity (plf) | Check |
|---|---|---|---|---|---|---|---|---|---|
| A.1 | 77 | 1.00 | 77 | 106 | 75 | 77 | SW-6 | 416 | OK |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| B.1 | 313 | 1.00 | 313 | 252 | 180 | 313 | SW-6 | 416 | OK |
| B.2 | 313 | 1.00 | 313 | 252 | 180 | 313 | SW-6 | 416 | OK |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| E.1 | 126 | 1.00 | 126 | 69 | 49 | 126 | SW-6 | 416 | OK |
| E.2 | 126 | 1.00 | 126 | 69 | 49 | 126 | SW-6 | 416 | OK |
| E.3 | 126 | 1.00 | 126 | 69 | 49 | 126 | SW-6 | 416 | OK |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| F.1 | 37 | 1.00 | 37 | 74 | 53 | 53 | SW-6 | 416 | OK |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |

**Determine Shear Wall Overturning Moment Lever Arm**

| SW Segment Mark | Wall Length Lever Arm (ft) | Calculated Lever Arm (ft) | % Different | Override Wall Length | User Input $M_{OT}$ Lever Arm (ft) |
|---|---|---|---|---|---|
| A.1 | 14.20 | 13.99 | 1.49% | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| B.1 | 6.30 | 6.09 | 3.42% | No | |
| B.2 | 5.20 | 4.99 | 4.17% | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| E.1 | 6.50 | 6.29 | 3.31% | No | |
| E.2 | 14.00 | 13.79 | 1.51% | Yes | 13.00 |
| E.3 | 21.70 | 21.49 | 0.97% | No | |
| | | | | No | |
| | | | | No | |
| F.1 | 13.50 | 13.29 | 1.57% | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |

# LIGHT FRAMED WOOD SHEATHED PANEL SHEAR WALL DESIGN

Per IBC 2015, ASCE 7-10, SDPWS 2015 & NDS 2015

Structure: **Lee-Boyle Residence**
Floor Level: **Roof (E-W)**

**Shear Wall End Axial Load (ASD)**

| SW Segment Mark | Seismic Tension (lb) | ASD Seismic Tension Above (lb) | Seismic Tension Total (lb) | Wind Tension (lb) | ASD Wind Tension Above (lb) | Wind Tension Total (lb) | End 1 Dead (lb) | End 2 Dead (lb) |
|---|---|---|---|---|---|---|---|---|
| A.1 | 488 | 0 | 488 | 570 | 0 | 570 | 1954 | 1954 |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| B.1 | 1972 | 0 | 1972 | 1362 | 0 | 1362 | 823 | 823 |
| B.2 | 1972 | 0 | 1972 | 1362 | 0 | 1362 | 484 | 484 |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| E.1 | 791 | 0 | 791 | 371 | 0 | 371 | 849 | 849 |
| E.2 | 852 | 0 | 852 | 400 | 0 | 400 | 1150 | 1150 |
| E.3 | 791 | 0 | 791 | 371 | 0 | 371 | 1293 | 1293 |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| F.1 | 233 | 0 | 233 | 400 | 0 | 400 | 1334 | 1334 |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |

**Determine Required Holdown (ASD)**

| SW Segment Mark | Wind End 1 Eq. 16-15 | End 1 Eq. 16-16 | End 2 Eq. 16-15 | End 2 Eq. 16-16 | Controlling Ten. Load (lb) | Holdown | Holdown Capacity (lb) | Status |
|---|---|---|---|---|---|---|---|---|
| A.1 | 602 | 427 | 602 | 427 | 427 | CS16 (1705) | -1705 | OK |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| B.1 | -868 | -1587 | -868 | -1587 | -1587 | CS16 (1705) | -1705 | OK |
| B.2 | -1071 | -1600 | -1071 | -1600 | -1600 | CS16 (1705) | -1705 | OK |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| E.1 | 138 | -394 | 138 | -394 | -394 | CS16 (1705) | -1705 | OK |
| E.2 | 290 | -314 | 290 | -314 | -314 | CS16 (1705) | -1705 | OK |
| E.3 | 404 | -186 | 404 | -186 | -186 | CS16 (1705) | -1705 | OK |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| F.1 | 400 | 391 | 400 | 391 | 391 | CS16 (1705) | -1705 | OK |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | No HD | | |
| | | | | | | No HD | | |

# LIGHT FRAMED WOOD SHEATHED PANEL SHEAR WALL DESIGN

Per IBC 2015, ASCE 7-10, SDPWS 2015 & NDS 2015

Structure: **Lee-Boyle Residence**
Floor Level: **Upper (E-W)**

**Sds =** **0.941**
**Depth of Floor Framing & Plates (Clearspan) at Interstory (in) =** **17.50**

**Shear Wall Line Information**

| SW Mark | | $L_{SW}$ (ft) | $h_{SW}$ (ft) | $h_{SW}/L_{SW}$ | Wall Framing Species | Specific Gravity G | Interstory of Base? |
|---|---|---|---|---|---|---|---|
| SW GRID | | 0.00 | - | - | - | - | - |
| SW Segment | | | | #DIV/0! | DF #2 | 0.50 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW GRID | | 0.00 | - | - | - | - | - |
| SW Segment | | | | #DIV/0! | DF #2 | 0.50 | Interstory |
| SW Segment | | | | #DIV/0! | DF #2 | 0.50 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW GRID | E | 30.90 | - | - | - | - | - |
| SW Segment | E.1 | 11.30 | 9.50 | 0.84 | DF #2 | 0.50 | Base |
| SW Segment | E.2 | 9.20 | 9.50 | 1.03 | DF #2 | 0.50 | Base |
| SW Segment | E.3 | 10.40 | 9.50 | 0.91 | DF #2 | 0.50 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW GRID | F | 13.50 | - | - | - | - | - |
| SW Segment | F.1 | 13.50 | 9.50 | 0.70 | DF #2 | 0.50 | Base |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |
| SW Segment | | | | #DIV/0! | S-P-F #1/#2 | 0.42 | Interstory |

**Shear Wall Loads and Summary**

| SW Mark | | EQ (lb) Wall (ULT) | Wind (lb) Wall (ULT) | Wall DL (lb) Wall | Wall DL (lb) End 1 | Wall DL (lb) End 2 | Shear Wall Type | MIN. # of End Studs | Holdown |
|---|---|---|---|---|---|---|---|---|---|
| SW GRID | | | | - | - | - | - | - | - |
| SW Segment | | #DIV/0! | #DIV/0! | | | | 2SW-2 | | No Strap |
| SW Segment | | #DIV/0! | #DIV/0! | | | | 2SW-2 | | No Strap |
| SW Segment | | #DIV/0! | #DIV/0! | | | | 2SW-2 | | No Strap |
| SW Segment | | #DIV/0! | #DIV/0! | | | | 2SW-2 | | No Strap |
| SW Segment | | #DIV/0! | #DIV/0! | | | | 2SW-2 | | No Strap |
| SW GRID | | | | | | | - | - | - |
| SW Segment | | #DIV/0! | #DIV/0! | | | | 2SW-2 | | No Strap |
| SW Segment | | #DIV/0! | #DIV/0! | | | | 2SW-2 | | No Strap |
| SW Segment | | #DIV/0! | #DIV/0! | | | | 2SW-2 | | No Strap |
| SW Segment | | #DIV/0! | #DIV/0! | | | | 2SW-2 | | No Strap |
| SW Segment | | #DIV/0! | #DIV/0! | | | | 2SW-2 | | No Strap |
| SW GRID | E | 13100 | 12200 | | | | - | - | - |
| SW Segment | E.1 | 4791 | 4461 | 678 | | | SW-4 | 2 | HDU4 (4565DF, 3285HF) |
| SW Segment | E.2 | 3900 | 3632 | 552 | | | SW-4 | 2 | HDU4 (4565DF, 3285HF) |
| SW Segment | E.3 | 4409 | 4106 | 312 | | | SW-4 | 2 | HDU4 (4565DF, 3285HF) |
| SW Segment | | 0 | 0 | | | | 2SW-2 | | No Strap |
| SW Segment | | 0 | 0 | | | | 2SW-2 | | No Strap |
| SW GRID | F | 1000 | 2600 | | | | - | - | - |
| SW Segment | F.1 | 1000 | 2600 | 4476 | | | SW-6 | 2 | HDU2 (3075DF,2215HF) |
| SW Segment | | 0 | 0 | | | | 2SW-2 | | No Strap |
| SW Segment | | 0 | 0 | | | | 2SW-2 | | No Strap |
| SW Segment | | 0 | 0 | | | | 2SW-2 | | No Strap |
| SW Segment | | 0 | 0 | | | | 2SW-2 | | No Strap |

# LIGHT FRAMED WOOD SHEATHED PANEL SHEAR WALL DESIGN

Per IBC 2015, ASCE 7-10, SDPWS 2015 & NDS 2015

Structure: **Lee-Boyle Residence**
Floor Level: **Upper (E-W)**

**Shear Wall Schedule (LRFD)** $\phi_D$ = 0.8

| Shear Wall Type | Sheathing Grade, Sheathing Thickness, & Nail Size | Panel Edge Nail Spacing (in) | Nominal Seismic SW Capacity (plf) | LRFD Seismic SW Capacity (plf) | Sheathing Shear Stiffness, $G_a$ (lb/in) |
|---|---|---|---|---|---|
| SW-6 | APA Rated, 15/32", 8d Common | 6 | 520 | 416 | 10 |
| SW-4 | APA Rated, 15/32", 8d Common | 4 | 760 | 608 | 13 |
| SW-3 | APA Rated, 15/32", 8d Common | 3 | 980 | 784 | 15 |
| SW-2 | APA Rated, 15/32", 8d Common | 2 | 1280 | 1024 | 20 |
| 2SW-4 | APA Rated, 15/32", 8d Common | 4 | 1520 | 1216 | 26 |
| 2SW-3 | APA Rated, 15/32", 8d Common | 3 | 1960 | 1568 | 30 |
| 2SW-2 | APA Rated, 15/32", 8d Common | 2 | 2560 | 2048 | 40 |

**Determine Shear Wall Type (LRFD)**

| SW Segment Mark | Seismic Shear (plf) | Seismic & Wind Aspect Ratio Reduction | Adjusted Seismic Shear (plf) | Wind Shear (plf) | Adjusted Wind Shear (plf) | Req'd Shear (plf) | Shear Wall Type | Shear Wall Capacity (plf) | Check |
|---|---|---|---|---|---|---|---|---|---|
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| E.1 | 424 | 1.00 | 424 | 395 | 282 | 424 | SW-4 | 608 | OK |
| E.2 | 424 | 1.00 | 424 | 395 | 282 | 424 | SW-4 | 608 | OK |
| E.3 | 424 | 1.00 | 424 | 395 | 282 | 424 | SW-4 | 608 | OK |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| F.1 | 74 | 1.00 | 74 | 193 | 138 | 138 | SW-6 | 416 | OK |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |
| | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 2SW-2 | 2048 | #DIV/0! |

**Determine Shear Wall Overturning Moment Lever Arm**

| SW Segment Mark | Wall Length Lever Arm (ft) | Calculated Lever Arm (ft) | % Different | Override Wall Length | User Input $M_{OT}$ Lever Arm (ft) |
|---|---|---|---|---|---|
| | 0.00 | -0.21 | 100.00% | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| E.1 | 11.30 | 10.82 | 4.48% | No | |
| E.2 | 9.20 | 8.72 | 5.56% | No | |
| E.3 | 10.40 | 9.92 | 4.88% | No | |
| | | | | No | |
| | | | | No | |
| F.1 | 13.50 | 13.02 | 3.72% | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |
| | | | | No | |

## LIGHT FRAMED WOOD SHEATHED PANEL SHEAR WALL DESIGN

Per IBC 2015, ASCE 7-10, SDPWS 2015 & NDS 2015

Structure: **Lee-Boyle Residence**
Floor Level: **Upper (E-W)**

**Shear Wall End Axial Load (ASD)**

| SW Segment Mark | Seismic Tension (lb) | ASD Seismic Tension Above (lb) | Seismic Tension Total (lb) | Wind Tension (lb) | ASD Wind Tension Above (lb) | Wind Tension Total (lb) | End 1 Dead (lb) | End 2 Dead (lb) |
|---|---|---|---|---|---|---|---|---|
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| E.1 | 2819 | 791 | 3610 | 2250 | 371 | 2621 | 339 | 339 |
| E.2 | 2819 | 852 | 3671 | 2250 | 400 | 2650 | 276 | 276 |
| E.3 | 2819 | 791 | 3610 | 2250 | 371 | 2621 | 156 | 156 |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| F.1 | 493 | 233 | 726 | 1098 | 400 | 1498 | 2238 | 2238 |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |
| | | 0 | | | 0 | | | |

**Determine Required Holdown (ASD)**

| SW Segment Mark | Wind End 1 Eq. 16-15 | End 1 Eq. 16-16 | End 2 Eq. 16 15 | End 2 Eq. 16-16 | Controlling Ten. Load (lb) | Holdown | Holdown Capacity (lb) | Status |
|---|---|---|---|---|---|---|---|---|
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
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| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
| E.1 | -2418 | -3452 | -2418 | -3452 | -3452 | HDU4 (4565DF, 3285HF) | -4565 | OK |
| E.2 | -2485 | -3542 | -2485 | -3542 | -3542 | HDU4 (4565DF, 3285HF) | -4565 | OK |
| E.3 | -2528 | -3537 | -2528 | -3537 | -3537 | HDU4 (4565DF, 3285HF) | -4565 | OK |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
| F.1 | -155 | 322 | -155 | 322 | -155 | HDU2 (3075DF,2215HF) | -3075 | OK |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |
| | | | | | | No Strap | | |

# Vertical Diaphragm Seismic Forces Distribution

## I- Diaphragm Forces.

From The Equivalent Lateral Force Procedure Spreadsheet, we obtain the following Results: (LRFD).

| Level | SW Design Force $F_x$ (K) | Diaphragm Design Force $F_{px}$ (K) | Notes |
|---|---|---|---|
| Roof | $10.50^k$ | $11.4^k$ | $= F_p$ min*; governs |
| Upper | $8.3^k$ | $13.1^k$ | $= F_p$ min*; governs |
| | $18.8^k$ | $24.5^k$ | |

* $F_{px-min} = 0.2 * S_{DS} * I_E * w_{px}$ per ASCE 7-10 12.10.1.1

## II- SubDiaphragm Calcs.

→ Roof

a) Generals (N-S) Direction

$l_1 = 21.3'$ ; $B_1 = 13.5'$ ; $F_{px} = 11.4^k$

$l_2 = 29.3'$ ; $B_2 = 22.7'$

$l_3 = 37.6'$ ; $B_3 = 17.4'$ ; $LT = 154.9'$

$l_4 = 28.2'$ ; $B_4 = 8.2'$

$l_5 = 29.3'$ ; $B_5 = 14.7'$

$l_6 = 9.2'$ ; $B_6 = 4.3'$

b) (N-S) Direction Subdiaphragm calcs

$WE1 = [11.4^k + (21.3'/154.9')]/13.5' = 0.116$ k/ft

$WE2 = [11.4^k * (29.3'/154.9')]/22.7' = 0.095$ k/ft

$WE3 = [11.4^k * (37.6'/154.9')]/17.4' = 0.159$ k/ft

$WE4 = [11.4^k * (28.2'/154.9')]/8.2' = 0.253$ k/ft

$W_{E5} = [11.4^k * (29.3'/154.9')] / 14.7' = 0.147\ ^k/_{ft}$

$W_{E6} = [11.4^k * (9.2'/154.9')] / 4.3' = 0.157\ ^k/_{ft}$

C) Generals (E-W) Direction

$l_7 = 26.3'$ ; $B_7 = 8.2'$ ; $F_{px} = 11.4^k$

$l_8 = 62.8'$ ; $B_8 = 13.0'$ ; $L_T = 262.2'$

$l_9 = 75.8'$ ; $B_9 = 7.2'$

$l_{10} = 75.0'$ ; $B_{10} = 9.2'$

$l_{11} = 13.5'$ ; $B_{11} = 5.0'$

$l_{12} = 8.8'$ ; $B_{12} = 2.7'$

D) (E-W) Direction Subdiaphragm Calcs.

$W_{E7} = [11.4^k * (26.3'/262.2')] / 8.2' = 0.139\ ^k/_{ft}$

$W_{E8} = [11.4^k * (62.8'/262.2')] / 13.0' = 0.210\ ^k/_{ft}$

$W_{E9} = [11.4^k * (75.8'/262.2')] / 7.2' = 0.456\ ^k/_{ft}$

$W_{E10} = [11.4^k * (75.0'/262.2')] / 9.2' = 0.354\ ^k/_{ft}$

$W_{E11} = [11.4^k * (13.5'/262.2')] / 5.0' = 0.117\ ^k/_{ft}$

$W_{E12} = [11.4^k * (8.8'/262.2')] / 2.7' = 0.142\ ^k/_{ft}$.

→ upper Floor. (seismic)

a) Generals (N-S) Direction

$l_1$ = 21.3' ; $B_1$ = 13.5' ; $F_{px}$ = 13.1$^k$

$l_2$ = 29.3' ; $B_2$ = 22.7' ; $L_T$ = 154.9'

$l_3$ = 37.6' ; $B_3$ = 17.4'

$l_4$ = 28.2' ; $B_4$ = 8.2'

$l_5$ = 29.3' ; $B_5$ = 14.7'

$l_6$ = 9.2' ; $B_6$ = 4.3'

b) (N-S) Direction Subdiaphragm Calcs

$W_{E1}$ = [13.1$^k$ * (21.3'/154.9')]/13.5' = 0.133 k/ft

$W_{E2}$ = [13.1$^k$ * (29.3'/154.9')]/22.7' = 0.109 k/ft

$W_{E3}$ = [13.1$^k$ * (37.6'/154.9')]/17.4' = 0.183 k/ft

$W_{E4}$ = [13.1$^k$ * (28.2'/154.9')]/8.2' = 0.291 k/ft

$W_{E5}$ = [13.1$^k$ * (29.2'/154.9')]/14.7' = 0.168 k/ft

$W_{E6}$ = [13.1$^k$ * (9.2'/154.9')]/4.3' = 0.181 k/ft

c) Generals (E-W) Direction

$l_7$ = 26.3' ; $B_7$ = 8.2' ; $F_{px}$ = 13.1$^k$

$l_8$ = 62.8' ; $B_8$ = 13.8' ; $L_T$ = 262.2'

$l_9$ = 75.8' ; $B_9$ = 6.3'

$l_{10}$ = 75.0' ; $B_{10}$ = 9.2'

$l_{11}$ = 13.5' ; $B_{11}$ = 5.0'

$l_{12}$ = 8.8' ; $B_{12}$ = 2.7'

D) (E-W) Direction Tributary Area Calcs

$W_{E7}$ = [13.1$^k$ * (26.3'/262.2')]/8.2' = 0.160 k/ft

$W_{E8}$ = [13.1$^k$ * (62.8'/262.2')]/13.8' = 0.227 k/ft

$W_{E9}$ = [13.1$^k$ * (75.8'/262.2')]/6.3' = 0.601 k/ft

$W_{E10}$ = [13.1$^k$ * (75.0'/262.2')]/9.2' = 0.407 k/ft

$W_{E11}$ = [13.1$^k$ * (13.5'/262.2')]/5.0' = 0.135 k/ft

$W_{E12}$ = [13.1$^k$ * (8.8'/262.2')]/2.7' = 0.163 k/ft

| | |
|---|---|
| **Design Method** | Allowable Stress Design (ASD) ▼ |
| **Connection Type** | Lateral loading ▼ |
| **Fastener Type** | Nail ▼ |
| **Loading Scenario** | Single Shear ▼ |

| | |
|---|---|
| **Main Member Type** | Douglas Fir-Larch ▼ |
| **Main Member Thickness** | 3.5 in. ▼ |
| **Side Member Type** | Steel ▼ |
| **Side Member Thickness** | 16 gage ▼ |
| **Nail Type** | Common Wire ▼ |
| **Nail Size** | 8d (D = 0.131 in.; L = 2.5 in.) ▼ |
| **Load Duration Factor** | C_D = 1.6 ▼ |
| **Wet Service Factor** | C_M = 1.0 ▼ |
| **End Grain Factor** | C_eg = 1.0 ▼ |
| **Temperature Factor** | C_t = 1.0 ▼ |
| **Diaphragm Factor** | C_di = 1.1 ▼ |

# Connection Yield Modes

| | |
|---|---|
| Im | 1189 lbs. |
| Is | 389 lbs. |
| II | 482 lbs. |
| IIIm | 499 lbs. |
| IIIs | 170 lbs. |
| IV | 233 lbs. |

| | |
|---|---|
| **Adjusted ASD Capacity** | **170 lbs.** |

- Nail bending yield strength of 100000 psi is assumed.
- The Adjusted ASD Capacity does not apply for toe-nails installed in wood members.
- Length of tapered tip is assumed to be two times the nail diameter for calculating dowel bearing length in the main member.
- The Adjusted ASD Capacity only applies for nails that have been driven flush with the side member surface. It does not apply for nails that have been overdriven into the side member.
- ASTM A36 Steel is assumed for steel side members 1/4 in. thick, and ASTM A653 Grade 33 Steel is assumed for steel side members less than 1/4 in. thick.



The Connection Calculator was designed and created by Cameron Knudson, Michael Dodson and David Pollock at Washington State University. Support for development of the Connection Calculator was provided by American Wood Council.

# Drag strut-Calcs.

→ Upper Floor:

(N-S) at Grid 2: (Reentrant Corner.

* Generals:

$w_{E_1} = 0.133\ ^k/ft$ (LRFD) ; $B_1 = 7.5'$ , $w_{E_2} = 0.109\ ^k/ft$ (LRFD) ; $B_2 = 11.3'$

$V_{NA} = 170\#/nail$ ASD. ; spacing 4" o.c ; strap Length = 4'0". (CS16)

Diaph. Cap. = 480 #/ft (seismic blocked 15/32" Plywood @ 6" o.c -NDS 2015)

* Calculation:

$V_E = \Sigma w_E * B$ [(0.133 k/ft * 7.5') + (0.109 k/ft * 11.3')] * 0.7 (ASD Seismic) * 25% Load increase (ASCE 7-10 12.3.3.4).

$V_E = 1.95^k$ (ASD)

SW 2.1 = 7.0' section of Shearwall w/ diaphragm on both sides.

$V_{SW}$ = 7.0' * 480 #/ft = 3360 # * 0.7 ASD = 2352 # (ASD).

$V_E$ = 1950 # < $V_{SW}$ = 2352 # ; ok For shear transfer.

∴ Prescriptive CS16 Strap to be added

* Strap Calculation

$V_{SA} = \frac{4'0" * 12"}{4" o.c} = \frac{48"}{4" o.c} =$ 12 nails * 170#/nails = 2,040 #.

∴ use a CS16 Strap x 4'-0" w/ 10d nails @ 4" o.c.

## (E-W) At Grid B : (Reentrant Corner)

* Generals:

$W_{E7} = 0.160\ ^k/ft$ , $B_1 = 8.2'$

$V_{NA} = 170\ \#/Nail$ (ASD) ; Spacing = 4" o.c , strap length = 4'-0" (CS16)

Dia Cap = 480 #/ft (seismic blocked)

* Calculation:

$V_E = (0.160\ ^k/ft * 8.2') * 0.7\ ASD * 25\%\ Inc$

$V_E = 1.15^k$ (ASD)

* Strap Calculation

$V_{SA} = \frac{4'0" \times 12"}{4" o.c} = \frac{48"}{4" o.c} = 12\ nails * 170\ \#/nail = 2{,}040\ \#$.

$V_E = 1{,}150\ \# < V_{SA} = 2040\ \#$ ; ok.

∴ USE A CS16 strap x 4'0" w/10d nails @ 4" o.c

## (E-W) At Grid C : Reentrant Corner

* Generals

$W_{E9} = 0.6\ ^k/ft$ , $B_9 = 6.3'$ ; $W_{E10} = 0.407\ ^k/ft$ , $B_{10} = 9.2'$

$V_{NA} = 170\ \#/nail$ (ASD) ; spacing 4" o.c. , strap length = 6'-0" (CS16)

Diaph. Cap. = 480 #/ft (seismic blocked)

* Calculation

$V_E = [(0.6\ ^k/ft * 6.3') + (0.407\ ^k/ft * 9.2')] * 0.7\ ASD * 25\%\ inc$

$V_E = 6.6\ ^k/ft$

* Strap Calculation.

$V_{SA} = \frac{7'0" * 12"}{4"o.c} = \frac{84"}{4"o.c} = 21$ nails * 170#/nails = 3,570 #

$V_E = 6,600/2 = 3300$ #/strap.

$V_E = 3300$ # < $V_{SA} = 3570$ # ; OK.

∴ use a CS16 strap x 7'-0" w/10d nails @ 4"o.c.

(N-S) AT stair opening :

* $W_{E3} = 0.183$ k/ft ; $B_1 = 13.3'$ ; $W_{E4} = 0.291$ k/ft ; $B_4 = 5.3'$.

$V_{NA} = 170$ #/nail (ASD) ; spacing 4"o.c, strap Length = 4'-0" (CS16)

Diaph. cap. = 480 #/ft (seismic blocked)

* Calculation

$V_{E1} = (0.183$ k/ft * 13.3') + 0.7 ASD * 25% inc = 2.13 k /2 collectors

$V_{E1} = 1.06$ k (ASD)

$V_{E2} = (0.291$ k/ft * 5.3') * 0.7 ASD * 25% inc = 1.35 k/2 collectors.

$V_{E2} = 0.68$ k (ASD)

* strap Calculation

$V_{SA} = \frac{4'0" * 12"}{4"o.c} = \frac{48"}{4"} = 12$ nails * 170#/nail = 2040 #

$V_E = V_{E1} + V_{E2} = 1060$ # + 680 # = 1740 #

$V_E = 1740$ # < $V_{SA} = 2040$ # ; ok

∴ use a CS16 strap x 4'-0" w/10d nails @ 4"o c

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1511 THIRD AVENUE
SUITE 323
SEATTLE, WA 98101
TEL 206.957.3900
FAX 206.957.3901
www.quantumce.com

project: Lee Boyle Res.
date: 07/23/2019
project no.: 19052.01
designer: MDA
sheet: # 3
client: Stuart Silk
checked by:

→ Roof :

(N-S) at Grid : (Reentrant Corner)

* Generals.

$W_{E1} = 0.116^k/ft$ ; $B_1 = 13.5 ft$ ; $W_{E2} = 0.095^k/ft$ ; $B_2 = 11.3'$

$V_{NA} = 170 \#/nail$ (ASD ; spacing 4"o.c , strap length = 4'-0" (CS16)

Diaph Cap. = 320 #/ft ( Seismic unblocked 15/32" plywood @ 6"o.c - NDS 2015 )

* Calculation

$V_E = \sum W_E * B = [(0.116^k/ft * 13.5') + (0.095^k/ft * 11.3')] * 0.7$ ASD Seismic * 25% increase (ASCE 7-10 12.3.3.4)

$V_E = 2.31^k$ (ASD)

SW 2.1 = 1.6' section of SW w/ Diaphragm on Both sides

$V_{SW} = 1.6' * 320 \#/ft = 512 \# * 0.7$ ASD = 358 # (ASD).

$V_E = 2{,}310 \# > V_{SW} = 358 \#$ ; N.G. strap Required For shear Transfer.

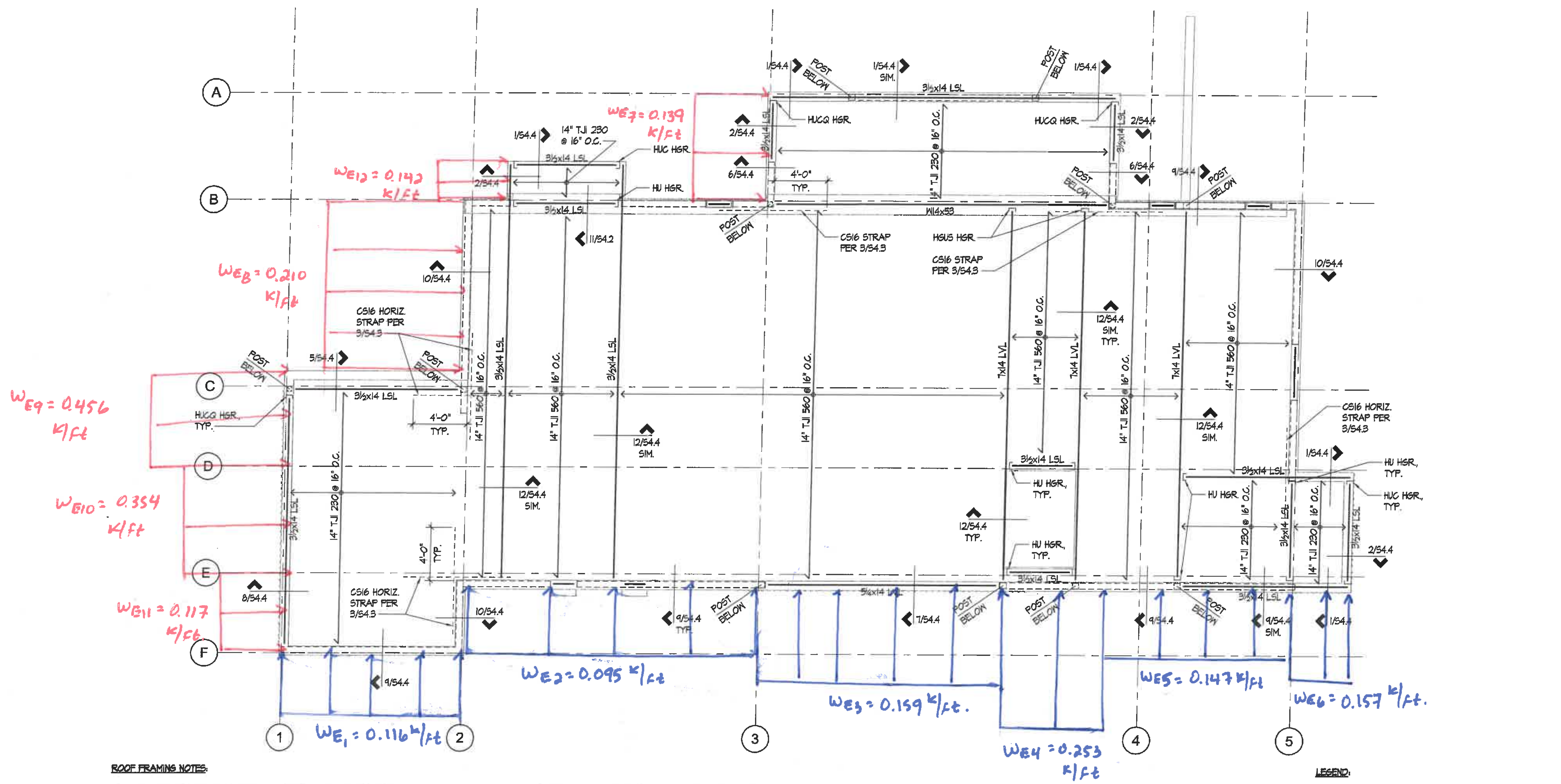
$V_{ST} = V_E - V_{SW} = 2310 \# - 358 \# = 1952 \#$

\+ strap Calculation:

$V_{SA} = \frac{4'0" * 12"}{4"o.c} = \frac{48"}{4"o.c} = 12$ nails * 170 #/nails = 2040 #

$V_{ST} = 1952 \# < V_{SA} = 2040 \#$ ; ok

∴ Use a CS16 strap x 4'0" w/ 10d nails @ 4"o.c




ROOF FRAMING NOTES:

1. ALL DIMENSIONS AND ELEVATIONS ON THE STRUCTURAL PLANS ARE FOR GENERAL INFORMATION ONLY AND SHALL BE VERIFIED BY THE CONTRACTOR WITH THE ARCHITECTURAL DRAWINGS BEFORE CONSTRUCTION BEGINS. ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ARCHITECT AND ENGINEER IMMEDIATELY.
2. SEE SHEETS S1.0 AND S1.1 FOR GENERAL STRUCTURAL NOTES AND ABBREVIATIONS. SEE SHEETS S4.0 THRU S4.4 FOR TYPICAL WOOD DETAILS. SEE SHEET S5.0 FOR TYPICAL STEEL DETAILS.
3. TYPICAL ROOF JOIST SHALL BE 14" TJI @ 16" O.C., U.O.N. HANG TJI JOISTS WITH ITS TOP FLANGE HANGERS TYPICAL AT FLUSH BEAMS, U.O.N.
4. NAIL ROOF SHEATHING TO FRAMING WITH 8d NAILS (0.131"φ x 2.5" LONG) AT 6" O.C. AT ALL PANELS EDGES AND 8d NAILS AT 12" O.C. AT INTERMEDIATE FRAMING MEMBERS (UNBLOCKED). SEE DETAIL 6/S4.0.
5. PROVIDE SOLID BLOCKING BETWEEN EACH ROOF JOIST AT SUPPORTS. PROVIDE AN H1 CLIP AT EVERY MEMBER TO TOP PLATE.
6. ALL HEADERS NOT SHOWN ON PLAN SHALL BE (2) 2x10 FOR EXTERIOR BEARING WALLS AND (2) 2x10 FOR INTERIOR BEARING WALLS. SEE 10/S4.1 FOR HEADER DETAIL.
7. PROVIDE SOLID OR BUILT-UP WOOD POSTS BENEATH THE ENDS OF ALL ROOF BEAMS FOR FULL BEARING.
8. FOR TOP PLATE SPLICE SEE DETAIL 6/S4.1.
9. ALL BEAMS BEARING ON DOUBLE TOP PLATE SHALL BE ATTACHED WITH (2) H2.5A EACH SIDE OF BEAM TO DOUBLE TOP PLATE.
10. ALL BEAMS ARE FLUSH FRAMED U.O.N.

LEGEND:

- INDICATES FRAMING DIRECTION
- INDICATES EXTENT OF FRAMING
- INDICATES WOOD BEARING WALL OR SHEAR WALL BELOW
- INDICATES HEADER MEMBER BELOW. SEE PLAN NOTE 6

ROOF FRAMING PLAN - Diaphragm Forces.

SCALE: 1/4" = 1'-0"


QUANTUM CONSULTING ENGINEERS
1511 THIRD AVENUE
SUITE 323
SEATTLE, WA 98101
TEL 206.957.3900
FAX 206.957.3901
www.quantumce.com


SANDRO K. KODAMA, STATE OF WASHINGTON, PROFESSIONAL STRUCTURAL ENGINEER

| | |
|---|---|
| DESIGN | FRU, TVM, MDA |
| DRAWN | SSN |
| CHECKED | SKK |
| SHEET ISSUE DATE - 3/11/19 | |
| DRAWING SETS | |
| DATE | DESCRIPTION |
| 3/11/19 | PERMIT SET |
| REVISIONS | |
| 1 6/7/19 | SUB_2 (SUB_1 CORRECTIONS) |

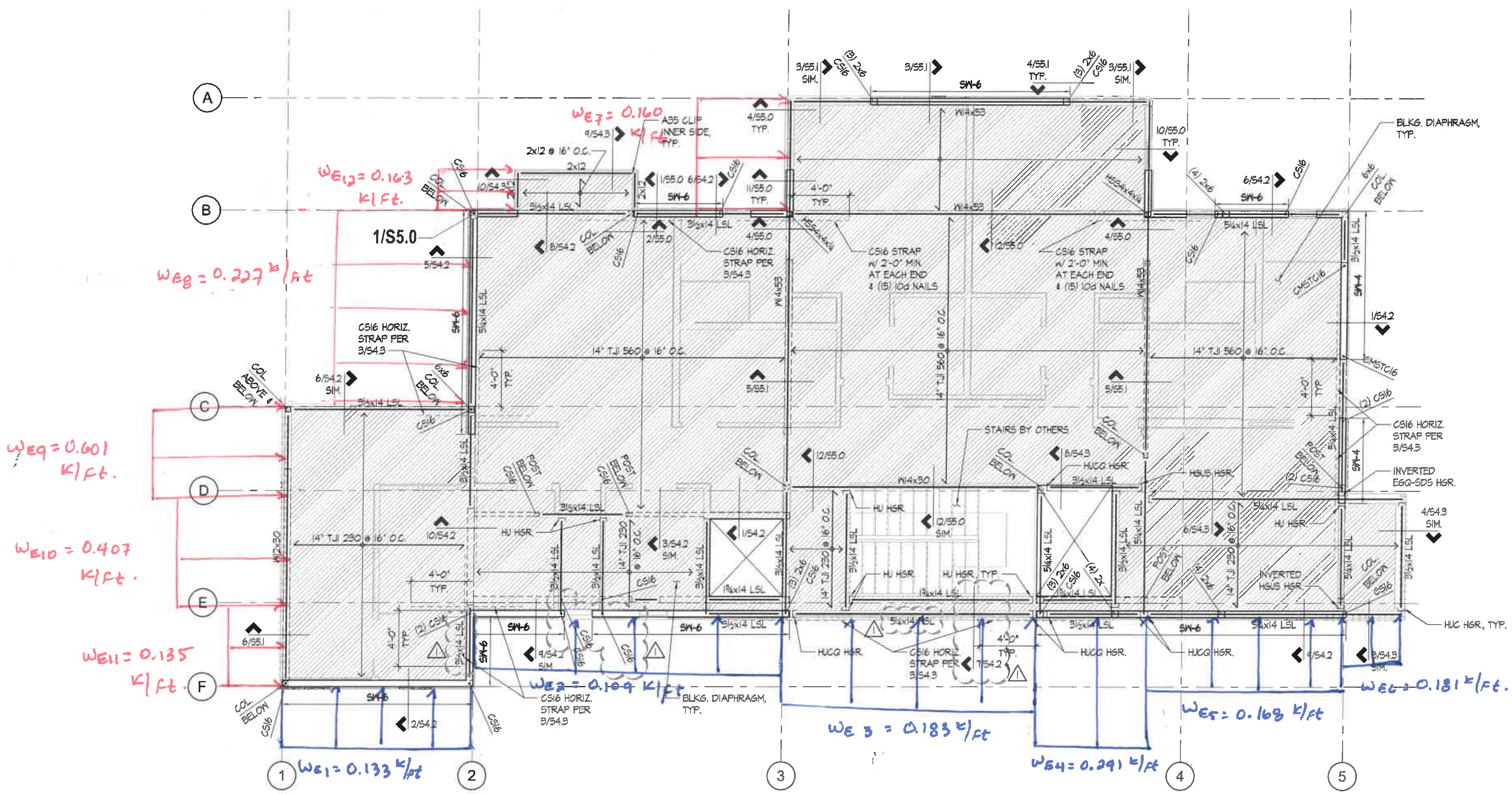

Stuart Silk Architects
2400 N. 45th St.
Seattle, WA 98103
WWW.STUARTSILK.COM


LEE-BOYLE

4150 BOULEVARD PLACE
MERCER ISLAND, WA 98040

PROJECT NO. 19052.01

ROOF FRAMING PLAN




FLOOR FRAMING NOTES:

1. ALL DIMENSIONS AND ELEVATIONS ON THE STRUCTURAL PLANS ARE FOR GENERAL INFORMATION ONLY AND SHALL BE VERIFIED BY THE CONTRACTOR WITH THE ARCHITECTURAL DRAWINGS BEFORE CONSTRUCTION BEGINS. ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ARCHITECT AND ENGINEER IMMEDIATELY.
2. SEE SHEETS S1.0 AND S1.1 FOR GENERAL STRUCTURAL NOTES AND ABBREVIATIONS. SEE SHEETS S4.0 THRU S4.4 FOR TYPICAL WOOD DETAILS. SEE SHEET S5.0 FOR TYPICAL STEEL DETAILS.
3. TYPICAL FLOOR FRAMING CONSISTS OF 23/32" APA RATED T&G SHEATHING (INDEX 48/24), LAID FACE GRAIN PERPENDICULAR OVER 14" TJI JOISTS AT 16" O.C. HANG TJI JOISTS WITH ITS TOP FLANGE HANGERS TYPICAL AT FLUSH BEAMS, U.O.N.
4. NAIL FLOOR SHEATHING TO FRAMING WITH 8d NAILS (0.131"Φ x 2.5" LONG) AT 6" O.C. AT ALL PANELS EDGES AND 8d NAILS AT 12" O.C. AT INTERMEDIATE FRAMING MEMBERS (UNBLOCKED). SEE DETAIL 6/S4.0.
5. ALL BEARING AND SHEAR WALLS SHALL BE 2x4 @ 16" O.C. INTERIOR AND 2x6 @ 16" O.C. EXTERIOR U.O.N.
6. POSTS INDICATED ARE AT THIS LEVEL. ALL POSTS NOT SPECIFIED SHALL BE (2) 2x U.O.N. SOLID SAWN MEMBERS OF EQUIVALENT SIZE MAY BE SUBSTITUTED FOR BUILT-UP MEMBERS (SUCH AS A 4x6 FOR (3) 2x4).
7. PROVIDE SOLID OR BUILT-UP WOOD POSTS BENEATH THE ENDS OF ALL FLOOR BEAMS AND ALL POSTS ABOVE FOR FULL BEARING. PROVIDE BLKG. AT JOISTS PER DETAIL 7/S4.1.
8. ALL HEADERS NOT SHOWN ON PLAN SHALL BE (2) 2x10 FOR EXTERIOR BEARING WALLS AND (2) 2x10 FOR INTERIOR BEARING WALLS. SEE 10/S4.1 FOR HEADER DETAIL.
9. FOR TOP PLATE SPLICE SEE DETAIL 6/S4.1.
10. ALIGN A JOIST OR JOIST BLOCKING OVER THE FULL LENGTH OF ALL BEARING/SHEAR WALLS. SEE 8/S4.0 FOR SPECIAL SHEAR WALL BLOCKING REQUIREMENTS.
11. SW-x INDICATES SHEAR WALL AT THIS LEVEL. SEE SHEAR WALL SCHEDULE 8/S4.0 FOR SHEATHING, BLOCKING, NAILING, AND ANCHOR BOLT REQUIREMENTS. ALL EXTERIOR WALLS SHALL BE SHEATHED PER SW-6 CRITERIA U.O.N.
12. HDUx INDICATES HOLDOWN TO CONCRETE FOUNDATION WALLS OR FOOTINGS. SEE 12/S4.0 FOR HOLDOWN DETAIL. USE MIN. (2) 2x POST U.O.N.
13. CMSTC16 INDICATES HOLDOWN STRAP TO FRAMING BELOW WALL. SEE 10/S4.0 FOR STRAP HOLDOWN DETAIL AT FLOOR-TO-FLOOR AND BEAM SUPPORTING SHEAR WALL END. USE MIN. (2) 2x POST U.O.N.
14. ALL INVERTED HANGERS SHALL BE INSTALLED WITH SIMPSON SDI0212 SCREWS. FILL ALL HOLES.
15. ALL BEAMS ARE FLUSH FRAMED U.O.N.

LEGEND:

- INDICATES FRAMING DIRECTION
- INDICATES EXTENT OF FRAMING
- SW-x INDICATES SHEAR WALL TYPE AT THIS LEVEL. SEE PLAN NOTE 11
- INDICATES WOOD BEARING OR SHEAR WALL AT THIS LEVEL. SEE PLAN NOTES 5 & 11
- INDICATES WOOD BEARING WALL OR SHEAR WALL BELOW. SEE PLAN NOTE 5
- INDICATES NON-BEARING/ NON-SHEAR WALL AT THIS LEVEL. SEE 1/S4.1 & 2/S4.1 FOR CONNECTION DETAILS
- INDICATES HEADER MEMBER BELOW. SEE PLAN NOTE 8
- (#)2x INDICATES MULTIPLE STUD POST AT THIS LEVEL. SEE PLAN NOTE 6
- xx INDICATES HOLDOWN TYPE AT THIS LEVEL. SEE PLAN NOTES 12 & 13

PROJECT NORTH / TRUE NORTH

## UPPER FLOOR FRAMING PLAN - Diaphragm Forces.

SCALE: 1/4" = 1'-0"

BLOCK DIAPHRAGM PER 6/S4.0 & 2/S4.3


QUANTUM
CONSULTING ENGINEERS
1511 THIRD AVENUE
SUITE 323
SEATTLE, WA 98101
TEL 206.957.3900
FAX 206.957.3901
www.quantumce.com

SANDRO K. KODAMA
STATE OF WASHINGTON
36613
STRUCTURAL ENGINEER
PROFESSIONAL ENGINEER


| | |
|---|---|
| DESIGN | FRU, TVM, MDA |
| DRAWN | SSN |
| CHECKED | SKK |
| SHEET ISSUE DATE - 3/11/19 | |
| DRAWING SETS | |

| DATE | DESCRIPTION |
|---|---|
| 3/11/19 | PERMIT SET |

REVISIONS

1 6/7/19 SUB_2 (SUB_1 CORRECTIONS)


Stuart Silk Architects
2400 N. 45th St.
Seattle, WA 98103
WWW.STUARTSILK.COM


LEE-BOYLE

4150 BOULEVARD PLACE
MERCER ISLAND, WA 98040

PROJECT NO. 19052.01

UPPER FLOOR FRAMING PLAN

# HDU/DTT

## Holdowns (cont.)

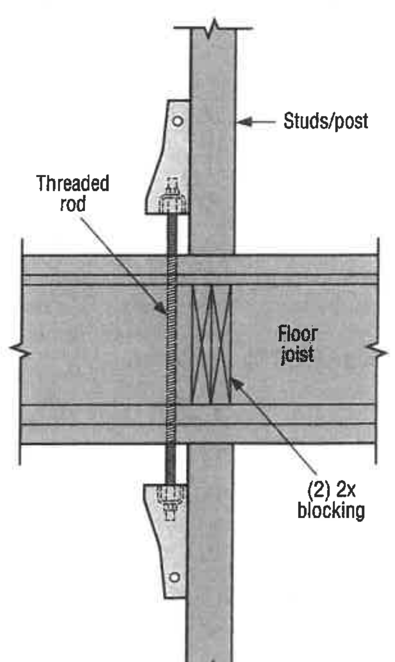
These products are available with additional corrosion protection. For more information, see p. 15.

SS For stainless-steel fasteners, see p. 21.

SD Many of these products are approved for installation with Strong-Drive® SD Connector screws. See pp. 335-337 for more information.

| Model No. | Ga. | Dimensions (in.) | | | | | Fasteners (in.) | | Minimum Wood Member Size (in.) | Allowable Tension Loads (160) | | | Code Ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | W | H | B | CL | SO | Anchor Bolt Dia. (in.) | Wood Fasteners | | DF/SP | SPF/HF | Deflection at Allowable Load (in.) | |
| DTT1Z | 14 | 1½ | 7⅛ | 1 7/16 | ¾ | 3/16 | ⅜ | (6) SD #9 x 1½ | 1½ x 5½ | 840 | 840 | 0.17 | IBC, FL, LA |
| | | | | | | | | (6) 0.148 x 1½ | | 910 | 640 | 0.167 | |
| | | | | | | | | (8) 0.148 x 1½ | | 910 | 850 | 0.167 | |
| SS DTT2Z | 14 | 3¼ | 6 15/16 | 1⅝ | 13/16 | 3/16 | ½ | (8) ¼ x 1½ SDS | 1½ x 3½ | 1,825 | 1,800 | 0.105 | |
| | | | | | | | | (8) ¼ x 1½ SDS | 3 x 3½ | 2,145 | 1,835 | 0.128 | |
| SS DTT2Z-SDS2.5 | | | | | | | | (8) ¼ x 2½ SDS | 3 x 3½ | 2,145 | 2,105 | 0.128 | |
| HDU2-SDS2.5 | 14 | 3 | 8 11/16 | 3¼ | 1 5/16 | 1⅜ | ⅝ | (6) ¼ x 2½ SDS | 3 x 3½ | 3,075 | 2,215 | 0.088 | |
| HDU4-SDS2.5 | 14 | 3 | 10 15/16 | 3¼ | 1 5/16 | 1⅜ | ⅝ | (10) ¼ x 2½ SDS | 3 x 3½ | 4,565 | 3,285 | 0.114 | |
| HDU5-SDS2.5 | 14 | 3 | 13 3/16 | 3¼ | 1 5/16 | 1⅜ | ⅝ | (14) ¼ x 2½ SDS | 3 x 3½ | 5,645 | 4,340 | 0.115 | |
| HDU8-SDS2.5 | 10 | 3 | 16⅝ | 3½ | 1⅜ | 1½ | ⅞ | (20) ¼ x 2½ SDS | 3 x 3½ | 6,765 | 5,820 | 0.11 | |
| | | | | | | | | | 3½ x 3½ | 6,970 | 5,995 | 0.116 | |
| | | | | | | | | | 3½ x 4½ | 7,870 | 6,580 | 0.113 | |
| HDU11-SDS2.5 | 10 | 3 | 22¼ | 3½ | 1⅜ | 1½ | 1 | (30) ¼ x 2½ SDS | 3½ x 5½ | 9,335 | 8,030 | 0.137 | |
| | | | | | | | | | 3½ x 7¼ | 11,175 | 9,610 | 0.137 | |
| HDU14-SDS2.5 | 7 | 3 | 25 11/16 | 3½ | 1 9/16 | 1 9/16 | 1 | (36) ¼ x 2½ SDS | 3½ x 5½² | 10,770 | 9,260 | 0.122 | — |
| | | | | | | | | | 3½ x 7¼ | 14,390 | 12,375 | 0.177 | IBC, FL, LA |
| | | | | | | | | | 5½ x 5½ | 14,445 | 12,425 | 0.172 | |

1. HDU14 requires heavy-hex anchor nut to achieve tabulated loads (supplied with holdown).
2. Where noted in table, loads are applicable to installation on either the narrow or the wide face of the post.




Typical HDU Tie Between Floors

## 1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

## 2. Input Data & Anchor Parameters

**General**
Design method:ACI 318-14
Units: Imperial units

**Anchor Information:**
Anchor type: Cast-in-place
Material: AB
Diameter (inch): 0.625
Effective Embedment depth, $h_{ef}$ (inch): 13.000
Anchor category: -
Anchor ductility: Yes
$h_{min}$ (inch): 15.13
$C_{min}$ (inch): 3.75
$S_{min}$ (inch): 3.75

**Base Material**
Concrete: Normal-weight
Concrete thickness, h (inch): 24.00
State: Cracked
Compressive strength, $f'_c$ (psi): 2500
$\Psi_{c,V}$: 1.0
Reinforcement condition: A tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: Yes
Ignore concrete breakout in shear: No
Ignore 6do requirement: No
Build-up grout pad: No

**Recommended Anchor**
Anchor Name: PAB Pre-Assembled Anchor Bolt - PAB5 (5/8"Ø)

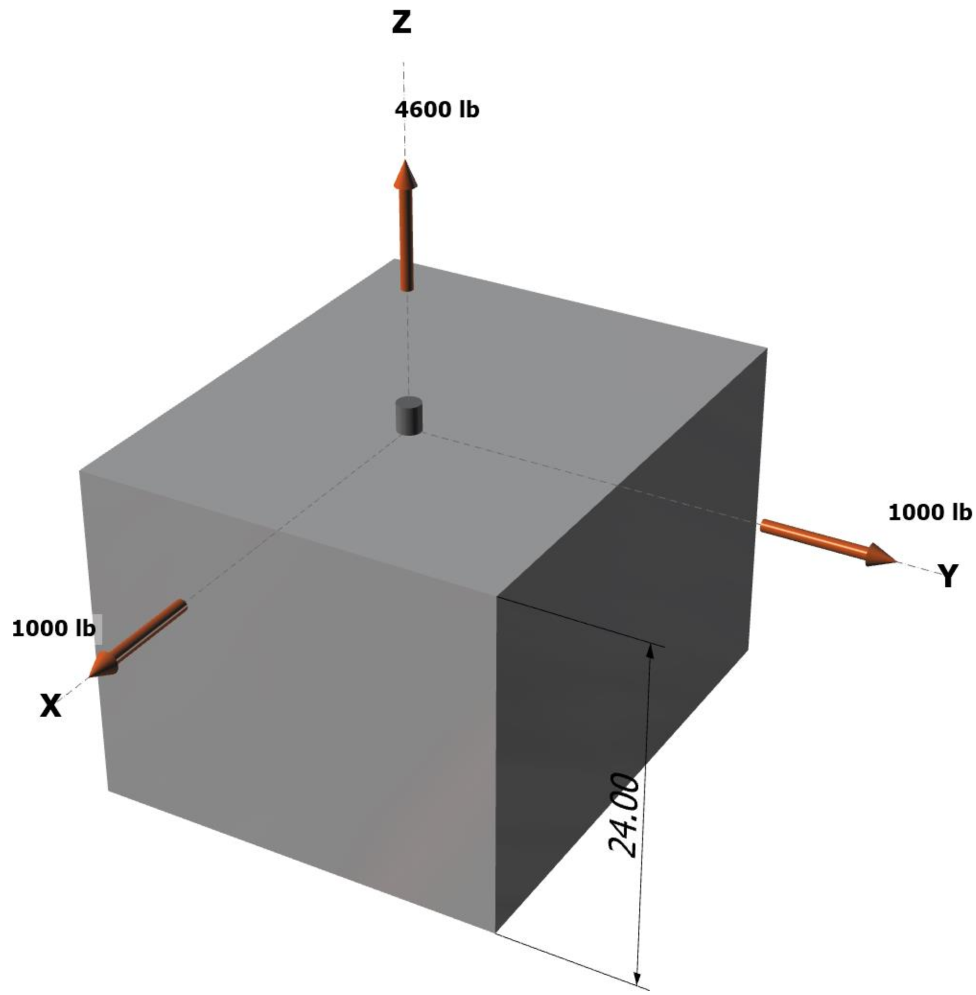
| Company: | | Date: | 5/24/2019 |
|---|---|---|---|
| Engineer: | | Page: | 2/6 |
| Project: | | | |
| Address: | | | |
| Phone: | | | |
| E-mail: | | | |

**Load and Geometry**
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: Not applicable
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

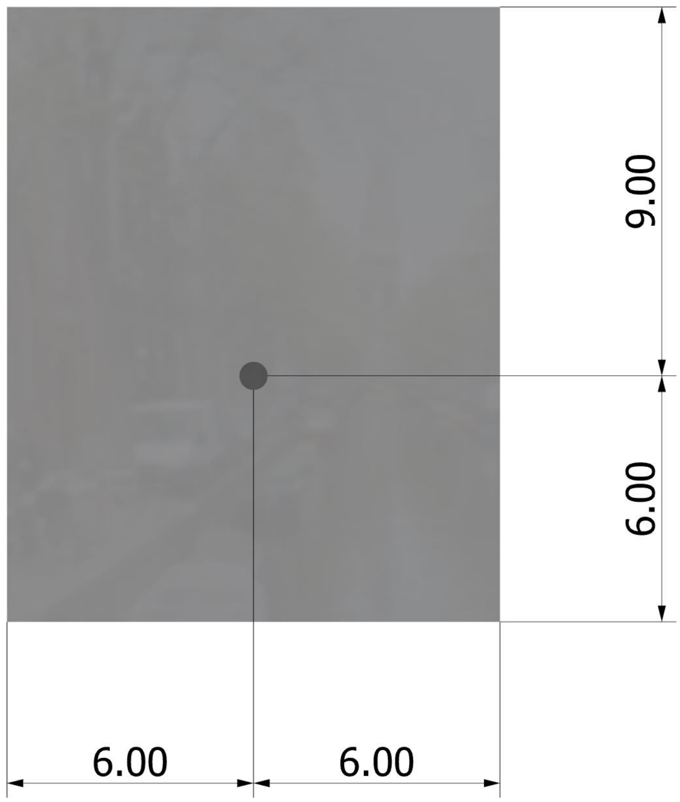
$N_{ua}$ [lb]: 4600
$V_{uax}$ [lb]: 1000
$V_{uay}$ [lb]: 1000

<Figure 1>



| Company: | | Date: | 5/24/2019 |
|---|---|---|---|
| Engineer: | | Page: | 3/6 |
| Project: | | | |
| Address: | | | |
| Phone: | | | |
| E-mail: | | | |

<Figure 2>



**3. Resulting Anchor Forces**

| Anchor | Tension load, $N_{ua}$ (lb) | Shear load x, $V_{uax}$ (lb) | Shear load y, $V_{uay}$ (lb) | Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb) |
|---|---|---|---|---|
| 1 | 4600.0 | 1000.0 | 1000.0 | 1414.2 |
| Sum | 4600.0 | 1000.0 | 1000.0 | 1414.2 |

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, $e'_{Nx}$ (inch): 0.00
Eccentricity of resultant tension forces in y-axis, $e'_{Ny}$ (inch): 0.00
Eccentricity of resultant shear forces in x-axis, $e'_{Vx}$ (inch): 0.00
Eccentricity of resultant shear forces in y-axis, $e'_{Vy}$ (inch): 0.00

**4. Steel Strength of Anchor in Tension (Sec. 17.4.1)**

| $N_{sa}$ (lb) | $\phi$ | $\phi N_{sa}$ (lb) |
|---|---|---|
| 13100 | 0.75 | 9825 |

**6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)**

$\phi N_{pn} = \phi \Psi_{c,P} N_p = \phi \Psi_{c,P} 8 A_{brg} f'_c$ (Sec. 17.3.1, Eq. 17.4.3.1 & 17.4.3.4)

| $\Psi_{c,P}$ | $A_{brg}$ (in$^2$) | $f'_c$ (psi) | $\phi$ | $\phi N_{pn}$ (lb) |
|---|---|---|---|---|
| 1.0 | 2.10 | 2500 | 0.70 | 29372 |

## 8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

| $V_{sa}$ (lb) | $\phi_{grout}$ | $\phi$ | $\phi_{grout}\phi V_{sa}$ (lb) |
|---|---|---|---|
| 7865 | 1.0 | 0.65 | 5112 |

## 9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

***Shear perpendicular to edge in y-direction:***

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

| $l_e$ (in) | $d_a$ (in) | $\lambda_a$ | $f'_c$ (psi) | $c_{a1}$ (in) | $V_{by}$ (lb) |
|---|---|---|---|---|---|
| 5.00 | 0.625 | 1.00 | 2500 | 6.00 | 6164 |

$\phi V_{cby} = \phi (A_{Vc} / A_{Vco}) \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} V_{by}$ (Sec. 17.3.1 & Eq. 17.5.2.1a)

| $A_{Vc}$ (in$^2$) | $A_{Vco}$ (in$^2$) | $\Psi_{ed,V}$ | $\Psi_{c,V}$ | $\Psi_{h,V}$ | $V_{by}$ (lb) | $\phi$ | $\phi V_{cby}$ (lb) |
|---|---|---|---|---|---|---|---|
| 135.00 | 162.00 | 0.900 | 1.000 | 1.000 | 6164 | 0.70 | 3236 |

***Shear perpendicular to edge in x-direction:***

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

| $l_e$ (in) | $d_a$ (in) | $\lambda_a$ | $f'_c$ (psi) | $c_{a1}$ (in) | $V_{bx}$ (lb) |
|---|---|---|---|---|---|
| 5.00 | 0.625 | 1.00 | 2500 | 6.00 | 6164 |

$\phi V_{cbx} = \phi (A_{Vc} / A_{Vco}) \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} V_{bx}$ (Sec. 17.3.1 & Eq. 17.5.2.1a)

| $A_{Vc}$ (in$^2$) | $A_{Vco}$ (in$^2$) | $\Psi_{ed,V}$ | $\Psi_{c,V}$ | $\Psi_{h,V}$ | $V_{bx}$ (lb) | $\phi$ | $\phi V_{cbx}$ (lb) |
|---|---|---|---|---|---|---|---|
| 108.00 | 162.00 | 0.900 | 1.000 | 1.000 | 6164 | 0.70 | 2589 |

***Shear parallel to edge in x-direction:***

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

| $l_e$ (in) | $d_a$ (in) | $\lambda_a$ | $f'_c$ (psi) | $c_{a1}$ (in) | $V_{by}$ (lb) |
|---|---|---|---|---|---|
| 5.00 | 0.625 | 1.00 | 2500 | 6.00 | 6164 |

$\phi V_{cbx} = \phi (2)(A_{Vc} / A_{Vco}) \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} V_{by}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1a)

| $A_{Vc}$ (in$^2$) | $A_{Vco}$ (in$^2$) | $\Psi_{ed,V}$ | $\Psi_{c,V}$ | $\Psi_{h,V}$ | $V_{by}$ (lb) | $\phi$ | $\phi V_{cbx}$ (lb) |
|---|---|---|---|---|---|---|---|
| 135.00 | 162.00 | 1.000 | 1.000 | 1.000 | 6164 | 0.70 | 7191 |

***Shear parallel to edge in y-direction:***

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

| $l_e$ (in) | $d_a$ (in) | $\lambda_a$ | $f'_c$ (psi) | $c_{a1}$ (in) | $V_{bx}$ (lb) |
|---|---|---|---|---|---|
| 5.00 | 0.625 | 1.00 | 2500 | 6.00 | 6164 |

$\phi V_{cby} = \phi (2)(A_{Vc} / A_{Vco}) \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} V_{bx}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1a)

| $A_{Vc}$ (in$^2$) | $A_{Vco}$ (in$^2$) | $\Psi_{ed,V}$ | $\Psi_{c,V}$ | $\Psi_{h,V}$ | $V_{bx}$ (lb) | $\phi$ | $\phi V_{cby}$ (lb) |
|---|---|---|---|---|---|---|---|
| 108.00 | 162.00 | 1.000 | 1.000 | 1.000 | 6164 | 0.70 | 5753 |

## 10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cp} = \phi k_{cp} N_{cb} = \phi k_{cp}(A_{Nc} / A_{Nco}) \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.5.3.1a)

| $k_{cp}$ | $A_{Nc}$ (in$^2$) | $A_{Nco}$ (in$^2$) | $\Psi_{ed,N}$ | $\Psi_{c,N}$ | $\Psi_{cp,N}$ | $N_b$ (lb) | $\phi$ | $\phi V_{cp}$ (lb) |
|---|---|---|---|---|---|---|---|---|
| 2.0 | 180.00 | 324.00 | 0.900 | 1.000 | 1.000 | 15849 | 0.70 | 11094 |

## 11. Results

**Interaction of Tensile and Shear Forces (Sec. R17.6)**

| Tension | Factored Load, $N_{ua}$ (lb) | Design Strength, ø$N_n$ (lb) | Ratio | Status |
|---|---|---|---|---|
| **Steel** | **4600** | **9825** | **0.47** | **Pass (Governs)** |
| Pullout | 4600 | 29372 | 0.16 | Pass |

| Shear | Factored Load, $V_{ua}$ (lb) | Design Strength, ø$V_n$ (lb) | Ratio | Status |
|---|---|---|---|---|
| Steel | 1414 | 5112 | 0.28 | Pass |
| T Concrete breakout y+ | 1000 | 3236 | 0.31 | Pass |
| T Concrete breakout x+ | 1000 | 2589 | 0.39 | Pass |
| \|\| Concrete breakout y+ | 1000 | 7191 | 0.14 | Pass |
| \|\| Concrete breakout x+ | 1000 | 5753 | 0.17 | Pass |
| **Concrete breakout, combined** | **-** | **-** | **0.49** | **Pass (Governs)** |
| Pryout | 1414 | 11094 | 0.13 | Pass |

| Interaction check | $(N_{ua}/\phi N_{ua})^{5/3}$ | $(V_{ua}/\phi V_{ua})^{5/3}$ | Combined Ratio | Permissible | Status |
|---|---|---|---|---|---|
| Sec. R17.6 | 0.28 | 0.31 | 59.2 % | 1.0 | Pass |

**PAB5 (5/8"Ø) with hef = 13.000 inch meets the selected design criteria.**

## 12. Warnings

- Concrete breakout strength in tension has not been evaluated against applied tension load(s) per designer option. Refer to ACI 318 Section 17.3.2.1 for conditions where calculations of the concrete breakout strength may not be required.

- Designer must exercise own judgement to determine if this design is suitable.

| SIMPSON Strong-Tie® Anchor Designer™ Software Version 2.7.6990.42 | | | |
|---|---|---|---|
| Company: | | Date: | 5/24/2019 |
| Engineer: | | Page: | 1/6 |
| Project: | | | |
| Address: | | | |
| Phone: | | | |
| E-mail: | | | |

## 1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

## 2. Input Data & Anchor Parameters

**General**
Design method:ACI 318-14
Units: Imperial units

**Anchor Information:**
Anchor type: Cast-in-place
Material: AB
Diameter (inch): 0.875
Effective Embedment depth, $h_{ef}$ (inch): 5.000
Anchor category: -
Anchor ductility: Yes
$h_{min}$ (inch): 7.38
$C_{min}$ (inch): 5.25
$S_{min}$ (inch): 5.25

**Base Material**
Concrete: Normal-weight
Concrete thickness, h (inch): 24.00
State: Cracked
Compressive strength, $f'_c$ (psi): 2500
$\Psi_{c,V}$: 1.0
Reinforcement condition: A tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: Yes
Ignore concrete breakout in shear: No
Ignore 6do requirement: No
Build-up grout pad: No

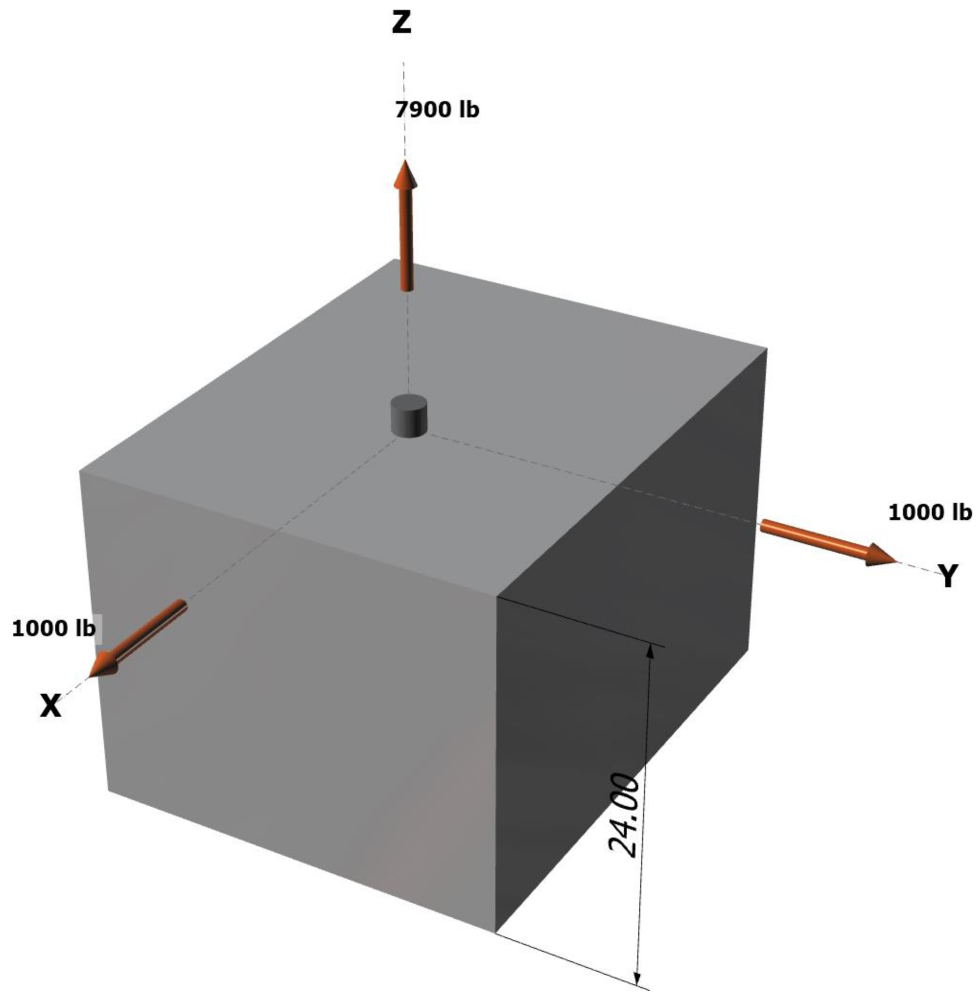
**Recommended Anchor**
Anchor Name: PAB Pre-Assembled Anchor Bolt - PAB7 (7/8"Ø)

**Load and Geometry**
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: Not applicable
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

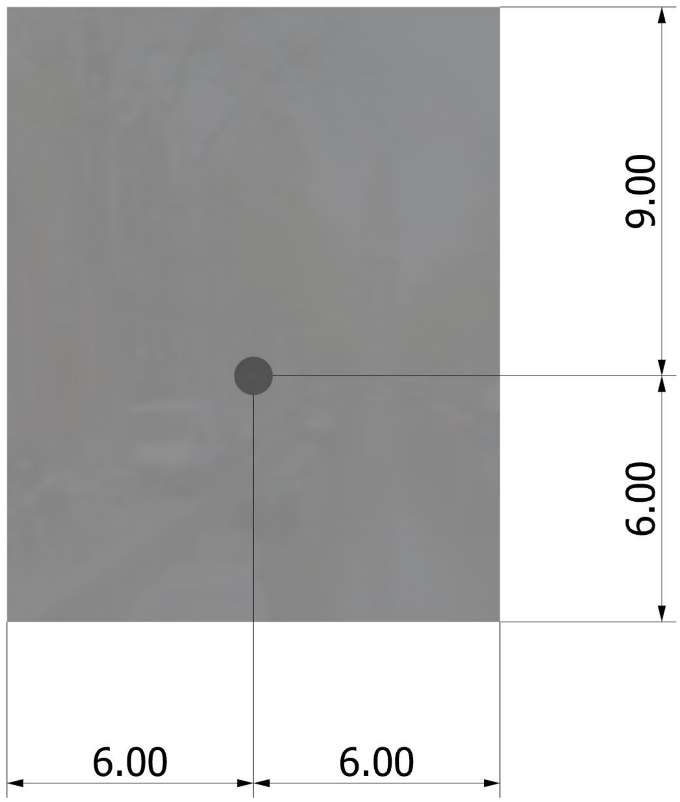
Strength level loads:

$N_{ua}$ [lb]: 7900
$V_{uax}$ [lb]: 1000
$V_{uay}$ [lb]: 1000

<Figure 1>



<Figure 2>



**3. Resulting Anchor Forces**

| Anchor | Tension load, $N_{ua}$ (lb) | Shear load x, $V_{uax}$ (lb) | Shear load y, $V_{uay}$ (lb) | Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb) |
|---|---|---|---|---|
| 1 | 7900.0 | 1000.0 | 1000.0 | 1414.2 |
| Sum | 7900.0 | 1000.0 | 1000.0 | 1414.2 |

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, $e'_{Nx}$ (inch): 0.00
Eccentricity of resultant tension forces in y-axis, $e'_{Ny}$ (inch): 0.00
Eccentricity of resultant shear forces in x-axis, $e'_{Vx}$ (inch): 0.00
Eccentricity of resultant shear forces in y-axis, $e'_{Vy}$ (inch): 0.00

**4. Steel Strength of Anchor in Tension (Sec. 17.4.1)**

| $N_{sa}$ (lb) | $\phi$ | $\phi N_{sa}$ (lb) |
|---|---|---|
| 26795 | 0.75 | 20096 |

**6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)**

$\phi N_{pn} = \phi \Psi_{c,P} N_p = \phi \Psi_{c,P} 8 A_{brg} f'_c$ (Sec. 17.3.1, Eq. 17.4.3.1 & 17.4.3.4)

| $\Psi_{c,P}$ | $A_{brg}$ (in$^2$) | $f'_c$ (psi) | $\phi$ | $\phi N_{pn}$ (lb) |
|---|---|---|---|---|
| 1.0 | 4.07 | 2500 | 0.70 | 56910 |

## 8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

| $V_{sa}$ (lb) | $\phi_{grout}$ | $\phi$ | $\phi_{grout}\phi V_{sa}$ (lb) |
|---|---|---|---|
| 16080 | 1.0 | 0.65 | 10452 |

## 9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

***Shear perpendicular to edge in y-direction:***

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

| $l_e$ (in) | $d_a$ (in) | $\lambda_a$ | $f'_c$ (psi) | $c_{a1}$ (in) | $V_{by}$ (lb) |
|---|---|---|---|---|---|
| 5.00 | 0.875 | 1.00 | 2500 | 6.00 | 6614 |

$\phi V_{cby} = \phi\ (A_{Vc} / A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1 & Eq. 17.5.2.1a)

| $A_{Vc}$ (in$^2$) | $A_{Vco}$ (in$^2$) | $\Psi_{ed,V}$ | $\Psi_{c,V}$ | $\Psi_{h,V}$ | $V_{by}$ (lb) | $\phi$ | $\phi V_{cby}$ (lb) |
|---|---|---|---|---|---|---|---|
| 135.00 | 162.00 | 0.900 | 1.000 | 1.000 | 6614 | 0.70 | 3472 |

***Shear perpendicular to edge in x-direction:***

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

| $l_e$ (in) | $d_a$ (in) | $\lambda_a$ | $f'_c$ (psi) | $c_{a1}$ (in) | $V_{bx}$ (lb) |
|---|---|---|---|---|---|
| 5.00 | 0.875 | 1.00 | 2500 | 6.00 | 6614 |

$\phi V_{cbx} = \phi\ (A_{Vc} / A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1 & Eq. 17.5.2.1a)

| $A_{Vc}$ (in$^2$) | $A_{Vco}$ (in$^2$) | $\Psi_{ed,V}$ | $\Psi_{c,V}$ | $\Psi_{h,V}$ | $V_{bx}$ (lb) | $\phi$ | $\phi V_{cbx}$ (lb) |
|---|---|---|---|---|---|---|---|
| 108.00 | 162.00 | 0.900 | 1.000 | 1.000 | 6614 | 0.70 | 2778 |

***Shear parallel to edge in x-direction:***

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

| $l_e$ (in) | $d_a$ (in) | $\lambda_a$ | $f'_c$ (psi) | $c_{a1}$ (in) | $V_{by}$ (lb) |
|---|---|---|---|---|---|
| 5.00 | 0.875 | 1.00 | 2500 | 6.00 | 6614 |

$\phi V_{cbx} = \phi\ (2)(A_{Vc} / A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1a)

| $A_{Vc}$ (in$^2$) | $A_{Vco}$ (in$^2$) | $\Psi_{ed,V}$ | $\Psi_{c,V}$ | $\Psi_{h,V}$ | $V_{by}$ (lb) | $\phi$ | $\phi V_{cbx}$ (lb) |
|---|---|---|---|---|---|---|---|
| 135.00 | 162.00 | 1.000 | 1.000 | 1.000 | 6614 | 0.70 | 7716 |

***Shear parallel to edge in y-direction:***

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

| $l_e$ (in) | $d_a$ (in) | $\lambda_a$ | $f'_c$ (psi) | $c_{a1}$ (in) | $V_{bx}$ (lb) |
|---|---|---|---|---|---|
| 5.00 | 0.875 | 1.00 | 2500 | 6.00 | 6614 |

$\phi V_{cby} = \phi\ (2)(A_{Vc} / A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1a)

| $A_{Vc}$ (in$^2$) | $A_{Vco}$ (in$^2$) | $\Psi_{ed,V}$ | $\Psi_{c,V}$ | $\Psi_{h,V}$ | $V_{bx}$ (lb) | $\phi$ | $\phi V_{cby}$ (lb) |
|---|---|---|---|---|---|---|---|
| 108.00 | 162.00 | 1.000 | 1.000 | 1.000 | 6614 | 0.70 | 6173 |

## 10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cp} = \phi k_{cp}N_{cb} = \phi k_{cp}(A_{Nc} / A_{Nco})\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.5.3.1a)

| $k_{cp}$ | $A_{Nc}$ (in$^2$) | $A_{Nco}$ (in$^2$) | $\Psi_{ed,N}$ | $\Psi_{c,N}$ | $\Psi_{cp,N}$ | $N_b$ (lb) | $\phi$ | $\phi V_{cp}$ (lb) |
|---|---|---|---|---|---|---|---|---|
| 2.0 | 158.63 | 144.00 | 1.000 | 1.000 | 1.000 | 9600 | 0.70 | 14805 |

## 11. Results

## Interaction of Tensile and Shear Forces (Sec. R17.6)

| Tension | Factored Load, $N_{ua}$ (lb) | Design Strength, ø$N_n$ (lb) | Ratio | Status |
|---|---|---|---|---|
| **Steel** | **7900** | **20096** | **0.39** | **Pass (Governs)** |
| Pullout | 7900 | 56910 | 0.14 | Pass |

| Shear | Factored Load, $V_{ua}$ (lb) | Design Strength, ø$V_n$ (lb) | Ratio | Status |
|---|---|---|---|---|
| Steel | 1414 | 10452 | 0.14 | Pass |
| T Concrete breakout y+ | 1000 | 3472 | 0.29 | Pass |
| T Concrete breakout x+ | 1000 | 2778 | 0.36 | Pass |
| \|\| Concrete breakout y+ | 1000 | 7716 | 0.13 | Pass |
| \|\| Concrete breakout x+ | 1000 | 6173 | 0.16 | Pass |
| **Concrete breakout, combined** | **-** | **-** | **0.46** | **Pass (Governs)** |
| Pryout | 1414 | 14805 | 0.10 | Pass |

| Interaction check | $(N_{ua}/\phi N_{ua})^{5/3}$ | $(V_{ua}/\phi V_{ua})^{5/3}$ | Combined Ratio | Permissible | Status |
|---|---|---|---|---|---|
| Sec. R17.6 | 0.21 | 0.28 | 48.6 % | 1.0 | Pass |

**PAB7 (7/8"Ø) with hef = 5.000 inch meets the selected design criteria.**

## 12. Warnings

- Concrete breakout strength in tension has not been evaluated against applied tension load(s) per designer option. Refer to ACI 318 Section 17.3.2.1 for conditions where calculations of the concrete breakout strength may not be required.

- Designer must exercise own judgement to determine if this design is suitable.

| Company: | | Date: | 5/24/2019 |
|---|---|---|---|
| Engineer: | | Page: | 1/6 |
| Project: | | | |
| Address: | | | |
| Phone: | | | |
| E-mail: | | | |

**1.Project information**

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

**2. Input Data & Anchor Parameters**

**General**
Design method:ACI 318-14
Units: Imperial units

**Anchor Information:**
Anchor type: Cast-in-place
Material: AB
Diameter (inch): 1.000
Effective Embedment depth, $h_{ef}$ (inch): 20.000
Anchor category: -
Anchor ductility: Yes
$h_{min}$ (inch): 22.63
$C_{min}$ (inch): 6.00
$S_{min}$ (inch): 6.00

**Base Material**
Concrete: Normal-weight
Concrete thickness, h (inch): 24.00
State: Cracked
Compressive strength, $f'_c$ (psi): 2500
$\Psi_{c,V}$: 1.0
Reinforcement condition: A tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: Yes
Ignore concrete breakout in shear: No
Ignore 6do requirement: No
Build-up grout pad: No

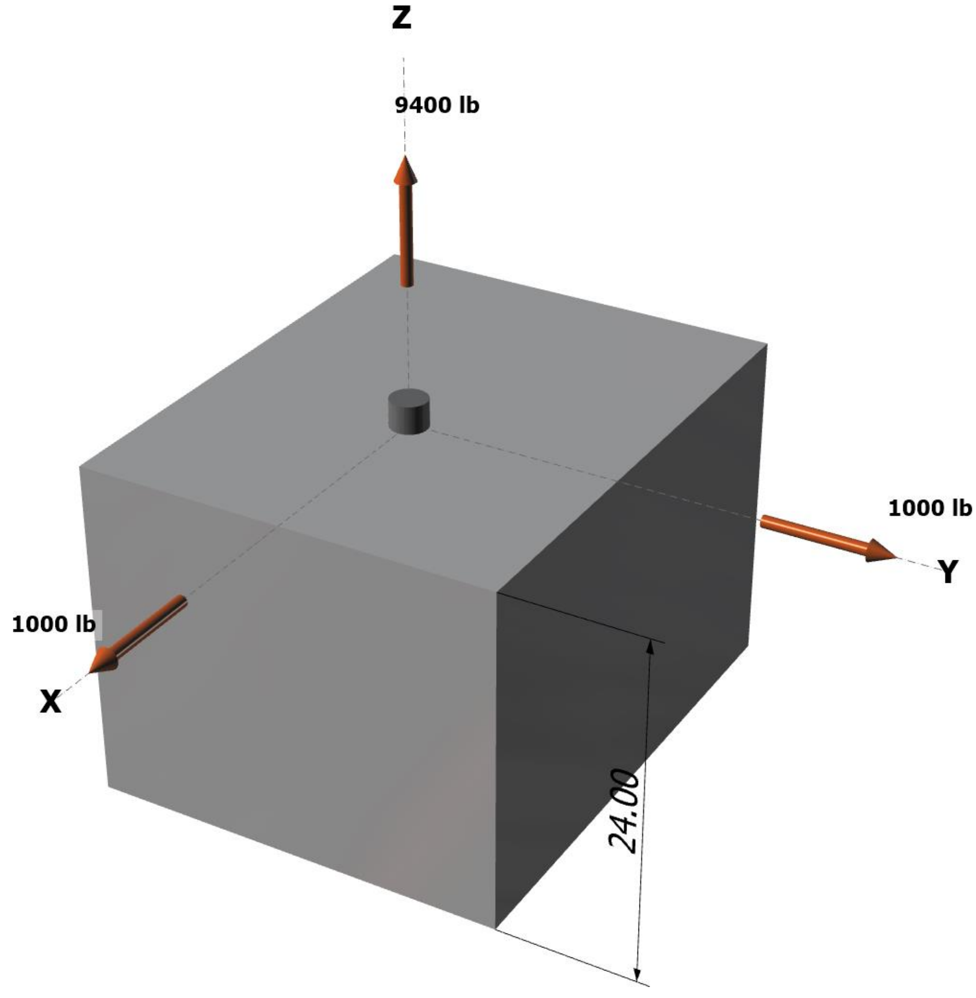
**Recommended Anchor**
Anchor Name: PAB Pre-Assembled Anchor Bolt - PAB8 (1"Ø)

**Load and Geometry**
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: Not applicable
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

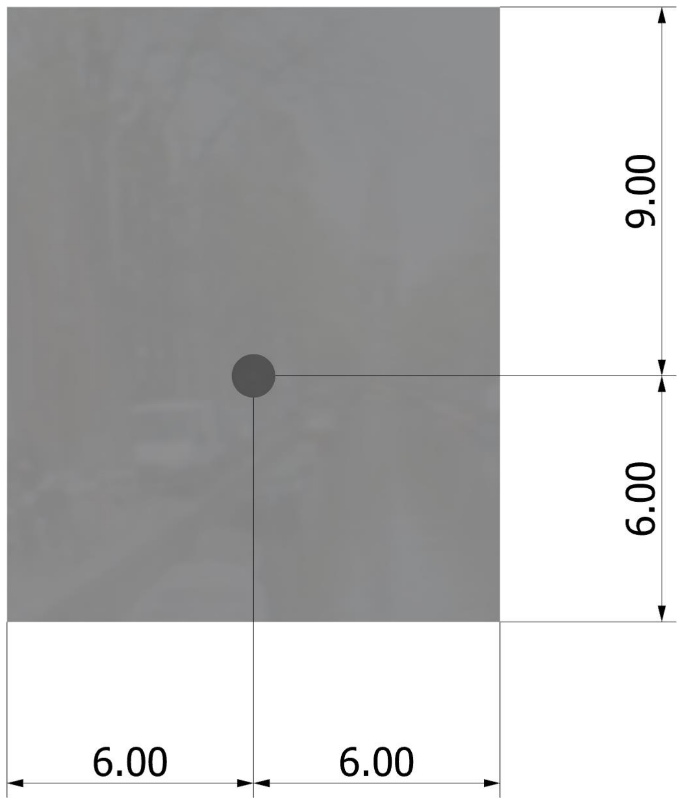
Strength level loads:

$N_{ua}$ [lb]: 9400
$V_{uax}$ [lb]: 1000
$V_{uay}$ [lb]: 1000

<Figure 1>



<Figure 2>



## 3. Resulting Anchor Forces

| Anchor | Tension load, $N_{ua}$ (lb) | Shear load x, $V_{uax}$ (lb) | Shear load y, $V_{uay}$ (lb) | Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb) |
|---|---|---|---|---|
| 1 | 9400.0 | 1000.0 | 1000.0 | 1414.2 |
| Sum | 9400.0 | 1000.0 | 1000.0 | 1414.2 |

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, $e'_{Nx}$ (inch): 0.00
Eccentricity of resultant tension forces in y-axis, $e'_{Ny}$ (inch): 0.00
Eccentricity of resultant shear forces in x-axis, $e'_{Vx}$ (inch): 0.00
Eccentricity of resultant shear forces in y-axis, $e'_{Vy}$ (inch): 0.00

## 4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

| $N_{sa}$ (lb) | $\phi$ | $\phi N_{sa}$ (lb) |
|---|---|---|
| 35150 | 0.75 | 26363 |

## 6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$\phi N_{pn} = \phi \Psi_{c,P} N_p = \phi \Psi_{c,P} 8 A_{brg} f'_c$ (Sec. 17.3.1, Eq. 17.4.3.1 & 17.4.3.4)

| $\Psi_{c,P}$ | $A_{brg}$ (in$^2$) | $f'_c$ (psi) | $\phi$ | $\phi N_{pn}$ (lb) |
|---|---|---|---|---|
| 1.0 | 5.15 | 2500 | 0.70 | 72156 |

## 7. Side-Face Blowout Strength of Anchor in Tension (Sec. 17.4.4)

$\phi N_{sb} = \phi\{(1+c_{a2}/c_{a1})/4\}(160c_{a1}\sqrt{A_{brg}})\lambda\sqrt{f'_c}$ (Sec. 17.3.1 & Eq. 17.4.4.1)

| $c_{a1}$ (in) | $c_{a2}$ (in) | $A_{brg}$ (in$^2$) | $\lambda_a$ | $f'_c$ (psi) | $\phi$ | $\phi N_{sb}$ (lb) |
|---|---|---|---|---|---|---|
| 6.00 | 6.00 | 5.15 | 1.00 | 2500 | 0.75 | 40864 |

## 8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

| $V_{sa}$ (lb) | $\phi_{grout}$ | $\phi$ | $\phi_{grout}\phi V_{sa}$ (lb) |
|---|---|---|---|
| 21090 | 1.0 | 0.65 | 13709 |

## 9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

### *Shear perpendicular to edge in y-direction:*

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

| $l_e$ (in) | $d_a$ (in) | $\lambda_a$ | $f'_c$ (psi) | $c_{a1}$ (in) | $V_{by}$ (lb) |
|---|---|---|---|---|---|
| 8.00 | 1.000 | 1.00 | 2500 | 6.00 | 6614 |

$\phi V_{cby} = \phi\,(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1 & Eq. 17.5.2.1a)

| $A_{Vc}$ (in$^2$) | $A_{Vco}$ (in$^2$) | $\Psi_{ed,V}$ | $\Psi_{c,V}$ | $\Psi_{h,V}$ | $V_{by}$ (lb) | $\phi$ | $\phi V_{cby}$ (lb) |
|---|---|---|---|---|---|---|---|
| 135.00 | 162.00 | 0.900 | 1.000 | 1.000 | 6614 | 0.70 | 3472 |

### *Shear perpendicular to edge in x-direction:*

$V_{bx} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

| $l_e$ (in) | $d_a$ (in) | $\lambda_a$ | $f'_c$ (psi) | $c_{a1}$ (in) | $V_{bx}$ (lb) |
|---|---|---|---|---|---|
| 8.00 | 1.000 | 1.00 | 2500 | 6.00 | 6614 |

$\phi V_{cbx} = \phi\,(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1 & Eq. 17.5.2.1a)

| $A_{Vc}$ (in$^2$) | $A_{Vco}$ (in$^2$) | $\Psi_{ed,V}$ | $\Psi_{c,V}$ | $\Psi_{h,V}$ | $V_{bx}$ (lb) | $\phi$ | $\phi V_{cbx}$ (lb) |
|---|---|---|---|---|---|---|---|
| 108.00 | 162.00 | 0.900 | 1.000 | 1.000 | 6614 | 0.70 | 2778 |

### *Shear parallel to edge in x-direction:*

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

| $l_e$ (in) | $d_a$ (in) | $\lambda_a$ | $f'_c$ (psi) | $c_{a1}$ (in) | $V_{by}$ (lb) |
|---|---|---|---|---|---|
| 8.00 | 1.000 | 1.00 | 2500 | 6.00 | 6614 |

$\phi V_{cbx} = \phi\,(2)(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1a)

| $A_{Vc}$ (in$^2$) | $A_{Vco}$ (in$^2$) | $\Psi_{ed,V}$ | $\Psi_{c,V}$ | $\Psi_{h,V}$ | $V_{by}$ (lb) | $\phi$ | $\phi V_{cbx}$ (lb) |
|---|---|---|---|---|---|---|---|
| 135.00 | 162.00 | 1.000 | 1.000 | 1.000 | 6614 | 0.70 | 7716 |

### *Shear parallel to edge in y-direction:*

$V_{bx} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

| $l_e$ (in) | $d_a$ (in) | $\lambda_a$ | $f'_c$ (psi) | $c_{a1}$ (in) | $V_{bx}$ (lb) |
|---|---|---|---|---|---|
| 8.00 | 1.000 | 1.00 | 2500 | 6.00 | 6614 |

$\phi V_{cby} = \phi\,(2)(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1a)

| $A_{Vc}$ (in$^2$) | $A_{Vco}$ (in$^2$) | $\Psi_{ed,V}$ | $\Psi_{c,V}$ | $\Psi_{h,V}$ | $V_{bx}$ (lb) | $\phi$ | $\phi V_{cby}$ (lb) |
|---|---|---|---|---|---|---|---|
| 108.00 | 162.00 | 1.000 | 1.000 | 1.000 | 6614 | 0.70 | 6173 |

## 10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cp} = \phi k_{cp}N_{cb} = \phi k_{cp}(A_{Nc}/A_{Nco})\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.5.3.1a)

| $k_{cp}$ | $A_{Nc}$ (in$^2$) | $A_{Nco}$ (in$^2$) | $\Psi_{ed,N}$ | $\Psi_{c,N}$ | $\Psi_{cp,N}$ | $N_b$ (lb) | $\phi$ | $\phi V_{cp}$ (lb) |
|---|---|---|---|---|---|---|---|---|
| 2.0 | 180.00 | 324.00 | 0.900 | 1.000 | 1.000 | 15849 | 0.70 | 11094 |

**11. Results**

**Interaction of Tensile and Shear Forces (Sec. 17.6.)**

| Tension | Factored Load, $N_{ua}$ (lb) | Design Strength, ø$N_n$ (lb) | Ratio | Status |
|---|---|---|---|---|
| **Steel** | **9400** | **26363** | **0.36** | **Pass (Governs)** |
| Pullout | 9400 | 72156 | 0.13 | Pass |
| Side-face blowout | 9400 | 40864 | 0.23 | Pass |

| Shear | Factored Load, $V_{ua}$ (lb) | Design Strength, ø$V_n$ (lb) | Ratio | Status |
|---|---|---|---|---|
| Steel | 1414 | 13709 | 0.10 | Pass |
| T Concrete breakout y+ | 1000 | 3472 | 0.29 | Pass |
| T Concrete breakout x+ | 1000 | 2778 | 0.36 | Pass |
| \|\| Concrete breakout y+ | 1000 | 7716 | 0.13 | Pass |
| \|\| Concrete breakout x+ | 1000 | 6173 | 0.16 | Pass |
| **Concrete breakout, combined** | **-** | **-** | **0.46** | **Pass (Governs)** |
| Pryout | 1414 | 11094 | 0.13 | Pass |

| Interaction check | $N_{ua}/\phi N_n$ | $V_{ua}/\phi V_n$ | Combined Ratio | Permissible | Status |
|---|---|---|---|---|---|
| Sec. 17.6..2 | 0.00 | 0.46 | 46.1 % | 1.0 | Pass |

**PAB8 (1"Ø) with hef = 20.000 inch meets the selected design criteria.**

**12. Warnings**

- Concrete breakout strength in tension has not been evaluated against applied tension load(s) per designer option. Refer to ACI 318 Section 17.3.2.1 for conditions where calculations of the concrete breakout strength may not be required.

- Designer must exercise own judgement to determine if this design is suitable.