VECTOR ENGINEERS

Project Number: U2784-001-181

August 28, 2018

WC3
908 West Gordon Ave. Suite #3
Layton, UT 84041

PLAN REVIEW ACCEPTANCE

FOR COMPLIANCE WITH THE APPLICABLE CONSTRUCTION CODES IDENTIFIED BELOW.

| | |
|---|---|
| [X] BUILDING | [X] STRUCTURAL |
| [X] MECHANICAL | [X] PLUMBING |
| [X] ELECTRICAL | [X] ENERGY |
| [ ] ACCESSIBILITY | [ ] FIRE |

PLAN REVIEW ACCEPTANCE OF DOCUMENTS DOES NOT AUTHORIZE CONSTRUCTION TO PROCEED IN VIOLATION OF ANY FEDERAL, STATE, OR LOCAL REGULATIONS.

BY: MEM DATE: 09/12/18

WEST COAST CODE CONSULTANTS, INC.

**ATTENTION:** **Mike Molyneux , P.E.**

**REFERENCE:** **Morar - SFD – Plan Review Comments 1st Review**
**WC3 Project #: 218-525-099 - Weber County**

Dear Mike,

The following is written in response to the plans check comments dated June 25, 2018. Our responses are limited to structural concerns only.

**STRUCTURAL REVIEW COMMENTS**

Comment S1: Fasteners, including nails, nuts and washers in contact with preservative treated wood shall be protected. It is not obvious that this has been indicated, please verify and include this on the drawing. (IBC 2304.10.5.1) (IRC 317.3)

Response: **See note E8 on sheet S1**

Comment S2: Sheet S1

a. Design loads: It appears that there are different seismic force resisting systems used. Please provide their corresponding V, Cs, R values. (IBC 1603.1.5)
b. Design loads: Floor dead load is shown as 28 psf. Sheet A3.2 appears to suggest 3" concrete topping. The indicated load may be below requirement. Please verify thickness gypcrete to be used. This could affect gravity and lateral design. (IBC 1604)
c. Special Inspection:

I. Please provide statement of special inspections identifying the following: (IBC 1704.3.1)

a. The materials, systems, components and work required to have special inspections
b. The type and extent of each special inspection.
c. The type and extent of each test.
d. For each type of special inspection, identification as to whether it will be continuous special inspection, periodic special inspection or performed in accordance with the notation used in the referenced standard where the inspections are defined.
e. For steel special inspections, please provide requirements from AISC 360 Chapter N. (IBC 1705.2.1)

Response:

**a. Seismic criteria for each LFRS are now listed**
**b. Loads are updated for 3" of gypcrete (24 psf) instead of the ~2" (17psf) that was used previously. Base shear increases less than 2%. Design is unchanged. Sheet S1 now lists heavier load. Updated calculations are attached.**
**c. Material, systems and components are listed in item M.2 of S1 with reference to schedules on S1.2.**
**d. See schedule on S1.2**
**e. See schedule on S1.2**

Comment S3: Sheet S1.2

A. Typical Truss Hangers: Cross grain bending may occur at ledger. Face nailing may also experience pull out forces. Please consider adding tension devices and blocking at suitable spacing to transfer transverse loads to the interior studs. (ASCE 7 12.11.2.2, 1.4, 12.1.3, 12.10.)

Response: **Detail is illustrative of typical hanger configurations and not all inclusive for conditions at beam/truss connections. No ledger specification is shown. Where ledgers are necessary it will be specified on applicable details.**

Comment S4: Sheet S3

A. Main Floor Framing: Detail 5/SD-1 does not appear to be applicable for the shown condition. Please verify and revise as required. (IBC 107)
B. GL-1, A: Beam information appears to be missing. Please verify and indicate on the drawing. (IBC 107)

Response:

**A. Detail callout is revised to 10/SD-2 similar.**
**B. Beam is structural fascia, called out as typical, and shown on detail 6/SD-1.**

Comment S5: Sheet SD1:

A. Detail 1
   I. Please verify that anchor bolt spacing on the plan has included consideration for restraint retaining wall condition. (IBC 1604)
   II. Please verify if continuous reinforcements are missing at anchor bolts location. Otherwise, please provide analysis for restraint condition of the retaining wall showing how the retained loads are transferred to the anchor bolts. (IBC 1604)
B. Detail 11
   I. The detail appears to show an unrestrained retaining wall. The reference to Detail 1 is for restrained condition. Please verify if the intent was for restraint condition and provide blocking at suitable spacing to transfer loads into the diaphragm. (IBC 107)
   II. Cross grain bending may occur at ledger. Please consider adding tension devices and blocking at suitable spacing to transfer transverse loads to the concrete wall. (ASCE 7 12.11.2.2, 1.4, 12.1.3, 12.10.)

Response:

**A. Detail 1**
   **I. Attached calculations show maximum expected reactions at top of wall. Per NDS table 12E 5/8" anchor bolts with 3x sill plate are adequate for reactions. Spacings appropriate to the reactions are called out on S2 and S3. Detail 6/SD-1 is also updated.**
   **II. Continuous reinforcement is added.**
**B. Detail 11**
   **I. Blocking has been added to restrain wall at top**
   **II. Tension devices are added.**

Comment S6: Special moment frame information does not appear to be complete. Please provide steel beam and column information. Please provide foundation connection detail of column. (IBC 107)

Response: **Beam and column information is shown on detail 16-SD2 as referenced on sheet S3. The moment frame columns do not extend to the foundation. They are supported by cantilevered steel beams. The beams and their connections have been designed for seismic load combinations including overstrength per ASCE 7.**

Comment S7: Special reinforced concrete shear wall information does not appear to be complete.

A. Please provide details for the special reinforced shear wall. (ACI 318 18.10)
B. At least 2 curtains of reinforcement shall be used in a wall if $h_w/l_w \geq 2.0$. Please verify and revise as required. (ACI 318 18.10.2.2)

Response:

**A. No special detailing is required for the walls. The shearwalls contain no openings and are not required to have special boundary elements per 18.10.6.2 or 18.10.6.3. See RC shearwall calcs attached again here for your convenience.**
**B. 2 Curtains of reinforcement are now called out.**

Comment S8: Sheet A3.0: Sections indicate that upper foundations may impose surcharge loads on lower foundations. Please verify that this has been considered for the design of the lower foundations. (IBC 1808.3.2)

Response: **Attached calculations show the wall to be adequate for adjacent footing loads that may be imposed. The geotechnical report also lists the substrate here as bedrock, surcharges on the wall are unlikely as the upper wall will be founded entirely on rock.**

We hope this meets your needs. If you have any questions or require additional information, please call this office at your convenience.

Very truly yours,
VECTOR STRUCTURAL ENGINEERING, LLC


8/29/18

Russell N. Emery, S.E.
Project Engineer

RNE/jba

**PROJECT:** Ridge Nest 14 **JOB NO.:** U2784-001-181 **SUBJECT:** GRAVITY LOADS

| **ROOF** | | | Increase due to pitch | Original loading |
|---|---|---|---|---|
| ROOF PITCH/12 | | 3 | | |
| MEMBRANE | | 1.55 | 1.03 | 1.50 |
| 19/32" PLYWOOD | | 1.96 | 1.03 | 1.90 |
| FRAMING | | 3.00 | | |
| INSULATION | | 2.00 | | |
| 1/2" GYPSUM CLG. | | 2.20 | | |
| M, E & MISC | | 2.30 | | |
| GREEN ROOF SYSTEM | | 30.00 | | |
| | DL | 43.00 | | |
| | LL | 20.00 | | |
| | SNOW | 185.00 | | |
| SNOW INCLUDED IN LATERAL | | 54.0 | | |

| **2ND FLOOR (WHERE OCCURS)** | | |
|---|---|---|
| FLOOR COVERING W/GYPCRETE | | 24.00 |
| 3/4" T&G PLYWOOD | | 2.30 |
| MFG TRUSSES / FRAMING | | 2.00 |
| INSULATION | | 1.00 |
| 1/2" GYPSUM CEILING | | 2.20 |
| PARTITION | | 2.00 |
| M, E & MISC. | | 1.50 |
| OTHER | | 0.00 |
| | DL | 35.00 |
| | LL | 40.00 |

| **EXTERIOR WALLS** | | |
|---|---|---|
| STUCCO/SIDING | | 3.50 |
| 2x6 FRAMING W/3 PLATES | | 1.30 |
| INSULATION | | 1.00 |
| 1/2" GYPSUM | | 2.20 |
| 1/2" PLYWOOD | | 1.50 |
| OTHER | | 0.50 |
| | DL | 10.00 |

| **OVERFILL** | | |
|---|---|---|
| ASPHALT SHINGLES | | 4.00 |
| 1/2" PLYWOOD | | 1.50 |
| RAFTERS & MISC | | 3.50 |
| OTHER | | 0.00 |
| | DL | 9.00 |
| | LL | 20.00 |

TYPICAL ROOF OVERBUILD MAX SPAN TABLE

| Grade | Size | Spacing (ft) | $L_{max}$ (ft) |
|---|---|---|---|
| DFL#2 | 2X4 | 2 | 2.50 |
| DFL#2 | 2X6 | 2 | 3.40 |
| DFL#2 | 2X8 | 2 | 4.40 |
| DFL#2 | 2X10 | 2 | 5.80 |

| $C_r$ | $C_D$ | $C_{F,V}$ | $M_{allow}$ (ft-lb) | $V_{allow}$ (lb) | Ctrl'g factor |
|---|---|---|---|---|---|
| 1.15 | 1.00 | 1.50 | 385 | 382 | Moment |
| 1.15 | 1.00 | 1.30 | 824 | 601 | LL def |
| 1.15 | 1.00 | 1.20 | 1322 | 792 | LL def |
| 1.15 | 1.00 | 1.10 | 1973 | 1011 | Moment |

**PROJECT:** Ridge Nest 14 **JOB NO.:** U2784-001-181 **SUBJECT:** BEAMS

**DESIGN LOADS:**

| Load Types: | Snow*$I_S$ | Live | Dead |
|---|---|---|---|
| Roof | 185 | 20 | 48 |
| Floor | | 40 | 39 |
| Wall | | | 11 |

Add .2*$S_{DS}$ to dead load? Yes 0.11013 =.2*$S_{DS}$

| CRITERIA (L/) | $D_{TL}$ | $D_{LL}$ | $D_{DL}$ |
|---|---|---|---|
| $A_{(BLANK)}$ | 240 | 360 | |
| B | 240 | 480 | |
| C | 600 | | 800 |

| Abbrev | GRADES | | $F_{bxx}$ (psi) | $F_{vxx}$ (psi) | $E_{xx}$ (psi) | | g (lb/ft$^3$) |
|---|---|---|---|---|---|---|---|
| DFL#1 | DOUGLAS FIR LARCH #1 | | 1,000 | 180 | 1700000 | | 31.2 |
| DFL#2 | DOUGLAS FIR LARCH #2 | | 875 | 180 | 1600000 | | 31.2 |
| DF1 (5x) | Douglas Fir Larch #1 5x & Larger | | 1,350 | 170 | 1700000 | | 31.2 |
| 24F-V4 | Glue Laminated Timber 24F-V4 D | | 2,400 | 265 | 1800000 | | 39.9 |
| 24F-V8 | Glue Laminated Timber 24F-V8 D | | 2,400 | 265 | 1800000 | | 39.9 |
| LVL (1.9) | MICROLLAM LVL (1.9E) | | 2,600 | 285 | 1900000 | | 41.8 |
| LVL (2.0) | VERSA-LAM (2.0E) | | 2,800 | 285 | 2000000 | | 41.8 |
| LSL | TIMBERSTRAND LSL (1.3E) | | 1,700 | 400 | 1300000 | | 41.8 |
| PSL | PARALLAM PSL (2.0E) | | 2,900 | 290 | 2000000 | | 41.8 |
| STL36 | GRADE 36 STEEL | | 21,600 | 14,400 | 29,000,000 | | 490 |
| STL46 | GRADE 46 STEEL | | 27,700 | 16,500 | 29,000,000 | | 490 |
| STL50 | GRADE 50 STEEL | | 30,000 | 20,000 | 29,000,000 | | 490 |

| Label | Length 'L' (ft) | Roof Trib (ft) | Floor Trib (ft) | Wall Trib (ft) | Add'l Live Load (plf) | Add'l Dead Load (plf) | Point Load From | React (A,B) | Dist 'a' (ft) | Point Live Load '$P_{LL}$' (lb) | Point Dead Load '$P_{DL}$' (lb) | # PLIES | Grade | Size | "BM/HDR" | D CRITERIA | $C_r$ | $C_D$ | $C_{F,V}$ | $R_a$ (lb) | $R_b$ (lb) | $M_{max}$ (ft-lb) | $M_{allow}$ (ft-lb) | $V_{max}$ (lb) | $V_{allow}$ (lb) | $D_{TL}$ (in) | $D_{TLallow}$ (in) | $D_{LL}$ (in) (SEE COND 'C') | $D_{LLallow}$ (in) (SEE COND 'C') | 1.5DL GLB Camb | Check |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RB1 | 22.33 | 13 | | | | | | | | | | | STL50 | W18x46 | B | | 1.00 | 1.00 | 1.00 | 34295 | 34295 | 191451 | 226750 | 29672 | 130320 | 0.832 | 1.117 | 0.652 | 0.744 | | 0.88 D |
| RB2 | 22.33 | 10.5 | | | | | | | | | | | STL50 | W10x88 | B | | 1.00 | 1.00 | 1.00 | 28267 | 28267 | 157802 | 282500 | 25980 | 130680 | 0.915 | 1.117 | 0.702 | 0.744 | | 0.94 D |
| RB3 | 24.5 | 12.3 | | | | | | | | | | | STL50 | W18x50 | B | | 1.00 | 1.00 | 1.00 | 35538 | 35538 | 217671 | 252500 | 31189 | 127800 | 1.014 | 1.225 | 0.792 | 0.817 | | 0.97 D |
| RB4 | Not Used | | | | | | | | | | | | | | | | 1.00 | #### | 1.00 | ###### | ###### | ###### | | | | | ##### | | ##### | | |
| RB5 | 10 | 13 | | | | | | | 2 | | | | STL50 | W12x16 | B | | 1.00 | 1.00 | 1.00 | 14600 | 21900 | 35040 | 50250 | 12777 | 52800 | 0.207 | 0.500 | 0.018 | 0.333 | | 0.70 M |
| | Cantilevered end conditions | | | | | | | | | | | | | | | | | | | | | @ Support | -6083 | -50250 | | @ end | -0.023 | 0.200 | 0.002 | 0.133 | | |
| RB6 | 2 | 2 | | | | | | | | | | (2) | DFL#2 | 2X6 | B | | 1.00 | 1.00 | 1.30 | 469 | 469 | 235 | 1434 | 254 | 1980 | 0.003 | 0.100 | 0.002 | 0.067 | | 0.16 M |
| | | | | | | | | | | | | | | | | | 1.00 | 1.00 | 1.00 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | 1.00 | 1.00 | 1.00 | | | | | | | | | | | | |
| FB1 | SEE ATTACHED CALCULATIONS | | | | | | | | | | | | STL50 | W18x50 | | | 1.00 | 1.00 | 1.00 | | | | | | | | | | | | |
| FB2 | SEE ATTACHED CALCULATIONS | | | | | | | | | | | | STL50 | W18x35 | | | 1.00 | 1.00 | 1.00 | | | | | | | | | | | | |
| FB3 | SEE ATTACHED CALCULATIONS | | | | | | | | | | | | STL50 | W18x50 | | | 1.00 | 1.00 | 1.00 | | | | | | | | | | | | |
| FB4 | SEE ATTACHED CALCULATIONS | | | | | | | | | | | | STL50 | W18x35 | | | 1.00 | 1.00 | 1.00 | | | | | | | | | | | | |
| FB5 | SEE ATTACHED CALCULATIONS | | | | | | | | | | | | STL50 | W10x22 | | | 1.00 | 1.00 | 1.00 | | | | | | | | | | | | |
| FB6 | 13.75 | 1 | | | | | GT1 | B | 2 | 5947 | 1535 | | STL50 | W10x17 | B | | 1.00 | 1.00 | 1.00 | 592 | 10822 | -1668 | 46750 | 7770 | 48480 | -0.047 | 0.688 | -0.095 | 0.458 | | 0.68 D |
| | Cantilevered end conditions | | | | | | | | | | | | | | | | | | | | | @ Support | -15462 | -46750 | | @ end | 0.105 | 0.200 | 0.091 | 0.133 | | |
| FB7 | SEE ATTACHED CALCULATIONS | | | | | | | | | | | | STL50 | W12x26 | | | 1.00 | 1.00 | 1.00 | | | | | | | | | | | | |
| FB8 | 12 | | 1 | 10 | | | SEISMIC | | 4 | 3012 | | 2 | LVL (1.9) | 1-3/4X20 | B | | 1.00 | 1.60 | 1.00 | 117 | 6259 | -2366 | 80889 | 3503 | 21280 | -0.024 | 0.600 | -0.037 | 0.400 | | 0.39 D |
| | Cantilevered end conditions | | | | | | | | | | | | | | | | | | | | | @ Support | -13731 | -80889 | | @ end | 0.094 | 0.400 | 0.103 | 0.267 | | |
| | | | | | | | | | | | | | | | | | 1.00 | 1.00 | 1.00 | | | | | | | | | | | | |
| GT1 | 7.66 | 1 | | | | | | | 1.5 | 4126 | 1065 | | | | | | 1.00 | 1.00 | 1.00 | -159 | 7481 | -2165 | | | | | 0.383 | | 0.255 | | |
| | Cantilevered end conditions | | | | | | | | | | | | | | | | | | | | | @ Support | -8047 | | | @ end | | 0.150 | | 0.100 | | |
| GT2 | 16 | 2.4 | | | | | | | | | | | | | | | 1.00 | 1.00 | 1.00 | 4469 | 4469 | 17874 | | | | | 0.800 | | 0.533 | | |
| | | | | | | | | | | | | | | | | | 1.00 | 1.00 | 1.00 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | 1.00 | 1.00 | 1.00 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | 1.00 | 1.00 | 1.00 | | | | | | | | | | | | |
| Deck Tru | 15.5 | 1.6 | | | | | | | | | | | | | | | 1.00 | 1.00 | 1.00 | 2886 | 2886 | 11183 | | | | | 0.775 | | 0.517 | | |
| Roof trus | 12 | 1.6 | | | | | | | | | | | | | | | 1.00 | 1.00 | 1.00 | 2234 | 2234 | 6703 | | | | | 0.600 | | 0.400 | | |

**PROJECT:** Ridge Nest 14 **JOB NO.:** U2784-001-181 **SUBJECT:** LINE LOADS

| | | |
|---|---|---|
| Roof DL | 43 | psf |
| Seismic | | |
| Snow | 54 | psf |
| Floor DL | 35 | psf |
| Wall DL | 10 | psf |
| Period, T | 0.22 | sec |

**Level Descriptions**

| Label | Height (ft) | $W_{control}$ (lb) | $V_{norm}$ (lb) | $V_{redist}$ (lb) | Redist Fact |
|---|---|---|---|---|---|
| Roof | 25 | 100414 | 8507 | 11248 | 1.32 |
| Upper Floor | 10 | 68675 | 5818 | 3077 | 0.53 |
| | | 0 | 0 | 0 | 1.00 |
| | | 0 | 0 | 0 | 1.00 |
| Total Weight (lb) | | 169089 | | | |
| Total Base Shear (lb) | | 14325 | | | |

k= 1

$\Sigma w_i h_i^k$= 3197101

Estimated Total Weight in Longitudinal Direction 169089

Estimated Total Weight in Transverse Direction 169089

Percent difference in estimated weights 0.0%

**Seismic Line Loads**

| Label | Width | Level | Direction | Number of times to include | Roof Trib (ft) | Floor Trib (ft) | Wall Trib Height (ft) | Ext Wall Length (ft) | Other Weight (lb/ft) | Total Weight (lb/ft) | Total Force (lb/ft) | Redist Factor | Revised Force (lb/ft) | Force Redist to 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ω1 | 24.7 | Roof | LONG | 1 | 40 | | 4.5 | 105 | | 4072 | 345 | 1.32 | 456 | NO |
| ω2 | 40 | Roof | TRANS | 1 | 24.7 | | 4.5 | 105 | | 2510 | 213 | 1.32 | 281 | NO |
| ω3 | 23.3 | Upper Floor | LONG | 1 | | 23.5 | 11 | 93.6 | | 1264 | 107 | 0.53 | 57 | NO |
| ω4 | 23.5 | Upper Floor | TRANS | 1 | | 23.3 | 11 | 93.6 | | 1254 | 106 | 0.53 | 56 | NO |
| ω5 | 16 | Upper Floor | LONG | 1 | 23 | | 4.5 | 78 | | 2451 | 208 | 0.53 | 110 | NO |
| ω6 | 23 | Upper Floor | TRANS | 1 | 16 | | 4.5 | 78 | | 1705 | 144 | 0.53 | 76 | NO |
| ω7 | | | | 1 | | | | 0 | | 0 | 0 | 1.00 | 0 | NO |
| ω8 | | | | 1 | | | | 0 | | 0 | 0 | 1.00 | 0 | NO |
| ω9 | | | | 1 | | | | 0 | | 0 | 0 | 1.00 | 0 | NO |
| ω10 | | | | 1 | | | | 0 | | 0 | 0 | 1.00 | 0 | NO |
| ω11 | | | | 1 | | | | 0 | | 0 | 0 | 1.00 | 0 | NO |
| ω12 | | | | 1 | | | | 0 | | 0 | 0 | 1.00 | 0 | NO |
| ω13 | | | | 1 | | | | 0 | | 0 | 0 | 1.00 | 0 | NO |
| ω14 | | | | 1 | | | | 0 | | 0 | 0 | 1.00 | 0 | NO |
| ω15 | | | | 1 | | | | 0 | | 0 | 0 | 1.00 | 0 | NO |
| ω16 | | | | 1 | | | | 0 | | 0 | 0 | 1.00 | 0 | NO |
| ω17 | | | | 1 | | | | 0 | | 0 | 0 | 1.00 | 0 | NO |
| ω18 | | | | 1 | | | | 0 | | 0 | 0 | 1.00 | 0 | NO |
| ω19 | | | | 1 | | | | 0 | | 0 | 0 | 1.00 | 0 | NO |
| ω20 | | | | 1 | | | | 0 | | 0 | 0 | 1.00 | 0 | NO |

**Wind Line Loads** *Surface type 'C' is flat wall and 'D' is sloped roof, 'CP1' and 'CP2' represent parapets on only one side and both sides of the structure, respectively*

| Label | Roof Pitch /12 | Mean Roof Height (ft) | Surface Type 1 | Equiv Height Exposed (ft) | Surface Type 2 | Equiv Height Exposed (ft) | Roof Angle (°) | Applied Interior Press 1 (psf) | Applied Interior Press 2 (psf) | Applied End Zone Press 1 (psf) | Applied End Zone Press 2 (psf) | Height & Exp Coeff, λ | Total Int Unif Load (plf) | Total End Zone Unif Load (plf) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ω1 | 3 | 25 | C | 8.5 | | | 14.0 | 23.16 | 0.00 | 34.83 | 0.00 | 1.35 | 196.83 | 296.04 |
| ω2 | 3 | 25 | C | 5.3 | | | 14.0 | 23.16 | 0.00 | 34.83 | 0.00 | 1.35 | 121.57 | 182.85 |
| ω3 | 3 | 25 | C | 15 | | | 14.0 | 23.16 | 0.00 | 34.83 | 0.00 | 1.35 | 347.35 | 522.43 |
| ω4 | 3 | 25 | C | 10.5 | | | 14.0 | 23.16 | 0.00 | 34.83 | 0.00 | 1.35 | 242.41 | 364.59 |
| ω5 | 3 | 15 | C | 6.75 | D | 2.5 | 14.0 | 20.76 | 0.00 | 31.22 | 0.00 | 1.21 | 140.10 | 210.71 |
| ω6 | 3 | 15 | C | 10.5 | | | 14.0 | 20.76 | 0.00 | 31.22 | 0.00 | 1.21 | 217.93 | 327.77 |
| ω7 | | | | | | | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |
| ω8 | | | | | | | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |
| ω9 | | | | | | | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |
| ω10 | | | | | | | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |
| ω11 | | | | | | | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |
| ω12 | | | | | | | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |
| ω13 | | | | | | | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |
| ω14 | | | | | | | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |
| ω15 | | | | | | | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |
| ω16 | | | | | | | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |
| ω17 | | | | | | | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |
| ω18 | | | | | | | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |
| ω19 | | | | | | | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |
| ω20 | | | | | | | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |

**PROJECT:** Ridge Nest 14 **JOB NO.:** U2784-001-181 **SUBJECT:** SHEAR WALLS

| | |
|---|---|
| $\rho_{Applied}$ = | 1 |
| Min Diaphragm Width (ft) = | 16 |
| Allowable Seismic Aspect Ratio = | 3.5 |
| Allowable Wind Aspect Ratio = | 3.5 |
| Comb. Overstrength Factors: (Ω-0.5)/1.2 = | 2.08 |

| $\rho_i$ | Loc |
|---|---|
| 1.00 | 1.2-1ST |
| 1.00 | 1-2ND |
| | |
| | |

**Roof DL (psf) =** 97 (includes seismic snow where occurs)
**Floor DL (psf) =** 35

ρ calculated in accordance with ASCE7-10 Section 12.3.4.1
No Exception in ASCE 7 12.3.4.2b met?

**LINE: 1 2ND STORY**

| Line Loads (plf) | | | | Loads from above | | | | | Actual Applied Loads (plf unless noted otherwise) | | | | | Diaphragm Shear (plf) | | | Perf/FTAO Wall Info | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Load | Trib w (ft) | E.Z. Appl* | Span (ft) | Line | % | Location | Seis (lbs) | Wind (lbs) | ρ*Seis | Wind | E.Z. Wind | 2a (ft) | E.Z. P (lb) | Drag (ft) | Seis (Load vs. Allow.) | | (Not Applicable) | | | |
| ω2 | 4.5 | Major | 9 | | 1.00 | Offset | | | 196.8 | 72.9 | 109.7 | 6 | 147 | 23 | 39 | 198 | | | | |
| ω2 | 17 | None | 34 | | 1.00 | Offset | | | 196.8 | 72.9 | 109.7 | 6.8 | | | | | | | | |
| | | | | | 1.00 | Above | | | | | | | | | Wind (Load vs. Allow.) | | | | | |
| Plate h (ft)= | | | | | | Total | **4912** | 2859 | Include Ω for irregularities (above)? | | | | No | | 21 | 276 | | | | |
| Max opening height (ft)= | | | | | | (Strength Level) | | | | | | | | | | | | | | |
| Apply aspect ratio reduction? | | | | #DIV/0! | Perforated SW? | | No | | Shear Length (ft)= | | | | | Story V (K)= | 11248 | | | | | |
| Opening elevation | | | | Force Transfer @ Openings? | | | No | | Wall DL (psf)= | | 10 | | | Max allow. drift (in) | | | | | | |

| Shear-Wall Length (ft) | $Roof_{DL}$ 'w' (ft) | $Floor_{DL}$ 'w' (ft) | $Other_{DL}$ 'w' (plf) | Tension From Above (lb) | Wall Type | Sill Type | Holdown Strap | HD Capacity (Stem 'w'-edge dist) | OTM (**wind**, seismic) (ft-lb) | .6*RM (ft-lb) | Aspect Ratio | Aspect Ratio Reduc. | Seis. Shear (plf) | Seis. Wall Cap. (plf) | Wind Shear (plf) | Wind Wall Cap. (plf) | Sill Plate Cap. (plf) | Tension (lb) | HD Capacity | Max Shear-Wall δ (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SPECIAL MOMENT FRAME PER ATTACHED CALCULATIONS | | | | | | | | | | | | | | | | | | | | |
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| Add'l Comments: | | | | | | | | | | | | | | | | | | | Max: | |

**LINE: A 2ND STORY**

| Line Loads (plf) | | | | Loads from above | | | | | Actual Applied Loads (plf unless noted otherwise) | | | | | Diaphragm Shear (plf) | | | Perf/FTAO Wall Info | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Load | Trib w (ft) | E.Z. Appl* | Span (ft) | Line | % | Location | Seis (lbs) | Wind (lbs) | ρ*Seis | Wind | E.Z. Wind | 2a (ft) | E.Z. P (lb) | Drag (ft) | Seis (Load vs. Allow.) | | (Not Applicable) | | | |
| ω1 | 12.33 | Major | 24.66 | | 1.00 | Offset | | | 319.3 | 118.1 | 177.6 | 6 | 314 | 26 | 151 | 198 | | | | |
| | | None | | | 1.00 | Offset | | | | | | | | 15.5 | | | | | | |
| | | | | | 1.00 | Above | | | | | | | | | Wind (Load vs. Allow.) | | | | | |
| Plate h (ft)= | 10 | | | | | Total | **3937** | 1770 | Include Ω for irregularities (above)? | | | | No | | 68 | 276 | | | | |
| Max opening height (ft)= | 10 | | | | | | | | | | | | | | | | | | | |
| Apply aspect ratio reduction? | Yes | | | 100% | Perforated SW? | | No | | Shear Length (ft)= | | 15.5 | | | Story V (K)= | 11248 | | | | | |
| Opening elevation | | | | Force Transfer @ Openings? | | | No | | Wall DL (psf)= | | 10 | | | Max allow. drift (in) | 3 | | | | | |

| Shear-Wall Length (ft) | $Roof_{DL}$ 'w' (ft) | $Floor_{DL}$ 'w' (ft) | $Other_{DL}$ 'w' (plf) | Tension From Above (lb) | Wall Type | Sill Type | Holdown Strap | HD Capacity (Stem 'w'-edge dist) | OTM (**wind**, seismic) (ft-lb) | .6*RM (ft-lb) | Aspect Ratio | Aspect Ratio Reduc. | Seis. Shear (plf) | Seis. Wall Cap. (plf) | Wind Shear (plf) | Wind Wall Cap. (plf) | Sill Plate Cap. (plf) | Tension (lb) | HD Capacity | Max Shear-Wall δ (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15.5 | 2 | | | | P2 | | CS16 | | 39367 | 21193 | 0.65 | 1.00 | 254 | 380 | 114 | 520 | | 1173 | 1705 | 0.22 |
| | | | | | | | | | | | | | | | | | | | | |
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| Add'l Comments: | | | | | | | | | | | | | | | | | | | Max: | 0.22 |

**LINE: C 2ND STORY**

| Line Loads (plf) | | | | Loads from above | | | | | Actual Applied Loads (plf unless noted otherwise) | | | | | Diaphragm Shear (plf) | | | Perf/FTAO Wall Info | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Load | Trib w (ft) | E.Z. Appl* | Span (ft) | Line | % | Location | Seis (lbs) | Wind (lbs) | ρ*Seis | Wind | E.Z. Wind | 2a (ft) | E.Z. P (lb) | Drag (ft) | Seis (Load vs. Allow.) | | (Not Applicable) | | | |
| ω1 | 12.33 | Minor | 24.66 | | 1.00 | Offset | | | 319.3 | 118.1 | 177.6 | 6 | 43 | 26 | 151 | 198 | | | | |
| | | None | | | 1.00 | Offset | | | | | | | | | | | | | | |
| | | | | | 1.00 | Above | | | | | | | | | Wind (Load vs. Allow.) | | | | | |
| Plate h (ft)= | 9.5 | | | | | Total | **5624** | 1500 | Include Ω for irregularities (above)? | | | | No | | 58 | 276 | | | | |
| Max opening height (ft)= | 9.5 | | | | | 7311 @R=5 | | | | | | | | | | | | | | |
| Apply aspect ratio reduction? | Yes | | | 100% | Perforated SW? | | No | | Shear Length (ft)= | | | | | Story V (K)= | 11248 | | | | | |
| Opening elevation | | | | Force Transfer @ Openings? | | | No | | Wall DL (psf)= | | 10 | | | Max allow. drift (in) | 2.85 | | | | | |

| Shear-Wall Length (ft) | $Roof_{DL}$ 'w' (ft) | $Floor_{DL}$ 'w' (ft) | $Other_{DL}$ 'w' (plf) | Tension From Above (lb) | Wall Type | Sill Type | Holdown Strap | HD Capacity (Stem 'w'-edge dist) | OTM (**wind**, seismic) (ft-lb) | .6*RM (ft-lb) | Aspect Ratio | Aspect Ratio Reduc. | Seis. Shear (plf) | Seis. Wall Cap. (plf) | Wind Shear (plf) | Wind Wall Cap. (plf) | Sill Plate Cap. (plf) | Tension (lb) | HD Capacity | Max Shear-Wall δ (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Drag beams and Special RC Shearwall see attached calcs | | | | | | | | | | | | | | #VALUE! | | #VALUE! | | | | |
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| Add'l Comments: | | | | | | | | | | | | | | | | | | | Max: | |

**LINE: 1.2 1ST STORY**

| Line Loads (plf) | | | | Loads from above | | | | | Actual Applied Loads (plf unless noted otherwise) | | | | | Diaphragm Shear (plf) | | | Perf/FTAO Wall Info | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Load | Trib w (ft) | E.Z. Appl* | Span (ft) | Line | % | Location | Seis (lbs) | Wind (lbs) | ρ*Seis | Wind | E.Z. Wind | 2a (ft) | E.Z. P (lb) | Drag (ft) | Seis (Load vs. Allow.) | | (Not Applicable) | | | |
| ω4 | 2.5 | Major | 5 | 1-2ND | 1.00 | Offset | 6046 | 2859 | 56.2 | 145.4 | 218.8 | 6 | 176 | 36 | 214 | 294 | | | | |
| ω4 | 9.25 | None | 18.5 | | 1.00 | Offset | | | 56.2 | 145.4 | 218.8 | 6 | | 36 | 14 | | | | | |
| | | | | | 1.00 | Above | | | | | | | | | Wind (Load vs. Allow.) | | | | | |
| Plate h (ft)= | 10 | | | | | Total | **6706** | 4744 | Include Ω for irregularities (above)? | | | | No | | 94 | 412 | | | | |
| Max opening height (ft)= | 10 | | | | | 8717 @R=5 | | | | | | | | | 37 | | | | | |
| Apply aspect ratio reduction? | Yes | | | 100% | Perforated SW? | | No | | Shear Length (ft)= | | | | | Story V (K)= | 14325 | | | | | |
| Opening elevation | | | | Force Transfer @ Openings? | | | No | | Wall DL (psf)= | | 10 | | | Max allow. drift (in) | 3 | | | | | |

| Shear-Wall Length (ft) | $Roof_{DL}$ 'w' (ft) | $Floor_{DL}$ 'w' (ft) | $Other_{DL}$ 'w' (plf) | Tension From Above (lb) | Wall Type | Sill Type | Holdown Strap | HD Capacity (Stem 'w'-edge dist) | OTM (**wind**, seismic) (ft-lb) | .6*RM (ft-lb) | Aspect Ratio | Aspect Ratio Reduc. | Seis. Shear (plf) | Seis. Wall Cap. (plf) | Wind Shear (plf) | Wind Wall Cap. (plf) | Sill Plate Cap. (plf) | Tension (lb) | HD Capacity | Max Shear-Wall δ (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SPECIAL REINFORCED CONCRETE SHEARWALL, SEE CALCS | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | | | |
| Add'l Comments: | | | | | | | | | | | | | | | | | | | Max: | |

**PROJECT:** Ridge Nest 14 **JOB NO.:** U2784-001-181 **SUBJECT:** SHEAR WALLS

| | | | |
|---|---|---|---|
| $\rho_{Applied}$ = | 1 | | |
| Min Diaphragm Width (ft) = | 16 | | |
| Allowable Seismic Aspect Ratio = | 3.5 | | |
| Allowable Wind Aspect Ratio = | 3.5 | | |
| Comb. Overstrength Factors: (Ω-0.5)/1.2 = | 2.08 | | |

| $\rho_i$ | Loc |
|---|---|
| 1.00 | 1.2-1ST |
| 1.00 | 1-2ND |
| | |
| | |

**Roof DL (psf) =** **97** (includes seismic snow where occurs)
**Floor DL (psf) =** **35**

ρ calculated in accordance with ASCE7-10 Section 12.3.4.1
No Exception in ASCE 7 12.3.4.2b met?

**LINE: C 1ST STORY**

| Line Loads (plf) | | | | Loads from above | | | | | Actual Applied Loads (plf unless noted otherwise) | | | | | Diaphragm Shear (plf) | | | Perf/FTAO Wall Info | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Load | Trib w (ft) | E.Z. Appl* | Span (ft) | Line | % | Location | Seis (lbs) | Wind (lbs) | ρ*Seis | Wind | E.Z. Wind | 2a (ft) | E.Z. P (lb) | Drag (ft) | Seis (Load vs. Allow.) | | (Not Applicable) | | | |
| ω3 | 11.65 | Minor | 23.3 | | 1.00 | Offset | | | 39.7 | 208.4 | 313.5 | 6 | 81 | 11 | 42 | 198 | | | | |
| ω5 | 8 | Minor | 16 | | 1.00 | Offset | | | 76.9 | 84.1 | 126.4 | 6 | 48 | 11 | 56 | | | | | |
| | | | | | 1.00 | Above | | | | | | | | | Wind (Load vs. Allow.) | | | | | |
| Plate h (ft)= | 9 | | | | | Total | 1077 | **3229** | Include Ω for irregularities (above)? | | | | No | | 228 | 276 | | | | |
| Max opening height (ft)= | 9 | | | | | | | | | | | | | | 65 | | | | | |
| Apply aspect ratio reduction? | Yes | | | 100% | Perforated SW? | | No | | Shear Length (ft)= | | 11 | | Story V (K)= | | 14325 | | | | | |
| Opening elevation | | | | Force Transfer @ Openings? | | | No | | Wall DL (psf)= | | 10 | | Max allow. drift (in) | | 2.7 | | | | | |

| Shear-Wall Length (ft) | $Roof_{DL}$ 'w' (ft) | $Floor_{DL}$ 'w' (ft) | $Other_{DL}$ 'w' (plf) | Tension From Above (lb) | Wall Type | Sill Type | Holdown Strap | HD Capacity (Stem 'w'-edge dist) | OTM (**wind**, seismic) (ft-lb) | .6*RM (ft-lb) | Aspect Ratio | Aspect Ratio Reduc. | Seis. Shear (plf) | Seis. Wall Cap. (plf) | Wind Shear (plf) | Wind Wall Cap. (plf) | Sill Plate Cap. (plf) | Tension (lb) | HD Capacity | Max Shear-Wall δ (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 3 | 1 | | | P1 | S1 | HDU2 | | **29063** | 9221 | 0.82 | 1.00 | 98 | 260 | 294 | 365 | 372 | 1804 | 3075 | 0.31 |
| | | | | | | | | | | | | | | | | | | | | |
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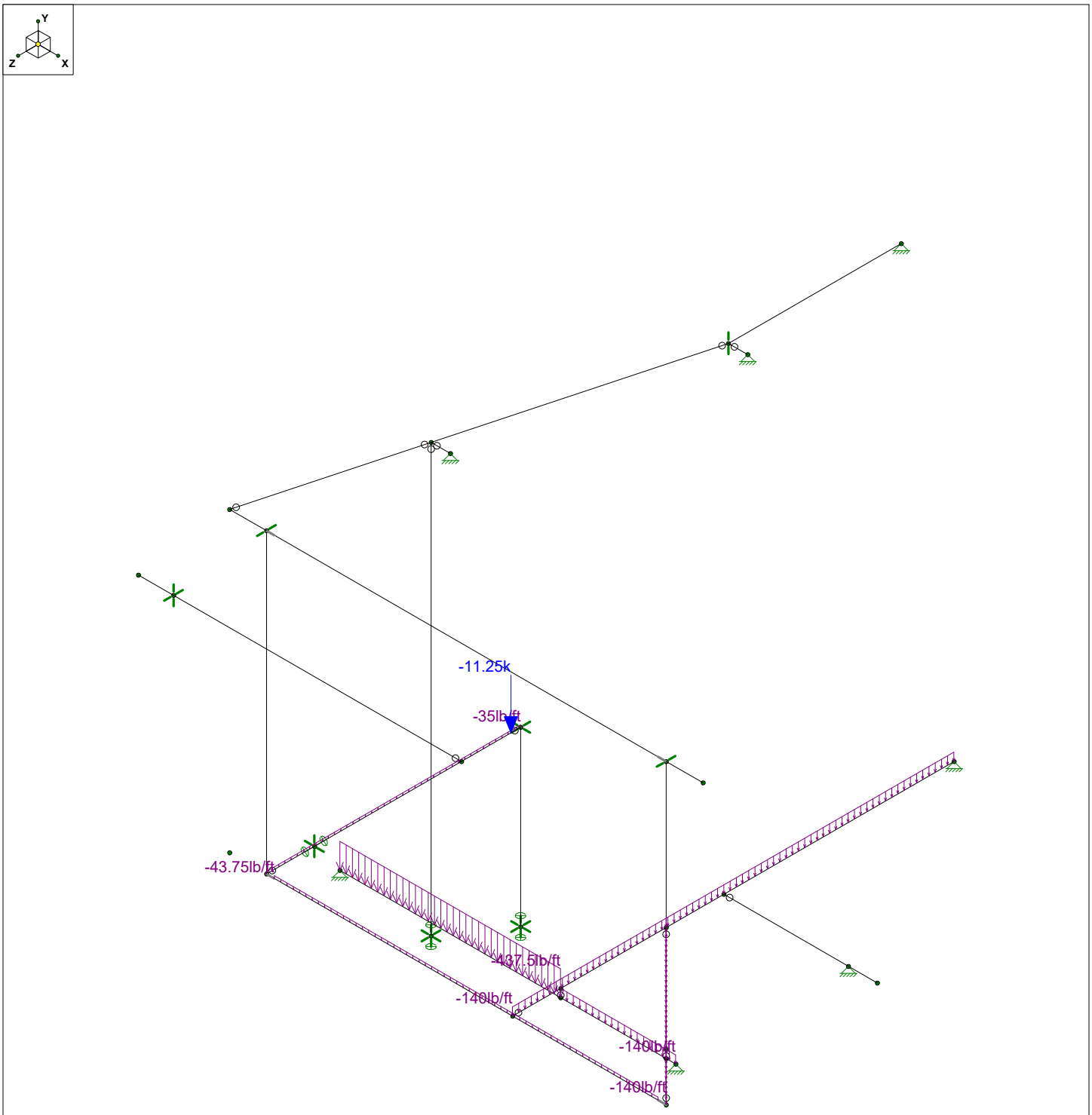
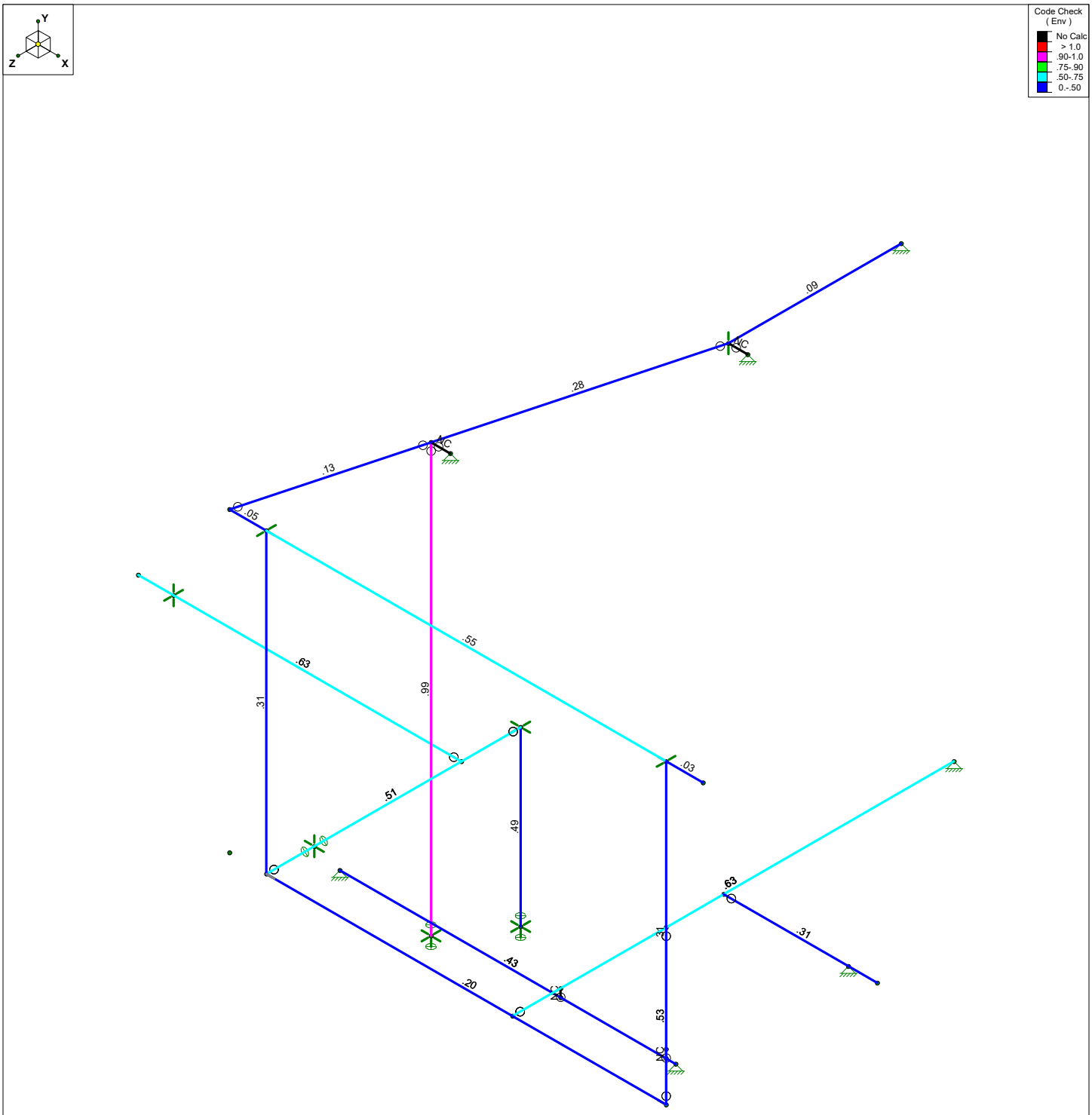
| | | | | | | | | | | | | | | | | | | | | |
| Add'l Comments: | | | | | | | | | | | | | | | | | | | Max: | 0.31 |



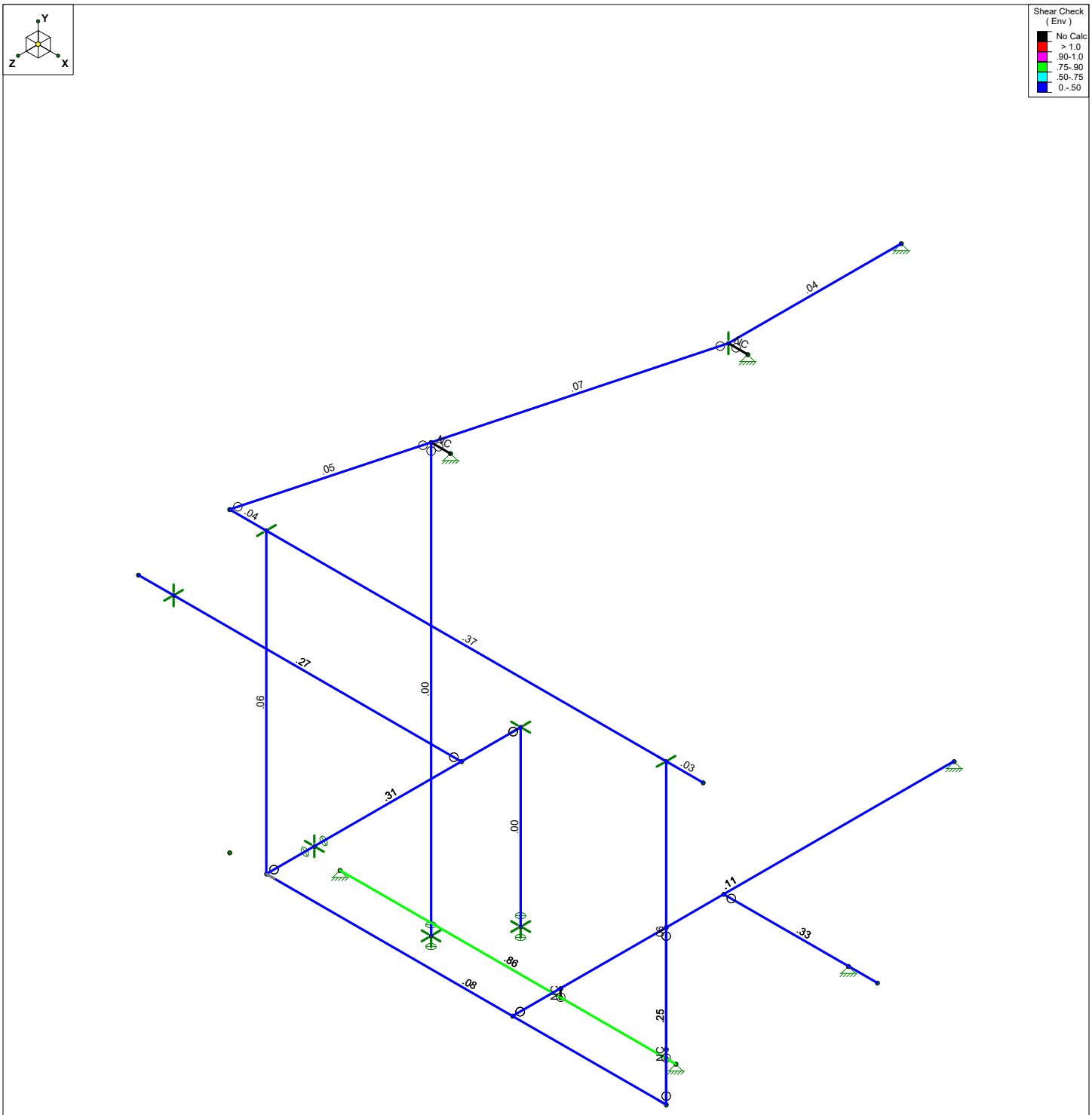

Loads: BLC 4, Floor Dead

| | | |
|---|---|---|
| VSE | Summit Powder Mtn | SK - |
| JBA | | Aug 29, 2018 at 4:16 PM |
| U2784-001-181 | | Moment Frame Special -- Relocate... |




Member Code Checks Displayed (Enveloped)
Results for LC 2, D

| | | |
|---|---|---|
| VSE | Summit Powder Mtn | SK - |
| JBA | | Aug 29, 2018 at 4:29 PM |
| U2784-001-181 | | Moment Frame Special -- Relocate... |




Member Shear Checks Displayed (Enveloped)
Results for LC 2, D

| | | |
|---|---|---|
| VSE | Summit Powder Mtn | SK - |
| JBA | | Aug 29, 2018 at 4:35 PM |
| U2784-001-181 | | Moment Frame Special -- Relocate... |

## Hot Rolled Steel Properties

| | Label | E [ksi] | G [ksi] | Nu | Therm (\1... | Density[k/ft^3] | Yield[ksi] | Ry | Fu[ksi] | Rt |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | A36 Gr.36 | 29000 | 11154 | .3 | .65 | .49 | 36 | 1.5 | 58 | 1.2 |
| 2 | A572 Gr.50 | 29000 | 11154 | .3 | .65 | .49 | 50 | 1.1 | 65 | 1.1 |
| 3 | A992 | 29000 | 11154 | .3 | .65 | .49 | 50 | 1.1 | 65 | 1.1 |
| 4 | A500 Gr.B RND | 29000 | 11154 | .3 | .65 | .527 | 42 | 1.4 | 58 | 1.3 |
| 5 | A500 Gr.B Rect | 29000 | 11154 | .3 | .65 | .527 | 46 | 1.4 | 58 | 1.3 |
| 6 | A53 Gr.B | 29000 | 11154 | .3 | .65 | .49 | 35 | 1.6 | 60 | 1.2 |
| 7 | A1085 | 29000 | 11154 | .3 | .65 | .49 | 50 | 1.4 | 65 | 1.3 |

## Hot Rolled Steel Section Sets

| | Label | Shape | Type | Design List | Material | Design ... | A [in2] | Iyy [in4] | Izz [in4] | J [in4] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Gravity Colu... | HSS3.5x3.5x5 | Column | RECT | A500 Gr.B Rect | Typical | 3.52 | 5.84 | 5.84 | 9.89 |
| 2 | HIGH FRAM... | W10x45 | Beam | SMF Wide Flange | A992 | Typical | 13.3 | 53.4 | 248 | 1.51 |
| 3 | LOW FRAM... | W10x45 | Beam | SMF Wide Flange | A992 | Typical | 13.3 | 53.4 | 248 | 1.51 |
| 4 | RB1 | W18x46 | Beam | Wide Flange | A992 | Typical | 13.5 | 22.5 | 712 | 1.22 |
| 5 | RB3 | W18x50 | Beam | Wide Flange | A992 | Typical | 14.7 | 40.1 | 800 | 1.24 |
| 6 | MF Col | W10x88 | Column | SMF Wide Flange | A992 | Typical | 26 | 179 | 534 | 7.53 |
| 7 | FB1 | W18x50 | Beam | Wide Flange | A992 | Typical | 14.7 | 40.1 | 800 | 1.24 |
| 8 | FB3 | W18x50 | Beam | Wide Flange | A992 | Typical | 14.7 | 40.1 | 800 | 1.24 |
| 9 | FB5 | W10x22 | Beam | Wide Flange | A992 | Typical | 6.49 | 11.4 | 118 | .239 |
| 10 | FB4 | W18x35 | Beam | Wide Flange | A992 | Typical | 10.3 | 15.3 | 510 | .506 |
| 11 | FB2 | W18x35 | Beam | Wide Flange | A992 | Typical | 10.3 | 15.3 | 510 | .506 |
| 12 | FB7 | W12x26 | Beam | Wide Flange | A992 | Typical | 7.65 | 17.3 | 204 | .3 |
| 13 | DRAG BM | W10x19 | Beam | Wide Flange | A992 | Typical | 5.62 | 4.29 | 96.3 | .233 |

## Frame / HR Column Seismic Design Rule

| | Label | Frame Ductility | Overstrength Reqd |
|---|---|---|---|
| 1 | OCBF | Minimal | Yes |
| 2 | SCBF | High | Yes |
| 3 | OMF | Minimal | Yes |
| 4 | IMF | Moderate | Yes |
| 5 | SMF | High | Yes |
| 6 | SCCS | High | Yes |
| 7 | Support | Minimal | Yes |

## HR Beam Seismic Design Rule

| | Label | Moment Connection | Overstrength Reqd | Z Factor | Hinge Location[in] |
|---|---|---|---|---|---|
| 1 | OCBF | Other/None | | | |
| 2 | SCBF | Other/None | | | |
| 3 | OMF | BFP | | | 12 |
| 4 | IMF | BFP | Yes | | 12 |
| 5 | SMF | BFP | | | 7.25 |
| 6 | SCCS | BFP | | | |
| 7 | Support | Other/None | Yes | | |

## Connection Rules

| | Label | Conn Type | Type | Beam Conn | Col/Girder Conn |
|---|---|---|---|---|---|
| 1 | Moment | Moment | Column/Beam Seismic Moment | N/A | N/A |
| 2 | Stub Connection | Moment | Column/Beam Direct Weld Moment | Bolted | N/A |
| 3 | Shear Tab Bm | Shear | Girder/Beam Shear Tab Shear | Bolted | N/A |
| 4 | Seismic Shear Tab | Shear | Beam Shear Tab Splice | N/A | N/A |

## Connection Rules (Continued)

| | Label | Conn Type | Type | Beam Conn | Col/Girder Conn |
|---|---|---|---|---|---|
| 5 | Shear Tab Col | Shear | Column/Beam Shear Tab Shear | Bolted | N/A |
| 6 | Baseplate | Baseplate | Single Column Baseplate | N/A | N/A |

## Drift Definitions

| | Type | Floor/Diaphragm | Joint Label | Elevation[ft] |
|---|---|---|---|---|
| 1 | Joint | - | N25 | 15.5 |
| 2 | Joint | - | N24 | 0 |

## Load Combinations

| | Description | Sol... | PDelta | SR... | BLC | Fa... | BLC | Fa... | BLC | Fa... | B... | Fa... | B... | Fa... | B... | Fa... | B... | Fa... | B... | Fa... | B... | Fa... | B... | Fa... |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Serviceability | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | D | Yes | Y | | DL | 1 | | | | | | | | | | | | | | | | | | |
| 3 | L | Yes | Y | | LL | 1 | RLL | 1 | | | | | | | | | | | | | | | | |
| 4 | D+L | Yes | Y | | DL | 1 | LL | 1 | RLL | 1 | | | | | | | | | | | | | | |
| 5 | WLX | Yes | Y | | DL | 1 | LL | .5 | WLX | .53 | | | | | | | | | | | | | | |
| 6 | S | Yes | Y | | SL | 1 | | | | | | | | | | | | | | | | | | |
| 7 | | | Y | | DL | 1 | LL | .5 | WLX | -.53 | | | | | | | | | | | | | | |
| 8 | ELX | Yes | Y | | DL | 1.2... | ELX | 1 | LL | .5 | | | | | | | | | | | | | | |
| 9 | | | Y | | DL | 1.2... | ELX | -1 | LL | .5 | | | | | | | | | | | | | | |
| 10 | | | Y | | DL | .826 | ELX | 1 | | | | | | | | | | | | | | | | |
| 11 | | | Y | | DL | .826 | ELX | -1 | | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | | | | | | |
| 13 | ASCE 7-10 Strength | | | | | | | | | | | | | | | | | | | | | | | |
| 14 | 1.4D | Yes | Y | | DL | 1.4 | | | | | | | | | | | | | | | | | | |
| 15 | 1.2D+1.6SL+.5L | Yes | Y | | DL | 1.2 | SL | 1.6 | LL | .5 | | | | | | | | | | | | | | |
| 16 | 1.2D+1.6SL+.5L+.5... | Yes | Y | | DL | 1.2 | SL | 1.6 | WLX | .5 | | | | | | | | | | | | | | |
| 17 | 1.2D+1.6SL-.5WLX | Yes | Y | | DL | 1.2 | SL | 1.6 | WLX | -.5 | | | | | | | | | | | | | | |
| 18 | 1.2D+WLX+.5SL | Yes | Y | | DL | 1.2 | WLX | 1 | SL | .5 | | | | | | | | | | | | | | |
| 19 | 1.2D-WLX+.5SL | Yes | Y | | DL | 1.2 | WLX | -1 | SL | .5 | | | | | | | | | | | | | | |
| 20 | 1.2D+WLX+L+.5S | Yes | Y | | DL | 1.2 | WLX | 1 | LL | 1 | SL | .5 | | | | | | | | | | | | |
| 21 | 1.2D-WLX+L+.5S | Yes | Y | | DL | 1.2 | WLX | -1 | LL | 1 | SL | .5 | | | | | | | | | | | | |
| 22 | 0.9D+WLX | Yes | Y | | DL | .9 | WLX | 1 | | | | | | | | | | | | | | | | |
| 23 | 0.9D-WLX | Yes | Y | | DL | .9 | WLX | -1 | | | | | | | | | | | | | | | | |
| 24 | 1.2D+ELX+.5L+.37... | Yes | Y | | DL | 1.2 | ELX | 1 | SL | .37 | LL | .5 | S... | .2 | | | | | | | | | | |
| 25 | 1.2D-ELX+.5L+.37... | Yes | Y | | DL | 1.2 | ELX | -1 | SL | .37 | LL | .5 | S... | .2 | | | | | | | | | | |
| 26 | 0.9D+ELX | Yes | Y | | DL | .9 | ELX | 1 | | | | | S... | -.2 | | | | | | | | | | |
| 27 | 0.9D-ELX | Yes | Y | | DL | .9 | ELX | -1 | | | | | S... | -.2 | | | | | | | | | | |
| 28 | 1.2D+OmELX+.5L... | Yes | Y | | DL | 1.2 | Om*... | 1 | SL | .37 | LL | .5 | S... | .2 | | | | | | | | | | |
| 29 | 1.2D-OmELX+.5L+... | Yes | Y | | DL | 1.2 | Om*... | -1 | SL | .37 | LL | .5 | S... | .2 | | | | | | | | | | |
| 30 | 0.9D+OmELX | Yes | Y | | DL | .9 | Om*... | 1 | | | | | S... | -.2 | | | | | | | | | | |
| 31 | 0.9D-OmELX | Yes | Y | | DL | .9 | Om*... | -1 | | | | | S... | -.2 | | | | | | | | | | |
| 32 | 1.2D+ELZ+.5L+.37... | Yes | Y | | DL | 1.2 | ELZ | 1 | SL | .37 | LL | .5 | S... | .2 | | | | | | | | | | |
| 33 | 1.2D-ELZ+.5L+.37... | Yes | Y | | DL | 1.2 | ELZ | -1 | SL | .37 | LL | .5 | S... | .2 | | | | | | | | | | |
| 34 | 0.9D+ELZ | Yes | Y | | DL | .9 | ELZ | 1 | | | | | S... | -.2 | | | | | | | | | | |
| 35 | 0.9D-ELZ | Yes | Y | | DL | .9 | ELZ | -1 | | | | | S... | -.2 | | | | | | | | | | |
| 36 | 1.2D+.5L+OmELZ+... | Yes | Y | | DL | 1.2 | Om*... | 1 | SL | .37 | LL | .5 | S... | .2 | | | | | | | | | | |
| 37 | 1.2D+.5L-OmELZ+... | Yes | Y | | DL | 1.2 | Om*... | -1 | SL | .37 | LL | .5 | S... | .2 | | | | | | | | | | |
| 38 | 0.9D+OmELZ | Yes | Y | | DL | .9 | Om*... | 1 | | | | | S... | -.2 | | | | | | | | | | |
| 39 | 0.9D-OmELZ | Yes | Y | | DL | .9 | Om*... | -1 | | | | | S... | -.2 | | | | | | | | | | |

## Envelope Joint Reactions

| | Joint | | X [k] | LC | Y [k] | LC | Z [k] | LC | MX [k-ft] | LC | MY [k-ft] | LC | MZ [k-ft] | LC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | N4 | max | 0 | 2 | 0 | 2 | .08 | 17 | 0 | 2 | 0 | 2 | 0 | 2 |
| 2 | | min | 0 | 2 | 0 | 2 | 0 | 3 | 0 | 2 | 0 | 2 | 0 | 2 |
| 3 | N8 | max | .11 | 25 | 1.87 | 3 | .15 | 26 | 0 | 2 | 0 | 2 | 0 | 2 |
| 4 | | min | -.11 | 8 | -8.64 | 16 | -.37 | 25 | 0 | 2 | 0 | 2 | 0 | 2 |
| 5 | N11 | max | 1.13 | 25 | 5.83 | 21 | .12 | 25 | 0 | 2 | 0 | 2 | 0 | 2 |
| 6 | | min | -.97 | 26 | -.88 | 6 | -.11 | 26 | 0 | 2 | 0 | 2 | 0 | 2 |
| 7 | N10 | max | 4.32 | 25 | 62.99 | 15 | .17 | 17 | 0 | 2 | 0 | 2 | 0 | 2 |
| 8 | | min | -4.81 | 24 | 5.92 | 3 | -.05 | 27 | 0 | 2 | 0 | 2 | 0 | 2 |
| 9 | N12 | max | .77 | 25 | 67.71 | 17 | 0 | 2 | 0 | 2 | 0 | 2 | .03 | 8 |
| 10 | | min | -.56 | 26 | 2.43 | 3 | 0 | 2 | 0 | 2 | 0 | 2 | -.03 | 17 |
| 11 | N14 | max | 0 | 17 | 62.11 | 16 | 0 | 16 | 0 | 2 | .03 | 16 | 0 | 2 |
| 12 | | min | 0 | 16 | 0 | 3 | 0 | 34 | 0 | 2 | 0 | 27 | 0 | 2 |
| 13 | N16 | max | 1.3 | 24 | 64.26 | 17 | 0 | 25 | 0 | 2 | 0 | 2 | 0 | 2 |
| 14 | | min | -1.29 | 25 | 0 | 3 | 0 | 5 | 0 | 2 | 0 | 2 | 0 | 2 |
| 15 | N18 | max | 0 | 33 | 3.24 | 15 | 7.58 | 32 | 0 | 2 | 0 | 2 | 0 | 2 |
| 16 | | min | 0 | 32 | 0 | 3 | -7.19 | 35 | 0 | 2 | 0 | 2 | 0 | 2 |
| 17 | N19 | max | 0 | 2 | 9.13 | 17 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 |
| 18 | | min | 0 | 2 | 0 | 3 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 |
| 19 | N21 | max | 0 | 16 | .04 | 14 | 0 | 32 | 0 | 2 | 0 | 2 | 0 | 2 |
| 20 | | min | 0 | 27 | 0 | 3 | 0 | 33 | 0 | 2 | 0 | 2 | 0 | 2 |
| 21 | N22 | max | 0 | 16 | .03 | 14 | 0 | 17 | 0 | 2 | 0 | 2 | 0 | 2 |
| 22 | | min | 0 | 25 | 0 | 6 | 0 | 16 | 0 | 2 | 0 | 2 | 0 | 2 |
| 23 | N25 | max | 0 | 2 | 0 | 2 | 0 | 3 | 0 | 2 | 0 | 2 | 0 | 2 |
| 24 | | min | 0 | 2 | 0 | 2 | -.85 | 16 | 0 | 2 | 0 | 2 | 0 | 2 |
| 25 | N26 | max | .1 | 26 | 0 | 2 | .11 | 25 | 0 | 2 | 0 | 2 | 0 | 2 |
| 26 | | min | -.15 | 25 | 0 | 2 | -.09 | 26 | 0 | 2 | 0 | 2 | 0 | 2 |
| 27 | N27 | max | 0 | 25 | 44.23 | 16 | 0 | 24 | 0 | 2 | 0 | 26 | 0 | 2 |
| 28 | | min | 0 | 16 | -.46 | 3 | 0 | 25 | 0 | 2 | 0 | 25 | 0 | 2 |
| 29 | N30 | max | 0 | 2 | 23.33 | 15 | 0 | 8 | 0 | 2 | 0 | 2 | 0 | 2 |
| 30 | | min | 0 | 2 | 0 | 3 | 0 | 25 | 0 | 2 | 0 | 2 | 0 | 2 |
| 31 | Totals: | max | 4.9 | 27 | 331.99 | 15 | 7.33 | 34 | | | | | | |
| 32 | | min | -4.9 | 8 | 12.51 | 3 | -7.33 | 33 | | | | | | |

## Envelope Joint Reactions - Overstrength

| | Joint | | X [k] | LC | Y [k] | LC | Z [k] | LC | MX [k-ft] | LC | MY [k-ft] | LC | MZ [k-ft] | LC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | N4 | max | 0 | 28 | 0 | 28 | .04 | 37 | 0 | 28 | 0 | 28 | 0 | 28 |
| 2 | | min | 0 | 28 | 0 | 28 | 0 | 38 | 0 | 28 | 0 | 28 | 0 | 28 |
| 3 | N8 | max | .27 | 29 | 1.01 | 31 | .7 | 28 | 0 | 28 | 0 | 28 | 0 | 28 |
| 4 | | min | -.29 | 28 | -2.42 | 28 | -.6 | 29 | 0 | 28 | 0 | 28 | 0 | 28 |
| 5 | N11 | max | 2.68 | 29 | 5.36 | 29 | .28 | 29 | 0 | 28 | 0 | 28 | 0 | 28 |
| 6 | | min | -2.5 | 30 | 1.59 | 30 | -.28 | 30 | 0 | 28 | 0 | 28 | 0 | 28 |
| 7 | N10 | max | 11.03 | 29 | 51.41 | 28 | .12 | 37 | 0 | 28 | 0 | 28 | 0 | 28 |
| 8 | | min | -11.8 | 28 | 5.75 | 31 | -.26 | 31 | 0 | 28 | 0 | 28 | 0 | 28 |
| 9 | N12 | max | 1.71 | 29 | 49.46 | 29 | 0 | 28 | 0 | 28 | 0 | 28 | .07 | 30 |
| 10 | | min | -1.5 | 30 | 3.7 | 30 | 0 | 28 | 0 | 28 | 0 | 28 | -.07 | 29 |
| 11 | N14 | max | 0 | 29 | 25.89 | 37 | 0 | 37 | 0 | 28 | .02 | 28 | 0 | 28 |
| 12 | | min | 0 | 28 | 5.48 | 38 | 0 | 36 | 0 | 28 | -.01 | 31 | 0 | 28 |
| 13 | N16 | max | 3.38 | 28 | 24.81 | 37 | 0 | 28 | 0 | 28 | 0 | 28 | 0 | 28 |
| 14 | | min | -3.1 | 29 | 7.32 | 31 | 0 | 38 | 0 | 28 | 0 | 28 | 0 | 28 |
| 15 | N18 | max | 0 | 37 | 1.25 | 28 | 22.15 | 36 | 0 | 28 | 0 | 28 | 0 | 28 |
| 16 | | min | 0 | 36 | .37 | 30 | -21.76 | 39 | 0 | 28 | 0 | 28 | 0 | 28 |
| 17 | N19 | max | 0 | 28 | 5.95 | 36 | 0 | 28 | 0 | 28 | 0 | 28 | 0 | 28 |
| 18 | | min | 0 | 28 | -1.35 | 39 | 0 | 28 | 0 | 28 | 0 | 28 | 0 | 28 |
| 19 | N21 | max | 0 | 28 | .03 | 28 | 0 | 36 | 0 | 28 | 0 | 28 | 0 | 28 |

## Envelope Joint Reactions - Overstrength (Continued)

| | Joint | | X [k] | LC | Y [k] | LC | Z [k] | LC | MX [k-ft] | LC | MY [k-ft] | LC | MZ [k-ft] | LC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | | min | 0 | 31 | .02 | 38 | 0 | 37 | 0 | 28 | 0 | 28 | 0 | 28 |
| 21 | N22 | max | 0 | 28 | .03 | 28 | 0 | 37 | 0 | 28 | 0 | 28 | 0 | 28 |
| 22 | | min | 0 | 29 | .02 | 31 | 0 | 28 | 0 | 28 | 0 | 28 | 0 | 28 |
| 23 | N25 | max | 0 | 28 | 0 | 28 | .06 | 38 | 0 | 28 | 0 | 28 | 0 | 28 |
| 24 | | min | 0 | 28 | 0 | 28 | -.48 | 37 | 0 | 28 | 0 | 28 | 0 | 28 |
| 25 | N26 | max | .28 | 30 | 0 | 28 | .25 | 29 | 0 | 28 | 0 | 28 | 0 | 28 |
| 26 | | min | -.32 | 29 | 0 | 28 | -.23 | 30 | 0 | 28 | 0 | 28 | 0 | 28 |
| 27 | N27 | max | 0 | 29 | 22.65 | 28 | 0 | 28 | 0 | 28 | 0 | 30 | 0 | 28 |
| 28 | | min | 0 | 28 | 5.49 | 31 | 0 | 29 | 0 | 28 | 0 | 29 | 0 | 28 |
| 29 | N30 | max | 0 | 28 | 8.67 | 28 | 0 | 28 | 0 | 28 | 0 | 28 | 0 | 28 |
| 30 | | min | 0 | 28 | 2.41 | 31 | 0 | 29 | 0 | 28 | 0 | 28 | 0 | 28 |
| 31 | Totals: | max | 12.25 | 31 | 163.95 | 28 | 21.99 | 38 | | | | | | |
| 32 | | min | -12.25 | 28 | 60.64 | 31 | -21.99 | 37 | | | | | | |

## Envelope Story Drift - X-Direction, Strength

| | Story (Elevation) | | Story Drift[in] | Loc (Z,X) | LC | Drift Ratio (%) | Loc (Z,X) | LC | 2nd/1st Ratio | Loc (Z,X) | LC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | N25 (15.5 ft) | max | 2.65 | 0, 1.92 | 24 | 1.42 | 0, 1.92 | 24 | 1.04 | 0, 1.92 | 16 |
| 2 | | min | -2.35 | 0, 1.92 | 27 | 0 | 0, 1.92 | 14 | 1.01 | 0, 1.92 | 35 |
| 3 | N24 (0 ft) | max | .34 | 0, 1.92 | 26 | NC | | | 1.11 | 0, 1.92 | 15 |
| 4 | | min | -.47 | 0, 1.92 | 25 | NC | | | .95 | 0, 1.92 | 20 |

## Envelope AISC 14th(360-10): LRFD Steel Code Checks

| | Member | Shape | Code Check | Lo... | ... | She... | Lo... | Dir | ... | phi*Pnc [k] | phi*Pnt [k] | phi*Mn y-y ... | phi*Mn z-z [k... | ... | Eqn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | M1 | W10x88 | .307 | 15.5 | ... | .059 | 7.67 | y | ... | 810.24 | 1170 | 199.13 | 423.75 | ... | H1-1b |
| 2 | M2 | W10x88 | .312 | 15.5 | ... | .065 | 7.67 | y | ... | 810.24 | 1170 | 199.13 | 423.75 | ... | H1-1b |
| 3 | M3 | W10x45 | .553 | 0 | ... | .373 | 20 | y | ... | 477.54 | 598.5 | 76.13 | 205.88 | ... | H1-1b |
| 4 | M4 | W18x50 | .526 | 3.43 | ... | .252 | 3.43 | y | ... | 401.21 | 661.5 | 62.25 | 378.75 | ... | H1-1b |
| 5 | M5 | W18x50 | .634 | 8.13 | ... | .107 | 7.9 | y | ... | 561.71 | 661.5 | 62.25 | 192.42 | ... | H1-1b |
| 6 | M6 | W10x22 | .430 | .53 | ... | .858 | 0 | y | ... | 243.84 | 292.05 | 22.88 | 97.5 | 1 | H1-1b |
| 7 | M7 | W18x35 | .514 | 10... | ... | .310 | 10... | y | ... | 136.72 | 463.5 | 30.23 | 238.29 | ... | H1-1b |
| 8 | M9 | W10x45 | .201 | 0 | ... | .078 | 20 | y | 8 | 209.51 | 598.5 | 76.13 | 205.88 | ... | H1-1b |
| 9 | M10 | W18x35 | .312 | 6.46 | ... | .327 | 6.55 | y | ... | 281.53 | 463.5 | 30.23 | 249.38 | ... | H1-1b |
| 10 | M11 | W10x19 | .275 | 7.84 | ... | .073 | 0 | y | ... | 216.75 | 252.9 | 12.56 | 81 | 1 | H1-1b |
| 11 | M12 | W10x19 | .093 | 0 | ... | .042 | 9 | y | ... | 237.47 | 252.9 | 12.56 | 81 | 1 | H1-... |
| 12 | M13 | HSS3.5... | .988 | 0 | ... | .002 | 0 | y | ... | 62.87 | 145.73 | 14.28 | 14.28 | 1 | H1-1a |
| 13 | M14 | W10x19 | .127 | 5.31 | ... | .053 | 10... | y | ... | 234.32 | 252.9 | 12.56 | 81 | 1 | H1-1b |
| 14 | M17 | W10x45 | .033 | 0 | ... | .034 | 0 | y | ... | 592.74 | 598.5 | 76.13 | 205.88 | ... | H1-1b |
| 15 | M18 | HSS3.5... | .487 | 9 | ... | .000 | 0 | y | 2 | 90.82 | 145.73 | 14.28 | 14.28 | 1 | H1-1a |
| 16 | M18A | W10x45 | .055 | 0 | ... | .036 | 0 | y | ... | 592.74 | 598.5 | 76.13 | 205.88 | ... | H1-1b |
| 17 | M21 | W12x26 | .634 | 7.65 | ... | .273 | 0 | y | ... | 290.01 | 344.25 | 30.64 | 139.5 | 1 | H1-1b |

## Seismic Detailing - Columns

| | Label | Seismic ... | Ductilit... | UC M... | LC | Slenderness ... | Panel Zone ... | Panel Zone ... | Cont. Plate... | Cont. Plate ... | SC/WB ... | SC/W... | Misc. ... |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | M1 | SMF | High | .31 | 17 | Warning | Fail (M3) | 360-10: Eqn ... | Yes (M3) | 360-10: Eq... | 1.27 (pa... | M3 | Pass |
| 2 | M2 | SMF | High | .31 | 16 | Warning | Fail (M3) | 360-10: Eqn ... | Yes (M3) | 360-10: Eq... | 1.27 (pa... | M3 | Pass |
| 3 | M18 | Support | Minimal | .49 | 16 | Pass | N/A | | No | N/A | N/A | N/A | Fail |

## Seismic Detailing - Beams

| | Label | Seis... | Ductilit... | UC ... | LC | Slenderness C... | Type | Req'd Sh... | Req'd Mome... | SC/WB R... | SC/WB Col | Span/D... | Misc. Che... |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | M3 | SMF | High | .55 | 17 | Pass | BFP | 65.91 | 329.19 | 1.27 | M2 | 23.7 (p... | Pass |
| 2 | M7 | Supp... | Minimal | .51 | 17 | Pass | Other... | N/A | N/A | N/A | N/A | N/A | Fail |
| 3 | M9 | SMF | High | .2 | 25 | Pass | BFP | 37.53 | 312.04 | 1.38 | M2 | 23.7 (p... | Pass |
| 4 | M11 | Supp... | Minimal | .28 | 16 | Pass | Other... | N/A | N/A | N/A | N/A | N/A | Fail |
| 5 | M12 | Supp... | Minimal | .09 | 36 | Pass | Other... | 27.44 | 108.9 | N/A | N/A | N/A | Fail |
| 6 | M14 | Supp... | Minimal | .13 | 15 | Pass | Other... | N/A | N/A | N/A | N/A | N/A | Pass |

## Global Parameters - Description:

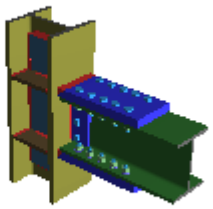
| | |
|---|---|
| Project Title | Summit Powder Mtn |
| Company | VSE |
| Designer | JBA |
| Job Number | U2784-001-181 |
| Notes | |

## Global Parameters - Solution:

| | |
|---|---|
| Design Method | AISC 14th (360-10): LRFD |
| Bolt Group Analysis Method | Center of Rotation |
| Weld Analysis Method | Center of Rotation |
| Consider Bold Hole Deformation? | Yes |
| Check Weld Filler Material Matching? | Yes |
| Check Rotational Ductility? | Yes |
| Full Shear Eccentricity Considered? | No |
| Plastic Panel-Zone Shear Deformation Considered? | No |

# *M3 I - M1: LRFD Results Report*

*Column/Beam Flange Plate Moment Connection*



| Material Properties: | | | | |
|---|---|---|---|---|
| **Column** | W10x88 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Beam** | W10x45 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Plate** | P0.75x4.00x8.00 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |
| **Moment Plate** | P1.50x8.00x16.50 | A572 Gr.50 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Doubler** | P0.75x7.42x25.10 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |
| **Transverse Stiffener** | P0.75x4.10x8.82 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |

| Input Data: | | |
|---|---|---|
| **Shear Load** | 39.38 kips | *User Input Shear Load* |
| **Moment** | -108.45 kips-ft | *User Input Moment* |
| **Axial Load** | 43.18 kips | *User Input Axial Force (compression)* |
| **Puf_c** | 133.78 kips | *Required Flange Force (compression)* |
| **Puf_t** | 90.60 kips | *Required Flange Force (tension)* |
| **Top Column Dist** | 0.00 in | *User Input Top Column Dist* |
| **Column Force** | 0.00 kips | *User Input Column Force* |
| **Story Shear** | 0.00 kips | *User Input Story Shear* |

| Input Data: | | |
|---|---|---|
| **Seismic System** | SMF (BFP) | *User Input Seismic System* |
| **Gravity Shear, Vg** | 0.00 kips | *User Input Shear due to Gravity* |
| **Clear Span, L** | 19.93 ft | *User Input Clear Span of Beam* |

Governing LC: 3D - 17 - 1.2D+1.6SL-.5WLX

Note: Unless specified, all code references are from AISC 360-10

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Geometry Restrictions at Beam** | | | | **PASS** |
| **Geometry Restrictions at Flange Beam** | | | | **PASS** |
| **Shear Plate Weld at Column Limitations** | | | | **PASS** |
| **Shear Plate Weld Strength at Column** | 39.38 kips | 89.09 kips | **0.44** | **PASS** |
| **Beam Web Shear Yield** | 39.38 kips | 106.05 kips | **0.37** | **PASS** |
| **Vert. Plate Shear Yield** | 39.38 kips | 129.60 kips | **0.30** | **PASS** |
| **Beam Web Shear Rupture** | 39.38 kips | 76.53 kips | **0.51** | **PASS** |
| **Vert. Plate Shear Rupture** | 39.38 kips | 105.22 kips | **0.37** | **PASS** |
| **Beam Web Block Shear** | 39.38 kips | 114.18 kips | **0.34** | **PASS** |
| **Vert. Plate Block Shear** | 39.38 kips | 144.18 kips | **0.27** | **PASS** |
| **Bolt Shear at Beam Web** | 39.38 kips | 83.50 kips | **0.47** | **PASS** |
| **Bolt Bearing at Beam Web** | 39.38 kips | 83.50 kips | **0.47** | **PASS** |
| **Bolt Bearing at Vert. Plate** | 39.38 kips | 78.91 kips | **0.50** | **PASS** |
| **Bolt Shear at Flange Plate** | 150.44 kips | 278.33 kips | **0.54** | **PASS** |
| **Bolt Bearing at Beam Flange** | 158.87 kips | 278.33 kips | **0.57** | **PASS** |
| **Bolt Bearing at Flange Plate** | 133.78 kips | 278.33 kips | **0.48** | **PASS** |

*continued on next page...*

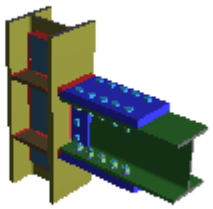
## *M3 I - M1: LRFD Results Report (continued):*

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Beam Flange Block Shear** | 115.69 kips | 393.53 kips | **0.29** | **PASS** |
| **Flange Plate Block Shear** | 90.60 kips | 950.62 kips | **0.10** | **PASS** |
| **Flange Plate Tearout** | 90.60 kips | 946.05 kips | **0.10** | **PASS** |
| **Flange Plate Weld Strength at Column** | | | | **PASS** |
| **Flange Plate Tensile Yield** | 90.60 kips | 540.00 kips | **0.17** | **PASS** |
| **Flange Plate Tensile Rupture** | 90.60 kips | 457.03 kips | **0.20** | **PASS** |
| **Flange Plate Compression** | 133.78 kips | 540.00 kips | **0.25** | **PASS** |
| **Column Flange Bending** | 90.60 kips | 137.83 kips | **0.66** | **PASS** |
| **Column Web Yielding** | 133.78 kips | 299.13 kips | **0.45** | **PASS** |
| **Column Web Buckling** | 133.78 kips | 963.59 kips | **0.14** | **PASS** |
| **Column Web Crippling** | 133.78 kips | 455.34 kips | **0.29** | **PASS** |
| **Column Panel Zone Shear** | 112.19 kips | 176.42 kips | **0.64** | **PASS** |
| **Doubler Shear Buckling** | | | | **PASS** |
| **Doubler Plate Shear Yield** | 0.00 kips | 174.96 kips | **0.00** | **PASS** |
| **Doubler Weld at Column Web Limitations** | | | | **PASS** |
| **Doubler Weld Strength at Column Flange** | | | | **PASS** |
| **Doubler Weld Strength at Column Web** | 0.00 kips | 123.94 kips | **0.00** | **n/a** |
| **Seismic Material and Geometry Limitations** | | | | **PASS** |
| **Seismic Width to Thickness Ratios** | | | | **PASS** |
| **Seismic Moment at Face of Column** | | ***326.19 kips-ft*** | | |
| **Seismic Weld Limitations** | | | | **PASS** |
| **Seismic Flange Bolt Limitations** | | | | **PASS** |
| **Seismic Flange Plate Limitations** | | | | **PASS** |
| **Seismic Column-Beam Moment Ratio** | | | | **PASS** |
| **Seismic Flange Strength** | | | | **PASS** |
| **Seismic Beam Web Checks** | | | **0.43** | **PASS** |
| **Seismic Flange Bolt Shear Strength** | 337.44 kips | 333.99 kips | **1.01** | **FAIL** |
| **Seismic Beam Web Bolt Checks** | | | | **PASS** |
| **Seismic Vert. Plate Checks** | | | | **PASS** |
| **Seismic Stiffener Plate Limitations** | | | | **PASS** |
| **Seismic Panel Zone Limitations** | | | | **PASS** |
| **Seismic Column Panel Zone Shear** | 305.24 kips | 196.02 kips | | **N/A** |
| **Seismic Doubler Plate Strength** | | | | **PASS** |

Given that this check is comparing reduced bolt strength against the strain-hardened maximum probable moment the beam can produce, we find within 1% acceptable

# *M3 J - M2: LRFD Results Report*

*Column/Beam Flange Plate Moment Connection*



| Material Properties: | | | | |
|---|---|---|---|---|
| **Column** | W10x88 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Beam** | W10x45 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Plate** | P0.75x4.00x8.00 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |
| **Moment Plate** | P1.50x8.00x16.50 | A572 Gr.50 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Doubler** | P0.75x7.42x25.10 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |
| **Transverse Stiffener** | P0.75x4.10x8.2 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |

| Input Data: | | |
|---|---|---|
| **Shear Load** | -39.56 kips | *User Input Shear Load* |
| **Moment** | -110.18 kips-ft | *User Input Moment* |
| **Axial Load** | 43.17 kips | *User Input Axial Force (compression)* |
| **Puf_c** | 135.57 kips | *Required Flange Force (compression)* |
| **Puf_t** | 92.40 kips | *Required Flange Force (tension)* |
| **Top Column Dist** | 0.00 in | *User Input Top Column Dist* |
| **Column Force** | 0.00 kips | *User Input Column Force* |
| **Story Shear** | 0.00 kips | *User Input Story Shear* |

| Input Data: | | |
|---|---|---|
| **Seismic System** | SMF (BFP) | *User Input Seismic System* |
| **Gravity Shear, Vg** | 0.00 kips | *User Input Shear due to Gravity* |
| **Clear Span, L** | 19.93 ft | *User Input Clear Span of Beam* |

Governing LC: 3D - 16 - 1.2D+1.6SL+.5L+.5WLX

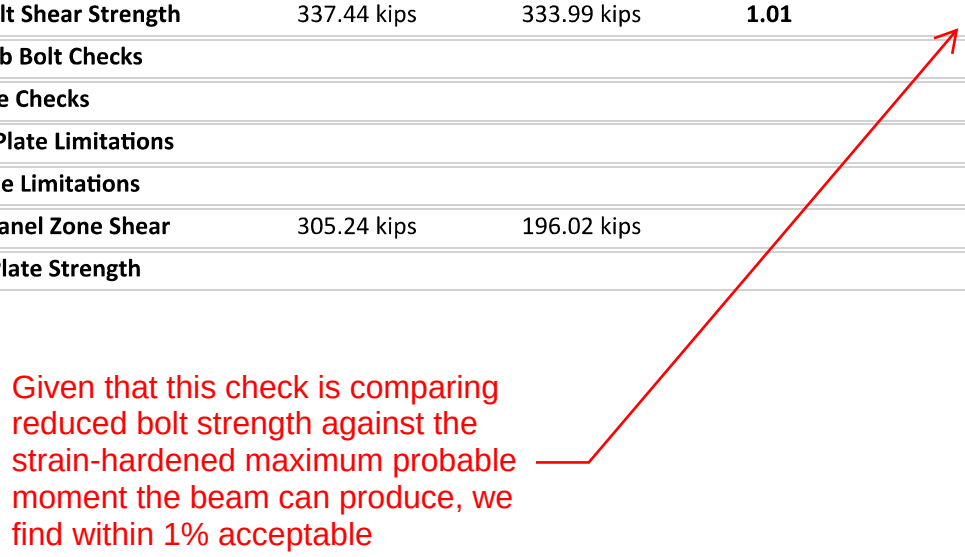
Note: Unless specified, all code references are from AISC 360-10

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Geometry Restrictions at Beam** | | | | **PASS** |
| **Geometry Restrictions at Flange Beam** | | | | **PASS** |
| **Shear Plate Weld at Column Limitations** | | | | **PASS** |
| **Shear Plate Weld Strength at Column** | 39.56 kips | 89.09 kips | **0.44** | **PASS** |
| **Beam Web Shear Yield** | 39.56 kips | 106.05 kips | **0.37** | **PASS** |
| **Vert. Plate Shear Yield** | 39.56 kips | 129.60 kips | **0.31** | **PASS** |
| **Beam Web Shear Rupture** | 39.56 kips | 76.53 kips | **0.52** | **PASS** |
| **Vert. Plate Shear Rupture** | 39.56 kips | 105.22 kips | **0.38** | **PASS** |
| **Beam Web Block Shear** | 39.56 kips | 110.08 kips | **0.36** | **PASS** |
| **Vert. Plate Block Shear** | 39.56 kips | 144.18 kips | **0.27** | **PASS** |
| **Bolt Shear at Beam Web** | 39.56 kips | 83.50 kips | **0.47** | **PASS** |
| **Bolt Bearing at Beam Web** | 39.56 kips | 83.50 kips | **0.47** | **PASS** |
| **Bolt Bearing at Vert. Plate** | 39.56 kips | 78.91 kips | **0.50** | **PASS** |
| **Bolt Shear at Flange Plate** | 152.49 kips | 278.33 kips | **0.55** | **PASS** |
| **Bolt Bearing at Beam Flange** | 161.05 kips | 278.33 kips | **0.58** | **PASS** |
| **Bolt Bearing at Flange Plate** | 135.57 kips | 278.33 kips | **0.49** | **PASS** |

*continued on next page...*

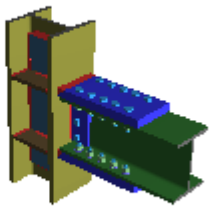
## *M3 J - M2: LRFD Results Report (continued):*

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Beam Flange Block Shear** | 117.88 kips | 393.53 kips | **0.30** | **PASS** |
| **Flange Plate Block Shear** | 92.40 kips | 950.62 kips | **0.10** | **PASS** |
| **Flange Plate Tearout** | 92.40 kips | 946.05 kips | **0.10** | **PASS** |
| **Flange Plate Weld Strength at Column** | | | | **PASS** |
| **Flange Plate Tensile Yield** | 92.40 kips | 540.00 kips | **0.17** | **PASS** |
| **Flange Plate Tensile Rupture** | 92.40 kips | 457.03 kips | **0.20** | **PASS** |
| **Flange Plate Compression** | 135.57 kips | 540.00 kips | **0.25** | **PASS** |
| **Column Flange Bending** | 92.40 kips | 137.83 kips | **0.67** | **PASS** |
| **Column Web Yielding** | 135.57 kips | 299.13 kips | **0.45** | **PASS** |
| **Column Web Buckling** | 135.57 kips | 963.59 kips | **0.14** | **PASS** |
| **Column Web Crippling** | 135.57 kips | 455.34 kips | **0.30** | **PASS** |
| **Column Panel Zone Shear** | 113.98 kips | 176.42 kips | **0.65** | **PASS** |
| **Doubler Shear Buckling** | | | | **PASS** |
| **Doubler Plate Shear Yield** | 0.00 kips | 174.96 kips | **0.00** | **PASS** |
| **Doubler Weld at Column Web Limitations** | | | | **PASS** |
| **Doubler Weld Strength at Column Flange** | | | | **PASS** |
| **Doubler Weld Strength at Column Web** | 0.00 kips | 123.94 kips | **0.00** | **n/a** |
| **Seismic Material and Geometry Limitations** | | | | **PASS** |
| **Seismic Width to Thickness Ratios** | | | | **PASS** |
| **Seismic Moment at Face of Column** | | ***326.19 kips-ft*** | | |
| **Seismic Weld Limitations** | | | | **PASS** |
| **Seismic Flange Bolt Limitations** | | | | **PASS** |
| **Seismic Flange Plate Limitations** | | | | **PASS** |
| **Seismic Column-Beam Moment Ratio** | | | | **PASS** |
| **Seismic Flange Strength** | | | | **PASS** |
| **Seismic Beam Web Checks** | | | **0.43** | **PASS** |
| **Seismic Flange Bolt Shear Strength** | 337.44 kips | 333.99 kips | **1.01** | **FAIL** |
| **Seismic Beam Web Bolt Checks** | | | | **PASS** |
| **Seismic Vert. Plate Checks** | | | | **PASS** |
| **Seismic Stiffener Plate Limitations** | | | | **PASS** |
| **Seismic Panel Zone Limitations** | | | | **PASS** |
| **Seismic Column Panel Zone Shear** | 305.24 kips | 196.02 kips | | **N/A** |
| **Seismic Doubler Plate Strength** | | | | **PASS** |



# *M9 I - M1: LRFD Results Report*

*Column/Beam Flange Plate Moment Connection*



| Material Properties: | | | | |
|---|---|---|---|---|
| **Column** | W10x88 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Beam** | W10x45 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Plate** | P0.75x4.00x8.00 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |
| **Moment Plate** | P1.50x8.00x16.50 | A572 Gr.50 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Doubler** | P0.75x7.42x25.10 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |
| **Transverse Stiffener** | P0.75x4.10x8.82 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |

| Input Data: | | |
|---|---|---|
| **Shear Load** | 10.30 kips | *User Input Shear Load* |
| **Moment** | -68.84 kips-ft | *User Input Moment* |
| **Axial Load** | 26.42 kips | *User Input Axial Force (compression)* |
| **Puf_c** | 84.43 kips | *Required Flange Force (compression)* |
| **Puf_t** | 58.01 kips | *Required Flange Force (tension)* |
| **Top Column Dist** | 0.00 in | *User Input Top Column Dist* |
| **Column Force** | 26.40 kips | *User Input Column Force* |
| **Story Shear** | 11.43 kips | *User Input Story Shear* |

| Input Data: | | |
|---|---|---|
| **Seismic System** | SMF (BFP) | *User Input Seismic System* |
| **Gravity Shear, Vg** | 0.00 kips | *User Input Shear due to Gravity* |
| **Clear Span, L** | 19.93 ft | *User Input Clear Span of Beam* |

Governing LC: 3D - 29 - 1.2D-OmELX+.5L+.37S

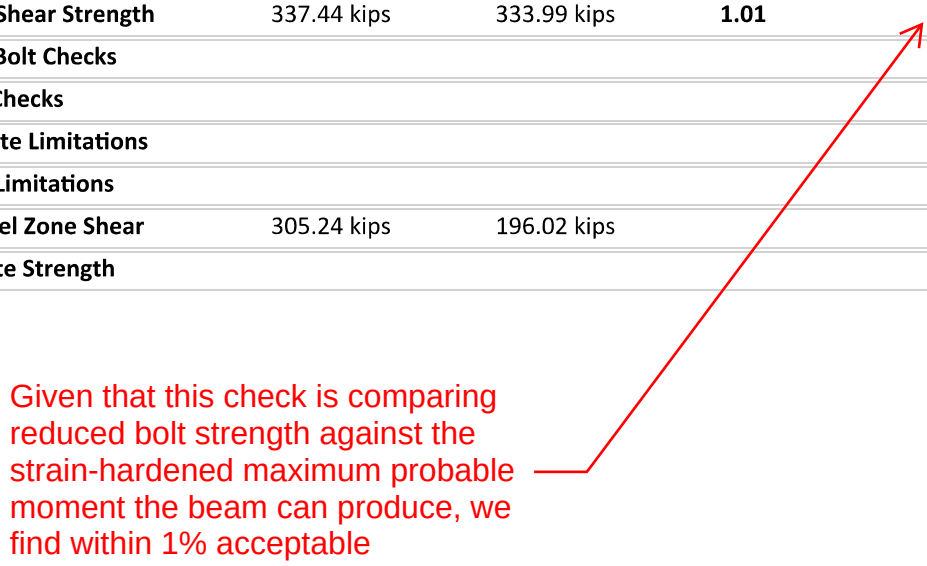
Note: Unless specified, all code references are from AISC 360-10

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Geometry Restrictions at Beam** | | | | **PASS** |
| **Geometry Restrictions at Flange Beam** | | | | **PASS** |
| **Shear Plate Weld at Column Limitations** | | | | **PASS** |
| **Shear Plate Weld Strength at Column** | 10.30 kips | 89.09 kips | **0.12** | **PASS** |
| **Beam Web Shear Yield** | 10.30 kips | 106.05 kips | **0.10** | **PASS** |
| **Vert. Plate Shear Yield** | 10.30 kips | 129.60 kips | **0.08** | **PASS** |
| **Beam Web Shear Rupture** | 10.30 kips | 76.53 kips | **0.13** | **PASS** |
| **Vert. Plate Shear Rupture** | 10.30 kips | 105.22 kips | **0.10** | **PASS** |
| **Beam Web Block Shear** | 10.30 kips | 114.18 kips | **0.09** | **PASS** |
| **Vert. Plate Block Shear** | 10.30 kips | 144.18 kips | **0.07** | **PASS** |
| **Bolt Shear at Beam Web** | 10.30 kips | 83.50 kips | **0.12** | **PASS** |
| **Bolt Bearing at Beam Web** | 10.30 kips | 83.50 kips | **0.12** | **PASS** |
| **Bolt Bearing at Vert. Plate** | 10.30 kips | 78.91 kips | **0.13** | **PASS** |
| **Bolt Shear at Flange Plate** | 95.00 kips | 278.33 kips | **0.34** | **PASS** |
| **Bolt Bearing at Beam Flange** | 100.35 kips | 278.33 kips | **0.36** | **PASS** |
| **Bolt Bearing at Flange Plate** | 84.43 kips | 278.33 kips | **0.30** | **PASS** |

*continued on next page...*

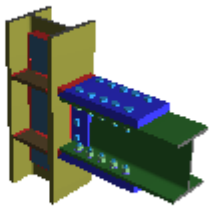
## *M9 I - M1: LRFD Results Report (continued):*

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Beam Flange Block Shear** | 73.93 kips | 393.53 kips | **0.19** | **PASS** |
| **Flange Plate Block Shear** | 58.01 kips | 950.62 kips | **0.06** | **PASS** |
| **Flange Plate Tearout** | 58.01 kips | 946.05 kips | **0.06** | **PASS** |
| **Flange Plate Weld Strength at Column** | | | | **PASS** |
| **Flange Plate Tensile Yield** | 58.01 kips | 540.00 kips | **0.11** | **PASS** |
| **Flange Plate Tensile Rupture** | 58.01 kips | 457.03 kips | **0.13** | **PASS** |
| **Flange Plate Compression** | 84.43 kips | 540.00 kips | **0.16** | **PASS** |
| **Column Flange Bending** | 58.01 kips | 137.83 kips | **0.42** | **PASS** |
| **Column Web Yielding** | 84.43 kips | 299.13 kips | **0.28** | **PASS** |
| **Column Web Buckling** | 84.43 kips | 963.59 kips | **0.09** | **PASS** |
| **Column Web Crippling** | 84.43 kips | 455.34 kips | **0.19** | **PASS** |
| **Column Panel Zone Shear** | 59.79 kips | 176.42 kips | **0.34** | **PASS** |
| **Doubler Shear Buckling** | | | | **PASS** |
| **Doubler Plate Shear Yield** | 0.00 kips | 174.96 kips | **0.00** | **PASS** |
| **Doubler Weld at Column Web Limitations** | | | | **PASS** |
| **Doubler Weld Strength at Column Flange** | | | | **PASS** |
| **Doubler Weld Strength at Column Web** | 0.00 kips | 123.94 kips | **0.00** | **n/a** |
| **Seismic Material and Geometry Limitations** | | | | **PASS** |
| **Seismic Width to Thickness Ratios** | | | | **PASS** |
| **Seismic Moment at Face of Column** | | ***326.19 kips-ft*** | | |
| **Seismic Weld Limitations** | | | | **PASS** |
| **Seismic Flange Bolt Limitations** | | | | **PASS** |
| **Seismic Flange Plate Limitations** | | | | **PASS** |
| **Seismic Column-Beam Moment Ratio** | | | | **PASS** |
| **Seismic Flange Strength** | | | | **PASS** |
| **Seismic Beam Web Checks** | | | **0.43** | **PASS** |
| **Seismic Flange Bolt Shear Strength** | 337.44 kips | 333.99 kips | **1.01** | **FAIL** |
| **Seismic Beam Web Bolt Checks** | | | | **PASS** |
| **Seismic Vert. Plate Checks** | | | | **PASS** |
| **Seismic Stiffener Plate Limitations** | | | | **PASS** |
| **Seismic Panel Zone Limitations** | | | | **PASS** |
| **Seismic Column Panel Zone Shear** | 305.24 kips | 196.02 kips | | **N/A** |
| **Seismic Doubler Plate Strength** | | | | **PASS** |



# *M9 J - M2: LRFD Results Report*

*Column/Beam Flange Plate Moment Connection*



| Material Properties: | | | | |
|---|---|---|---|---|
| **Column** | W10x88 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Beam** | W10x45 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Plate** | P0.75x4.00x8.00 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |
| **Moment Plate** | P1.50x8.00x16.50 | A572 Gr.50 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Doubler** | P0.75x7.42x25.10 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |
| **Transverse Stiffener** | P0.75x4.10x8.82 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |

| Input Data: | | |
|---|---|---|
| **Shear Load** | -9.94 kips | *User Input Shear Load* |
| **Moment** | -65.65 kips-ft | *User Input Moment* |
| **Axial Load** | 26.18 kips | *User Input Axial Force (compression)* |
| **Puf_c** | 81.00 kips | *Required Flange Force (compression)* |
| **Puf_t** | 54.82 kips | *Required Flange Force (tension)* |
| **Top Column Dist** | 0.00 in | *User Input Top Column Dist* |
| **Column Force** | 26.16 kips | *User Input Column Force* |
| **Story Shear** | 11.15 kips | *User Input Story Shear* |

| Input Data: | | |
|---|---|---|
| **Seismic System** | SMF (BFP) | *User Input Seismic System* |
| **Gravity Shear, Vg** | 0.00 kips | *User Input Shear due to Gravity* |
| **Clear Span, L** | 19.93 ft | *User Input Clear Span of Beam* |

Governing LC: 3D - 28 - 1.2D+OmELX+.5L+.37S

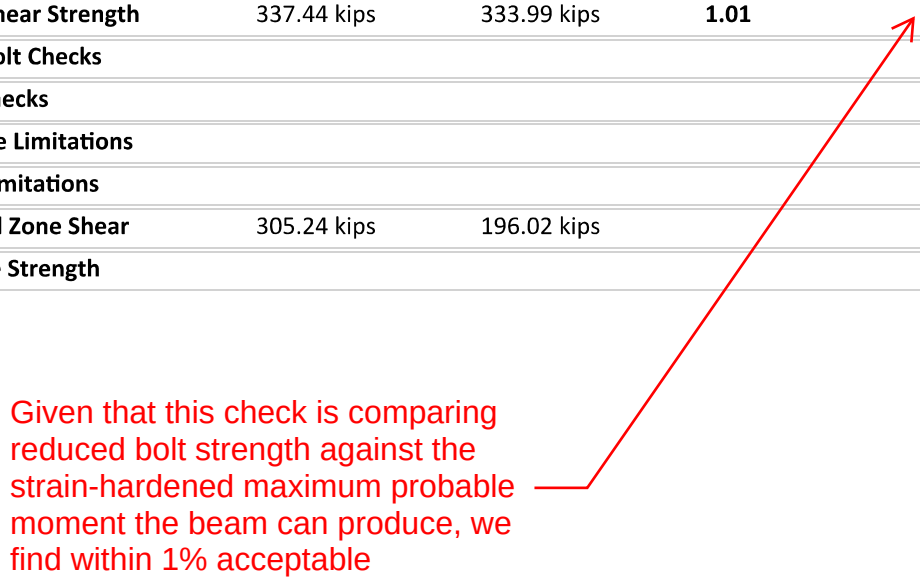
Note: Unless specified, all code references are from AISC 360-10

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Geometry Restrictions at Beam** | | | | **PASS** |
| **Geometry Restrictions at Flange Beam** | | | | **PASS** |
| **Shear Plate Weld at Column Limitations** | | | | **PASS** |
| **Shear Plate Weld Strength at Column** | 9.94 kips | 89.09 kips | **0.11** | **PASS** |
| **Beam Web Shear Yield** | 9.94 kips | 106.05 kips | **0.09** | **PASS** |
| **Vert. Plate Shear Yield** | 9.94 kips | 129.60 kips | **0.08** | **PASS** |
| **Beam Web Shear Rupture** | 9.94 kips | 76.53 kips | **0.13** | **PASS** |
| **Vert. Plate Shear Rupture** | 9.94 kips | 105.22 kips | **0.09** | **PASS** |
| **Beam Web Block Shear** | 9.94 kips | 110.08 kips | **0.09** | **PASS** |
| **Vert. Plate Block Shear** | 9.94 kips | 144.18 kips | **0.07** | **PASS** |
| **Bolt Shear at Beam Web** | 9.94 kips | 83.50 kips | **0.12** | **PASS** |
| **Bolt Bearing at Beam Web** | 9.94 kips | 83.50 kips | **0.12** | **PASS** |
| **Bolt Bearing at Vert. Plate** | 9.94 kips | 78.91 kips | **0.13** | **PASS** |
| **Bolt Shear at Flange Plate** | 91.08 kips | 278.33 kips | **0.33** | **PASS** |
| **Bolt Bearing at Beam Flange** | 96.19 kips | 278.33 kips | **0.35** | **PASS** |
| **Bolt Bearing at Flange Plate** | 81.00 kips | 278.33 kips | **0.29** | **PASS** |

*continued on next page...*

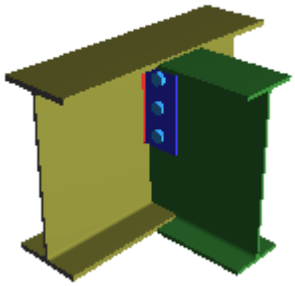
## *M9 J - M2: LRFD Results Report (continued):*

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Beam Flange Block Shear** | 70.01 kips | 393.53 kips | **0.18** | **PASS** |
| **Flange Plate Block Shear** | 54.82 kips | 950.62 kips | **0.06** | **PASS** |
| **Flange Plate Tearout** | 54.82 kips | 946.05 kips | **0.06** | **PASS** |
| **Flange Plate Weld Strength at Column** | | | | **PASS** |
| **Flange Plate Tensile Yield** | 54.82 kips | 540.00 kips | **0.10** | **PASS** |
| **Flange Plate Tensile Rupture** | 54.82 kips | 457.03 kips | **0.12** | **PASS** |
| **Flange Plate Compression** | 81.00 kips | 540.00 kips | **0.15** | **PASS** |
| **Column Flange Bending** | 54.82 kips | 137.83 kips | **0.40** | **PASS** |
| **Column Web Yielding** | 81.00 kips | 299.13 kips | **0.27** | **PASS** |
| **Column Web Buckling** | 81.00 kips | 963.59 kips | **0.08** | **PASS** |
| **Column Web Crippling** | 81.00 kips | 455.34 kips | **0.18** | **PASS** |
| **Column Panel Zone Shear** | 56.76 kips | 176.42 kips | **0.32** | **PASS** |
| **Doubler Shear Buckling** | | | | **PASS** |
| **Doubler Plate Shear Yield** | 0.00 kips | 174.96 kips | **0.00** | **PASS** |
| **Doubler Weld at Column Web Limitations** | | | | **PASS** |
| **Doubler Weld Strength at Column Flange** | | | | **PASS** |
| **Doubler Weld Strength at Column Web** | 0.00 kips | 123.94 kips | **0.00** | **n/a** |
| **Seismic Material and Geometry Limitations** | | | | **PASS** |
| **Seismic Width to Thickness Ratios** | | | | **PASS** |
| **Seismic Moment at Face of Column** | | ***326.19 kips-ft*** | | |
| **Seismic Weld Limitations** | | | | **PASS** |
| **Seismic Flange Bolt Limitations** | | | | **PASS** |
| **Seismic Flange Plate Limitations** | | | | **PASS** |
| **Seismic Column-Beam Moment Ratio** | | | | **PASS** |
| **Seismic Flange Strength** | | | | **PASS** |
| **Seismic Beam Web Checks** | | | **0.43** | **PASS** |
| **Seismic Flange Bolt Shear Strength** | 337.44 kips | 333.99 kips | **1.01** | **FAIL** |
| **Seismic Beam Web Bolt Checks** | | | | **PASS** |
| **Seismic Vert. Plate Checks** | | | | **PASS** |
| **Seismic Stiffener Plate Limitations** | | | | **PASS** |
| **Seismic Panel Zone Limitations** | | | | **PASS** |
| **Seismic Column Panel Zone Shear** | 305.24 kips | 196.02 kips | | **N/A** |
| **Seismic Doubler Plate Strength** | | | | **PASS** |



# *M10 I - M5: LRFD Results Report*

*Girder/Beam Shear Tab Shear Connection*



| Material Properties: | | | | |
|---|---|---|---|---|
| **Girder** | W18x50 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Beam** | W18x35 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Plate** | P0.31x4.00x9.00 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |

| Input Data: | | |
|---|---|---|
| **Shear Load** | -11.87 kips | *User Input Shear Load* |
| **Axial Load** | 0.10 kips | *User Input Axial Force (compression)* |

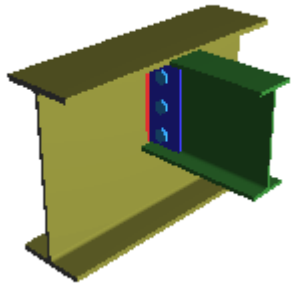
Governing LC: 3D - 15 - 1.2D+1.6SL+.5L

Note: Unless specified, all code references are from AISC 360-10

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Geometry Restrictions at Beam** | | | | **PASS** |
| **Girder Weld Limitations** | | | | **PASS** |
| **Rotational Ductility, Erection Stability** | | | | **PASS** |
| **Beam Shear Yield** | 11.87 kips | 142.77 kips | **0.08** | **PASS** |
| **Plate Shear Yield** | 11.87 kips | 60.75 kips | **0.20** | **PASS** |
| **Beam Shear Rupture** | 11.87 kips | 116.16 kips | **0.10** | **PASS** |
| **Plate Shear Rupture at Beam** | 11.87 kips | 52.00 kips | **0.23** | **PASS** |
| **Beam Block Shear** | 11.87 kips | 111.68 kips | **0.11** | **PASS** |
| **Plate Block Shear** | 11.87 kips | 59.21 kips | **0.20** | **PASS** |
| **Lateral Stability / Stabilizer Plates** | 11.87 kips | 291.22 kips | **0.04** | **PASS** |
| **Plate Flexural Yield** | | | **0.04** | **PASS** |
| **Plate Flexural Rupture** | | | **0.06** | **PASS** |
| **Plate Flexural Buckling** | 11.87 kips | 100.87 kips | **0.12** | **PASS** |
| **Coped Beam Flexural Rupture** | 11.87 kips | 150.61 kips | **0.08** | **PASS** |
| **Coped Beam Lateral Torsional Buckling** | 11.87 kips | 139.02 kips | **0.09** | **PASS** |
| **Bolt Bearing on Beam** | 11.87 kips | 53.68 kips | **0.22** | **PASS** |
| **Bolt Bearing on Plate at Beam** | 11.87 kips | 53.63 kips | **0.22** | **PASS** |
| **Bolt Shear at Beam** | 11.87 kips | 48.57 kips | **0.24** | **PASS** |
| **Bolt Group Eccentricity** | | ***0.90*** | | |
| **Girder Weld Strength** | 11.87 kips | 67.89 kips | **0.17** | **PASS** |

# *M11 I - M16: LRFD Results Report*

*Girder/Beam Shear Tab Shear Connection*



| Material Properties: | | | | |
|---|---|---|---|---|
| **Girder** | W18x50 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Beam** | W10x19 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Plate** | P0.38x4.00x9.00 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |

| Input Data: | | |
|---|---|---|
| **Shear Load** | 1.14 kips | *User Input Shear Load* |
| **Axial Load** | 17.19 kips | *User Input Axial Force (compression)* |

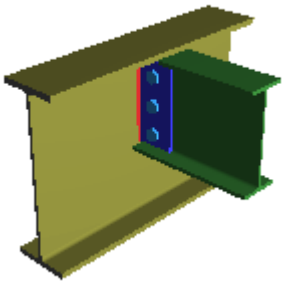
Governing LC: 3D - 36 - 1.2D+.5L+OmELZ+.37S

Note: Unless specified, all code references are from AISC 360-10

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Geometry Restrictions at Beam** | | | | **PASS** |
| **Girder Weld Limitations** | | | | **PASS** |
| **Rotational Ductility, Erection Stability** | | | | **PASS** |
| **Beam Shear Yield** | 1.14 kips | 68.92 kips | **0.02** | **PASS** |
| **Plate Shear Yield** | 1.14 kips | 72.90 kips | **0.02** | **PASS** |
| **Beam Shear Rupture** | 1.14 kips | 48.01 kips | **0.02** | **PASS** |
| **Plate Shear Rupture at Beam** | 1.14 kips | 62.40 kips | **0.02** | **PASS** |
| **Beam Axial Yield** | 17.19 kips | 172.46 kips | **0.10** | **PASS** |
| **Plate Axial Yield** | 17.19 kips | 109.35 kips | **0.16** | **PASS** |
| **Beam Block Shear** | 1.14 kips | 51.80 kips | **0.02** | **PASS** |
| **Plate Block Shear** | 1.14 kips | 71.05 kips | **0.02** | **PASS** |
| **Compression Buckling of the Plate** | 17.19 kips | 109.35 kips | **0.16** | **PASS** |
| **Lateral Stability / Stabilizer Plates** | 17.23 kips | 503.22 kips | **0.03** | **PASS** |
| **Plate Flexural Yield** | | | **0.17** | **PASS** |
| **Plate Flexural Rupture** | | | **0.07** | **PASS** |
| **Plate Flexural Buckling** | | | **0.18** | **PASS** |
| **Coped Beam Flexural Rupture** | 1.14 kips | 63.71 kips | **0.02** | **PASS** |
| **Coped Beam Local Web Buckling** | 1.14 kips | 58.81 kips | **0.02** | **PASS** |
| **Bolt Bearing on Beam** | 17.23 kips | 53.68 kips | **0.32** | **PASS** |
| **Bolt Bearing on Plate at Beam** | 17.23 kips | 53.68 kips | **0.32** | **PASS** |
| **Bolt Shear at Beam** | 17.23 kips | 48.01 kips | **0.36** | **PASS** |
| **Bolt Group Eccentricity** | | ***0.89*** | | |
| **Girder Weld Strength** | 17.23 kips | 88.18 kips | **0.20** | **PASS** |

# *M11 J - M15: LRFD Results Report*

*Girder/Beam Shear Tab Shear Connection*



Material Properties:

| | | | | |
|---|---|---|---|---|
| **Girder** | W18x46 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Beam** | W10x19 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Plate** | P0.38x4.00x9.00 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |

Input Data:

| | | |
|---|---|---|
| **Shear Load** | -3.17 kips | *User Input Shear Load* |
| **Axial Load** | -7.00 kips | *User Input Axial Force (tension)* |

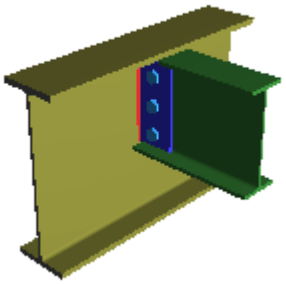
Governing LC: 3D - 37 - 1.2D+.5L-OmELZ+.37S

Note: Unless specified, all code references are from AISC 360-10

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Geometry Restrictions at Beam** | | | | **PASS** |
| **Girder Weld Limitations** | | | | **PASS** |
| **Rotational Ductility, Erection Stability** | | | | **PASS** |
| **Beam Shear Yield** | 3.17 kips | 68.92 kips | **0.05** | **PASS** |
| **Plate Shear Yield** | 3.17 kips | 72.90 kips | **0.04** | **PASS** |
| **Beam Shear Rupture** | 3.17 kips | 48.01 kips | **0.07** | **PASS** |
| **Plate Shear Rupture at Beam** | 3.17 kips | 62.40 kips | **0.05** | **PASS** |
| **Beam Axial Yield** | 7.00 kips | 172.46 kips | **0.04** | **PASS** |
| **Plate Axial Yield** | 7.00 kips | 109.35 kips | **0.06** | **PASS** |
| **Beam Tension Rupture** | 7.00 kips | 154.84 kips | **0.05** | **PASS** |
| **Plate Tension Rupture at Beam** | 7.00 kips | 103.99 kips | **0.07** | **PASS** |
| **Beam Block Shear** | 3.17 kips | 82.87 kips | **0.04** | **PASS** |
| **Plate Block Shear** | 3.17 kips | 71.05 kips | **0.04** | **PASS** |
| **Beam Tearout** | 7.00 kips | 67.34 kips | **0.10** | **PASS** |
| **Plate Tearout on Plate at Beam** | 7.00 kips | 93.63 kips | **0.07** | **PASS** |
| **Lateral Stability / Stabilizer Plates** | 7.68 kips | 503.22 kips | **0.02** | **PASS** |
| **Plate Flexural Yield** | | | **0.04** | **PASS** |
| **Plate Flexural Rupture** | | | **0.04** | **PASS** |
| **Plate Flexural Buckling** | 3.17 kips | 60.52 kips | **0.05** | **PASS** |
| **Coped Beam Flexural Rupture** | 3.17 kips | 68.15 kips | **0.05** | **PASS** |
| **Coped Beam Local Web Buckling** | 3.17 kips | 62.91 kips | **0.05** | **PASS** |
| **Bolt Bearing on Beam** | 7.68 kips | 53.68 kips | **0.14** | **PASS** |
| **Bolt Bearing on Plate at Beam** | 7.68 kips | 53.68 kips | **0.14** | **PASS** |
| **Bolt Shear at Beam** | 7.68 kips | 47.09 kips | **0.16** | **PASS** |
| **Bolt Group Eccentricity** | | ***0.88*** | | |
| **Girder Weld Strength** | 18011.21 lbs/ft | 117576.70 lbs/ft | **0.15** | **PASS** |

# *M14 I - M15: LRFD Results Report*

*Girder/Beam Shear Tab Shear Connection*



| Material Properties: | | | | |
|---|---|---|---|---|
| **Girder** | W18x46 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Beam** | W10x19 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Plate** | P0.38x4.00x9.00 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |

| Input Data: | | |
|---|---|---|
| **Shear Load** | 0.77 kips | *User Input Shear Load* |
| **Axial Load** | 7.11 kips | *User Input Axial Force (compression)* |

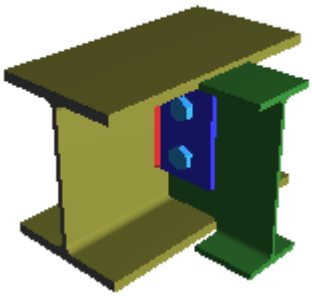
Governing LC: 3D - 36 - 1.2D+.5L+OmELZ+.37S

Note: Unless specified, all code references are from AISC 360-10

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Geometry Restrictions at Beam** | | | | **PASS** |
| **Girder Weld Limitations** | | | | **PASS** |
| **Rotational Ductility, Erection Stability** | | | | **PASS** |
| **Beam Shear Yield** | 0.77 kips | 68.92 kips | **0.01** | **PASS** |
| **Plate Shear Yield** | 0.77 kips | 72.90 kips | **0.01** | **PASS** |
| **Beam Shear Rupture** | 0.77 kips | 48.01 kips | **0.02** | **PASS** |
| **Plate Shear Rupture at Beam** | 0.77 kips | 62.40 kips | **0.01** | **PASS** |
| **Beam Axial Yield** | 7.11 kips | 172.46 kips | **0.04** | **PASS** |
| **Plate Axial Yield** | 7.11 kips | 109.35 kips | **0.06** | **PASS** |
| **Beam Block Shear** | 0.77 kips | 51.80 kips | **0.01** | **PASS** |
| **Plate Block Shear** | 0.77 kips | 71.05 kips | **0.01** | **PASS** |
| **Compression Buckling of the Plate** | 7.11 kips | 109.35 kips | **0.06** | **PASS** |
| **Lateral Stability / Stabilizer Plates** | 7.15 kips | 503.22 kips | **0.01** | **PASS** |
| **Plate Flexural Yield** | | | **0.03** | **PASS** |
| **Plate Flexural Rupture** | | | **0.01** | **PASS** |
| **Plate Flexural Buckling** | | | **0.08** | **PASS** |
| **Coped Beam Flexural Rupture** | 0.77 kips | 68.15 kips | **0.01** | **PASS** |
| **Coped Beam Local Web Buckling** | 0.77 kips | 62.91 kips | **0.01** | **PASS** |
| **Bolt Bearing on Beam** | 7.15 kips | 53.68 kips | **0.13** | **PASS** |
| **Bolt Bearing on Plate at Beam** | 7.15 kips | 53.68 kips | **0.13** | **PASS** |
| **Bolt Shear at Beam** | 7.15 kips | 49.49 kips | **0.14** | **PASS** |
| **Bolt Group Eccentricity** | | ***0.92*** | | |
| **Girder Weld Strength** | 7.15 kips | 88.18 kips | **0.08** | **PASS** |

# *M14 J - M18A: LRFD Results Report*

*Girder/Beam Shear Tab Shear Connection*



| Material Properties: | | | | |
|---|---|---|---|---|
| **Girder** | W10x45 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Beam** | W10x19 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Plate** | P0.38x4.00x6.00 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |

| Input Data: | | |
|---|---|---|
| **Shear Load** | -3.78 kips | *User Input Shear Load* |
| **Axial Load** | 0.00 kips | *User Input Axial Force* |

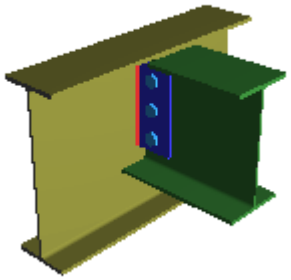
Governing LC: 3D - 15 - 1.2D+1.6SL+.5L

Note: Unless specified, all code references are from AISC 360-10

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Geometry Restrictions at Beam** | | | | **PASS** |
| **Girder Weld Limitations** | | | | **PASS** |
| **Rotational Ductility, Erection Stability** | | | | **PASS** |
| **Beam Shear Yield** | 3.78 kips | 58.95 kips | **0.06** | **PASS** |
| **Plate Shear Yield** | 3.78 kips | 48.60 kips | **0.08** | **PASS** |
| **Beam Shear Rupture** | 3.78 kips | 44.68 kips | **0.08** | **PASS** |
| **Plate Shear Rupture at Beam** | 3.78 kips | 41.60 kips | **0.09** | **PASS** |
| **Beam Block Shear** | 3.78 kips | 48.72 kips | **0.08** | **PASS** |
| **Plate Block Shear** | 3.78 kips | 52.83 kips | **0.07** | **PASS** |
| **Lateral Stability / Stabilizer Plates** | 3.78 kips | 335.48 kips | **0.01** | **PASS** |
| **Plate Flexural Yield** | | | **0.01** | **PASS** |
| **Plate Flexural Rupture** | | | **0.01** | **PASS** |
| **Plate Flexural Buckling** | 3.78 kips | 56.50 kips | **0.07** | **PASS** |
| **Coped Beam Flexural Rupture** | 3.78 kips | 28.80 kips | **0.13** | **PASS** |
| **Coped Beam Lateral Torsional Buckling** | 3.78 kips | 26.58 kips | **0.14** | **PASS** |
| **Bolt Bearing on Beam** | 3.78 kips | 35.78 kips | **0.11** | **PASS** |
| **Bolt Bearing on Plate at Beam** | 3.78 kips | 35.78 kips | **0.11** | **PASS** |
| **Bolt Shear at Beam** | 3.78 kips | 29.23 kips | **0.13** | **PASS** |
| **Bolt Group Eccentricity** | | ***0.82*** | | |
| **Girder Weld Strength** | 3.78 kips | 46.58 kips | **0.08** | **PASS** |

# *M21 I - M7: LRFD Results Report*

*Girder/Beam Shear Tab Shear Connection*



| Material Properties: | | | | |
|---|---|---|---|---|
| **Girder** | W18x35 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Beam** | W12x26 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Plate** | P0.38x4.00x9.00 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |

| Input Data: | | |
|---|---|---|
| **Shear Load** | 22.98 kips | *User Input Shear Load* |
| **Axial Load** | 0.00 kips | *User Input Axial Force* |

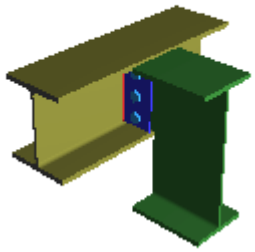
Governing LC: 3D - 15 - 1.2D+1.6SL+.5L

Note: Unless specified, all code references are from AISC 360-10

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Geometry Restrictions at Beam** | | | | **PASS** |
| **Girder Weld Limitations** | | | | **PASS** |
| **Rotational Ductility, Erection Stability** | | | | **PASS** |
| **Beam Shear Yield** | 22.98 kips | 77.21 kips | **0.30** | **PASS** |
| **Plate Shear Yield** | 22.98 kips | 72.90 kips | **0.32** | **PASS** |
| **Beam Shear Rupture** | 22.98 kips | 57.62 kips | **0.40** | **PASS** |
| **Plate Shear Rupture at Beam** | 22.98 kips | 62.40 kips | **0.37** | **PASS** |
| **Beam Block Shear** | 22.98 kips | 50.95 kips | **0.45** | **PASS** |
| **Plate Block Shear** | 22.98 kips | 71.05 kips | **0.32** | **PASS** |
| **Lateral Stability / Stabilizer Plates** | 22.98 kips | 503.22 kips | **0.05** | **PASS** |
| **Plate Flexural Yield** | | | **0.11** | **PASS** |
| **Plate Flexural Rupture** | | | **0.14** | **PASS** |
| **Plate Flexural Buckling** | 22.98 kips | 121.05 kips | **0.19** | **PASS** |
| **Coped Beam Flexural Rupture** | 22.98 kips | 98.47 kips | **0.23** | **PASS** |
| **Coped Beam Local Web Buckling** | 22.98 kips | 90.90 kips | **0.25** | **PASS** |
| **Bolt Bearing on Beam** | 22.98 kips | 53.68 kips | **0.43** | **PASS** |
| **Bolt Bearing on Plate at Beam** | 22.98 kips | 53.68 kips | **0.43** | **PASS** |
| **Bolt Shear at Beam** | 22.98 kips | 48.57 kips | **0.47** | **PASS** |
| **Bolt Group Eccentricity** | | ***0.90*** | | |
| **Girder Weld Strength** | 22.98 kips | 81.47 kips | **0.28** | **PASS** |

# *M5 I - M9: LRFD Results Report*

*Girder/Beam Shear Tab Shear Connection*



| Material Properties: | | | | |
|---|---|---|---|---|
| **Girder** | W10x45 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Beam** | W18x50 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Plate** | P0.31x4.00x8.03 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |

| Input Data: | | |
|---|---|---|
| **Shear Load** | 5.29 kips | *User Input Shear Load* |
| **Axial Load** | -0.04 kips | *User Input Axial Force (tension)* |

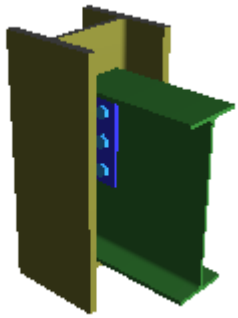
Governing LC: 3D - 4 - D+L

Note: Unless specified, all code references are from AISC 360-10

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Girder Weld Limitations** | | | | **PASS** |
| **Rotational Ductility, Erection Stability** | | | | **PASS** |
| **Beam Shear Yield** | 5.29 kips | 83.92 kips | **0.06** | **PASS** |
| **Plate Shear Yield** | 5.29 kips | 54.20 kips | **0.10** | **PASS** |
| **Beam Shear Rupture** | 5.29 kips | 54.57 kips | **0.10** | **PASS** |
| **Plate Shear Rupture at Beam** | 5.29 kips | 44.08 kips | **0.12** | **PASS** |
| **Beam Block Shear** | 5.29 kips | 67.43 kips | **0.08** | **PASS** |
| **Plate Block Shear** | 5.29 kips | 55.56 kips | **0.10** | **PASS** |
| **Lateral Stability / Stabilizer Plates** | 5.29 kips | 259.83 kips | **0.02** | **PASS** |
| **Plate Flexural Yield** | | | **0.01** | **PASS** |
| **Plate Flexural Rupture** | | | **0.02** | **PASS** |
| **Plate Flexural Buckling** | 5.29 kips | 37.32 kips | **0.14** | **PASS** |
| **Coped Beam Flexural Rupture** | 5.29 kips | 41.10 kips | **0.13** | **PASS** |
| **Coped Beam Lateral Torsional Buckling** | 5.29 kips | 37.94 kips | **0.14** | **PASS** |
| **Bolt Bearing on Beam** | 5.29 kips | 53.68 kips | **0.10** | **PASS** |
| **Bolt Bearing on Plate at Beam** | 5.29 kips | 49.55 kips | **0.11** | **PASS** |
| **Bolt Shear at Beam** | 5.29 kips | 38.26 kips | **0.14** | **PASS** |
| **Bolt Group Eccentricity** | | ***0.71*** | | |
| **Girder Weld Strength** | 5.29 kips | 58.72 kips | **0.09** | **PASS** |

# *M7 J - M1: LRFD Results Report*

*Column/Beam Shear Tab Shear Connection*



| Material Properties: | | | | |
|---|---|---|---|---|
| **Column** | W10x88 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Beam** | W18x35 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Plate** | P0.38x3.50x9.00 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |

| Input Data: | | |
|---|---|---|
| **Shear Load** | 47.51 kips | *User Input Shear Load* |
| **Axial Load** | 0.03 kips | *User Input Axial Force (compression)* |

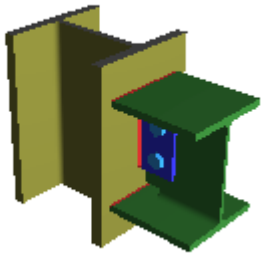
Governing LC: 3D - 17 - 1.2D+1.6SL-.5WLX

Note: Unless specified, all code references are from AISC 360-10

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Geometry Restrictions at Beam** | | | | **PASS** |
| **Column Weld Limitations** | | | | **PASS** |
| **Rotational Ductility, Erection Stability** | | | | **PASS** |
| **Beam Shear Yield** | 47.51 kips | 159.30 kips | **0.30** | **PASS** |
| **Plate Shear Yield** | 47.51 kips | 72.90 kips | **0.65** | **PASS** |
| **Beam Shear Rupture** | 47.51 kips | 132.28 kips | **0.36** | **PASS** |
| **Plate Shear Rupture at Beam** | 47.51 kips | 62.40 kips | **0.76** | **PASS** |
| **Beam Block Shear** | 47.51 kips | 104.98 kips | **0.45** | **PASS** |
| **Plate Block Shear** | 47.51 kips | 62.89 kips | **0.76** | **PASS** |
| **Lateral Stability / Stabilizer Plates** | 47.51 kips | 503.22 kips | **0.09** | **PASS** |
| **Plate Flexural Yield** | | | **0.46** | **PASS** |
| **Plate Flexural Rupture** | | | **0.62** | **PASS** |
| **Plate Flexural Buckling** | 47.51 kips | 121.05 kips | **0.39** | **PASS** |
| **Bolt Bearing on Beam** | 47.51 kips | 67.59 kips | **0.70** | **PASS** |
| **Bolt Bearing on Plate at Beam** | 47.51 kips | 66.47 kips | **0.71** | **PASS** |
| **Bolt Shear at Beam** | 47.51 kips | 61.16 kips | **0.78** | **PASS** |
| **Bolt Group Eccentricity** | | ***0.90*** | | |
| **Weld at Column** | 47.51 kips | 81.47 kips | **0.58** | **PASS** |

# *M17 I - M2: LRFD Results Report*

*Column/Beam Direct Weld Moment Connection*



| Material Properties: | | | | |
|---|---|---|---|---|
| **Column** | W10x88 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Beam** | W10x45 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Plate** | P0.38x3.50x6.00 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |

| Input Data: | | |
|---|---|---|
| **Shear Load** | 3.60 kips | *User Input Shear Load* |
| **Moment** | -6.81 kips-ft | *User Input Moment* |
| **Axial Load** | 0.00 kips | *User Input Axial Force* |
| **Puf_c** | 8.62 kips | *Required Flange Force (compression)* |
| **Puf_t** | 8.62 kips | *Required Flange Force (tension)* |
| **Top Column Dist** | 0.00 in | *User Input Top Column Dist* |
| **Column Force** | 0.00 kips | *User Input Column Force* |
| **Story Shear** | 0.00 kips | *User Input Story Shear* |

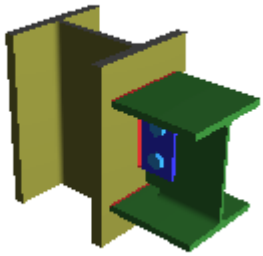
Governing LC: 3D - 15 - 1.2D+1.6SL+.5L

Note: Unless specified, all code references are from AISC 360-10

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Geometry Restrictions at Beam** | | | | **PASS** |
| **Column Weld Limitations** | | | | **PASS** |
| **Flange Weld Limitations** | | | | **PASS** |
| **Beam Web Shear Yield** | 3.60 kips | 77.28 kips | **0.05** | **PASS** |
| **Plate Shear Yield** | 3.60 kips | 48.60 kips | **0.07** | **PASS** |
| **Beam Web Shear Rupture** | 3.60 kips | 57.43 kips | **0.06** | **PASS** |
| **Plate Shear Rupture** | 3.60 kips | 41.60 kips | **0.09** | **PASS** |
| **Beam Block Shear** | 3.60 kips | 50.76 kips | **0.07** | **PASS** |
| **Plate Block Shear at Beam** | 3.60 kips | 44.67 kips | **0.08** | **PASS** |
| **Bolt Bearing at Beam Web** | 3.60 kips | 35.78 kips | **0.10** | **PASS** |
| **Bolt Bearing at Shear Plate** | 3.60 kips | 35.78 kips | **0.10** | **PASS** |
| **Bolt Shear at Beam Web** | 3.60 kips | 35.78 kips | **0.10** | **PASS** |
| **Column Weld Strength** | 3.60 kips | 58.79 kips | **0.06** | **PASS** |
| **Flange Weld Strength** | 8.62 kips | 67.37 kips | **0.13** | **PASS** |
| **Beam Flange Tensile Yield** | 8.62 kips | 223.76 kips | **0.04** | **PASS** |
| **Beam Flange Tensile Rupture** | 8.62 kips | 242.40 kips | **0.04** | **PASS** |
| **Beam Flange Compression** | 8.62 kips | 223.76 kips | **0.04** | **PASS** |
| **Column Flange Bending** | 8.62 kips | 137.83 kips | **0.06** | **PASS** |
| **Column Web Yielding** | 8.62 kips | 123.37 kips | **0.07** | **PASS** |
| **Column Web Buckling** | 8.62 kips | 368.27 kips | **0.02** | **PASS** |
| **Column Web Crippling** | 8.62 kips | 177.08 kips | **0.05** | **PASS** |
| **Column Panel Zone Shear** | 8.62 kips | 176.42 kips | **0.05** | **PASS** |

# *M18A I - M1: LRFD Results Report*

*Column/Beam Direct Weld Moment Connection*



| Material Properties: | | | | |
|---|---|---|---|---|
| **Column** | W10x88 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Beam** | W10x45 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Plate** | P0.38x3.50x6.00 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |

| Input Data: | | |
|---|---|---|
| **Shear Load** | 3.80 kips | *User Input Shear Load* |
| **Moment** | -7.20 kips-ft | *User Input Moment* |
| **Axial Load** | 0.00 kips | *User Input Axial Force (compression)* |
| **Puf_c** | 9.12 kips | *Required Flange Force (compression)* |
| **Puf_t** | 9.12 kips | *Required Flange Force (tension)* |
| **Top Column Dist** | 0.00 in | *User Input Top Column Dist* |
| **Column Force** | 0.00 kips | *User Input Column Force* |
| **Story Shear** | 0.00 kips | *User Input Story Shear* |

Governing LC: 3D - 16 - 1.2D+1.6SL+.5L+.5WLX

Note: Unless specified, all code references are from AISC 360-10

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Geometry Restrictions at Beam** | | | | **PASS** |
| **Column Weld Limitations** | | | | **PASS** |
| **Flange Weld Limitations** | | | | **PASS** |
| **Beam Web Shear Yield** | 3.80 kips | 77.28 kips | **0.05** | **PASS** |
| **Plate Shear Yield** | 3.80 kips | 48.60 kips | **0.08** | **PASS** |
| **Beam Web Shear Rupture** | 3.80 kips | 57.43 kips | **0.07** | **PASS** |
| **Plate Shear Rupture** | 3.80 kips | 41.60 kips | **0.09** | **PASS** |
| **Beam Block Shear** | 3.80 kips | 50.76 kips | **0.07** | **PASS** |
| **Plate Block Shear at Beam** | 3.80 kips | 44.67 kips | **0.09** | **PASS** |
| **Bolt Bearing at Beam Web** | 3.80 kips | 35.78 kips | **0.11** | **PASS** |
| **Bolt Bearing at Shear Plate** | 3.80 kips | 35.78 kips | **0.11** | **PASS** |
| **Bolt Shear at Beam Web** | 3.80 kips | 35.78 kips | **0.11** | **PASS** |
| **Column Weld Strength** | 3.80 kips | 58.79 kips | **0.06** | **PASS** |
| **Flange Weld Strength** | 9.12 kips | 67.37 kips | **0.14** | **PASS** |
| **Beam Flange Tensile Yield** | 9.12 kips | 223.76 kips | **0.04** | **PASS** |
| **Beam Flange Tensile Rupture** | 9.12 kips | 242.40 kips | **0.04** | **PASS** |
| **Beam Flange Compression** | 9.12 kips | 223.76 kips | **0.04** | **PASS** |
| **Column Flange Bending** | 9.12 kips | 137.83 kips | **0.07** | **PASS** |
| **Column Web Yielding** | 9.12 kips | 123.37 kips | **0.07** | **PASS** |
| **Column Web Buckling** | 9.12 kips | 368.27 kips | **0.02** | **PASS** |
| **Column Web Crippling** | 9.12 kips | 177.08 kips | **0.05** | **PASS** |
| **Column Panel Zone Shear** | 9.12 kips | 176.42 kips | **0.05** | **PASS** |

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# Restrained Retaining Wall

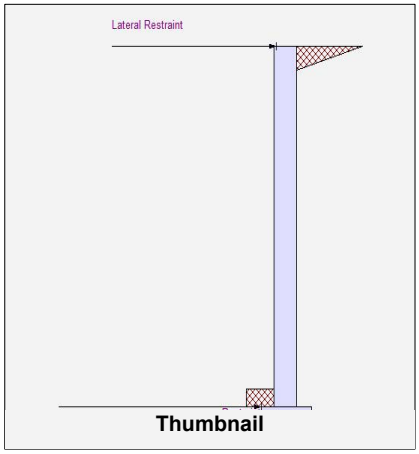
Code: IBC 2012,ACI 318-11,ACI 530-11

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 10.00 ft |
| Wall height above soil | = | 0.00 ft |
| Total Wall Height | = | 10.00 ft |
| Top Support Height | = | 10.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 5,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| At-rest Heel Pressure | = | 55.0 psf/ft |
| | = | |
| Passive Pressure | = | 250.0 psf/ft |
| Soil Density | = | 110.00 pcf |
| Footing\|\|Soil Frictior | = | 0.450 |
| Soil height to ignore for passive pressure | = | 12.00 in |



Thumbnail

## Surcharge Loads

Surcharge Over Heel = 0.0 psf
>>>Used To Resist Sliding & Overturning
Surcharge Over Toe = 0.0 psf
Used for Sliding & Overturning

## Axial Load Applied to Stem

| | | |
|---|---|---|
| Axial Dead Load | = | 200.0 lbs |
| Axial Live Load | = | 800.0 lbs |
| Axial Load Eccentricity | = | 0.0 in |

## Earth Pressure Seismic Load

## Stem Weight Seismic Load

## Uniform Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) (Strength Level) |
| Wind on Exposed Stem | = | 0.0 psf |

$K_h$ Soil Density Multiplier = 0.200 g — Added seismic per unit area = 0.0 psf

$F_p / W_p$ Weight Multiplier = 0.000 g — Added seismic per unit area = 0.0 psf

## Adjacent Footing Load

| | | |
|---|---|---|
| Adjacent Footing Load | = | 1,150.0 lbs |
| Footing Width | = | 1.80 ft |
| Eccentricity | = | 0.00 in |
| Wall to Ftg CL Dist | = | 6.00 ft |
| Footing Type | | Line Load |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

## Design Summary

| | | | |
|---|---|---|---|
| Total Bearing Load | = | 2,818 lbs | |
| ...resultant ecc. | = | 1.44 in | |
| Soil Pressure @ Toe | = | 1,698 psf | OK |
| Soil Pressure @ Heel | = | 1,698 psf | OK |
| Allowable | = | 5,000 psf | |
| Soil Pressure Less Than Allowable | | | |
| ACI Factored @ Toe | = | 3,199 psf | |
| ACI Factored @ Heel | = | 1,261 psf | |
| Footing Shear @ Toe | = | 0.1 psi | OK |
| Footing Shear @ Heel | = | 0.4 psi | OK |
| Allowable | = | 75.0 psi | |
| **Reaction at Top** | = | 1,029.1 lbs | |
| **Reaction at Bottom** | = | 2,456.2 lbs | |

**Sliding Calcs**
Lateral Sliding Force = 2,456.2 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

**Load Factors**

| | |
|---|---|
| Building Code | IBC 2012,ACI |
| Dead Load | 1.200 |
| Live Load | 1.600 |
| Earth, H | 1.600 |
| Wind, W | 1.000 |
| Seismic, E | 1.000 |

## Concrete Stem Construction

Thickness = 8.00 in — Fy = 60,000 psi
Wall Weight = 100.0 psf — f'c = 3,000 psi
Stem is FREE to rotate at top of footing

| | @ Top Support | Mmax Between Top & Base | @ Base of Wall |
|---|---|---|---|
| | Stem OK | Stem OK | Stem OK |
| **Design Height Above Ftg** = | 10.00 ft | 4.26 ft | 0.00 ft |
| Rebar Size = | # 4 | # 4 | # 4 |
| Rebar Spacing = | 6.00 in | 6.00 in | 6.00 in |
| Rebar Placed at = | Center | Center | Edge |
| Rebar Depth 'd' = | 4.00 in | 4.00 in | 5.50 in |
| **Design Data** | | | |
| fb/FB + fa/Fa = | 0.000 | 0.937 | 0.000 |
| Mu....Actual = | 0.0 ft-# | 6,085.7 ft-# | 0.0 ft-# |
| Mn * Phi.....Allowable = | 6,492.0 ft-# | 6,492.0 ft-# | 9,192.0 ft-# |
| Shear Force @ this height = | 1,580.1 lbs | | 3,078.8 lbs |
| Shear.....Actual = | 32.92 psi | | 46.65 psi |
| Shear.....Allowable = | 82.16 psi | | 82.16 psi |

**Other Acceptable Sizes & Spacings:**

| | | |
|---|---|---|
| Toe: None Spec'd | -or- | Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm |
| Heel: None Spec'd | -or- | Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm |
| Key: No key defined | -or- | No key defined |

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# Restrained Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

## Concrete Stem Rebar Area Details

| Top Support | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0 in2/ft | | |
| (4/3) * As : | 0 in2/ft | Min Stem T&S Reinf Area 1.920 in2 | |
| 200bd/fy : 200(12)(4)/60000 : | 0.16 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.1728 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.6503 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

| Mmax Between Ends | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.3674 in2/ft | | |
| (4/3) * As : | 0.4898 in2/ft | Min Stem T&S Reinf Area 1.103 in2 | |
| 200bd/fy : 200(12)(4)/60000 : | 0.16 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.3674 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.6503 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

| Base Support | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0 in2/ft | | |
| (4/3) * As : | 0 in2/ft | Min Stem T&S Reinf Area 0.817 in2 | |
| 200bd/fy : 200(12)(5.5)/60000 : | 0.22 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.1728 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.8941 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

### Footing Strengths & Dimensions

| | | |
|---|---|---|
| Toe Width | = | 0.50 ft |
| Heel Width | = | 1.16 |
| Total Footing Width | = | 1.66 |
| Footing Thickness | = | 10.00 in |
| Key Width | = | 0.00 in |
| Key Depth | = | 0.00 in |
| Key Distance from Toe | = | 0.00 ft |

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top = 2.00 in @ Btm.= 3.00 in

### Footing Design Results

| | | Toe | Heel | |
|---|---|---|---|---|
| Factored Pressure | = | 3,199 | 1,261 | psf |
| Mu' : Upward | = | 371 | 179 | ft-# |
| Mu' : Downward | = | 27 | 181 | ft-# |
| Mu: Design | = | 344 | 2 | ft-# |
| Actual 1-Way Shear | = | 0.12 | 0.45 | psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 | psi |

Min footing T&S reinf Area 0.36 in2
Min footing T&S reinf Area per foot 0.22 in2 /ft

| If one layer of horizontal bars: | If two layers of horizontal bars: |
|---|---|
| #4@ 11.11 in | #4@ 22.22 in |
| #5@ 17.22 in | #5@ 34.44 in |
| #6@ 24.44 in | #6@ 48.89 in |

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## Summary of Forces on Footing : Slab RESISTS sliding, stem is PINNED at footing

### Forces acting on footing soil pressure

(taking moments about front of footing to find eccentricity)

| | | | | | |
|---|---|---|---|---|---|
| Surcharge Over Heel | = | lbs | ft | | ft-# |
| Axial Dead Load on Stem | = | 200.0 lbs | 0.83 ft | | 166.0 ft-# |
| Soil Over Toe | = | 27.3 lbs | 0.25 ft | | 6.8 ft-# |
| Adjacent Footing Load | = | 37.1 lbs | 1.46 ft | | 54.2 ft-# |
| Surcharge Over Toe | = | lbs | ft | | ft-# |
| Stem Weight | = | 1,000.0 lbs | 0.83 ft | | 830.0 ft-# |
| Soil Over Heel | = | 546.3 lbs | 1.41 ft | | 771.2 ft-# |
| Footing Weight | = | 207.5 lbs | 0.83 ft | | 172.2 ft-# |
| **Total Vertical Force** | = | 2,818.2 lbs | Moment = | | 2,000.5 ft-# |

**Net Mom. at Stem/Ftg Interface = 338.7 ft-#**

**Allow. Mom. @ Stem/Ftg Interface = 5,745.0 ft-#**

**Allow. Mom. Exceeds Applied Mom.? Yes**

**Therefore Uniform Soil Pressure = 1,697.7 psf**

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

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# Restrained Retaining Wall

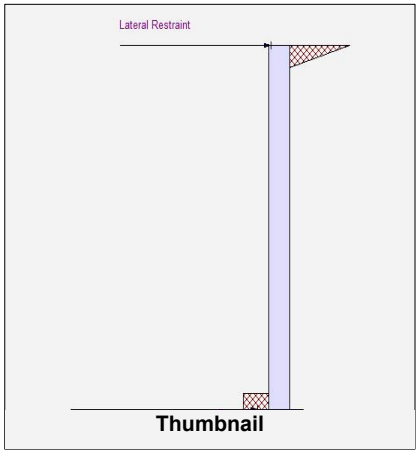
Code: IBC 2012,ACI 318-11,ACI 530-11

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 11.00 ft |
| Wall height above soil | = | 0.00 ft |
| Total Wall Height | = | 11.00 ft |
| Top Support Height | = | 11.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 5,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| At-rest Heel Pressure | = | 55.0 psf/ft |
| | = | |
| Passive Pressure | = | 250.0 psf/ft |
| Soil Density | = | 110.00 pcf |
| Footing\|\|Soil Frictior | = | 0.450 |
| Soil height to ignore for passive pressure | = | 12.00 in |



Thumbnail

## Surcharge Loads

Surcharge Over Heel = 0.0 psf
>>>Used To Resist Sliding & Overturning
Surcharge Over Toe = 0.0 psf
Used for Sliding & Overturning

## Axial Load Applied to Stem

| | | |
|---|---|---|
| Axial Dead Load | = | 200.0 lbs |
| Axial Live Load | = | 800.0 lbs |
| Axial Load Eccentricity | = | 0.0 in |

## Earth Pressure Seismic Load

## Stem Weight Seismic Load

## Uniform Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) (Strength Level) |
| Wind on Exposed Stem | = | 0.0 psf |

$K_h$ Soil Density Multiplier = 0.200 g — Added seismic per unit area = 0.0 psf

$F_p / W_p$ Weight Multiplier = 0.000 g — Added seismic per unit area = 0.0 psf

## Adjacent Footing Load

| | | |
|---|---|---|
| Adjacent Footing Load | = | 1,150.0 lbs |
| Footing Width | = | 1.80 ft |
| Eccentricity | = | 0.00 in |
| Wall to Ftg CL Dist | = | 6.00 ft |
| Footing Type | | Line Load |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

## Design Summary

| | | | |
|---|---|---|---|
| Total Bearing Load | = | 2,980 lbs | |
| ...resultant ecc. | = | 1.23 in | |
| Soil Pressure @ Toe | = | 1,795 psf | OK |
| Soil Pressure @ Heel | = | 1,795 psf | OK |
| Allowable | = | 5,000 psf | |
| Soil Pressure Less Than Allowable | | | |
| ACI Factored @ Toe | = | 3,214 psf | |
| ACI Factored @ Heel | = | 1,480 psf | |
| Footing Shear @ Toe | = | 0.1 psi | OK |
| Footing Shear @ Heel | = | 0.8 psi | OK |
| Allowable | = | 75.0 psi | |
| **Reaction at Top** | = | 1,213.7 lbs | |
| **Reaction at Bottom** | = | 2,897.6 lbs | |

**Sliding Calcs**
Lateral Sliding Force = 2,897.6 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

**Load Factors**

| | |
|---|---|
| Building Code | IBC 2012,ACI |
| Dead Load | 1.200 |
| Live Load | 1.600 |
| Earth, H | 1.600 |
| Wind, W | 1.000 |
| Seismic, E | 1.000 |

## Concrete Stem Construction

Thickness = 8.00 in — Fy = 60,000 psi
Wall Weight = 100.0 psf — f'c = 3,000 psi
Stem is FREE to rotate at top of footing

| | @ Top Support | Mmax Between Top & Base | @ Base of Wall |
|---|---|---|---|
| | Stem OK | Stem OK | Stem OK |
| **Design Height Above Ftg** = | 11.00 ft | 4.68 ft | 0.00 ft |
| Rebar Size = | # 5 | # 5 | # 5 |
| Rebar Spacing = | 6.00 in | 6.00 in | 6.00 in |
| Rebar Placed at = | Center | Center | Edge |
| Rebar Depth 'd' = | 4.00 in | 4.00 in | 5.50 in |
| **Design Data** | | | |
| fb/FB + fa/Fa = | 0.000 | 0.846 | 0.000 |
| Mu....Actual = | 0.0 ft-# | 7,999.8 ft-# | 0.0 ft-# |
| Mn * Phi.....Allowable = | 9,459.0 ft-# | 9,459.0 ft-# | 13,644.0 ft-# |
| Shear Force @ this height = | 1,880.2 lbs | | 3,705.4 lbs |
| Shear.....Actual = | 39.17 psi | | 56.14 psi |
| Shear.....Allowable = | 82.16 psi | | 82.16 psi |

**Other Acceptable Sizes & Spacings:**

Toe: None Spec'd -or- Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Heel: None Spec'd -or- Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined -or- No key defined

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## Concrete Stem Rebar Area Details

| Top Support | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0 in2/ft | | |
| (4/3) * As : | 0 in2/ft | Min Stem T&S Reinf Area 2.112 in2 | |
| 200bd/fy : 200(12)(4)/60000 : | 0.16 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.1728 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.62 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.6503 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

| Mmax Between Ends | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.4829 in2/ft | | |
| (4/3) * As : | 0.6439 in2/ft | Min Stem T&S Reinf Area 1.213 in2 | |
| 200bd/fy : 200(12)(4)/60000 : | 0.16 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.4829 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.62 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.6503 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

| Base Support | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0 in2/ft | | |
| (4/3) * As : | 0 in2/ft | Min Stem T&S Reinf Area 0.899 in2 | |
| 200bd/fy : 200(12)(5.5)/60000 : | 0.22 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.1728 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.62 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.8941 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

### Footing Strengths & Dimensions

| | | |
|---|---|---|
| Toe Width | = | 0.50 ft |
| Heel Width | = | 1.16 |
| Total Footing Width | = | 1.66 |
| Footing Thickness | = | 10.00 in |
| Key Width | = | 0.00 in |
| Key Depth | = | 0.00 in |
| Key Distance from Toe | = | 0.00 ft |

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top = 2.00 in @ Btm.= 3.00 in

### Footing Design Results

| | | Toe | Heel | |
|---|---|---|---|---|
| Factored Pressure | = | 3,214 | 1,480 | psf |
| Mu' : Upward | = | 375 | 204 | ft-# |
| Mu' : Downward | = | 27 | 198 | ft-# |
| Mu: Design | = | 348 | -6 | ft-# |
| Actual 1-Way Shear | = | 0.12 | 0.76 | psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 | psi |

Min footing T&S reinf Area 0.36 in2
Min footing T&S reinf Area per foot 0.22 in2 /ft

| If one layer of horizontal bars: | If two layers of horizontal bars: |
|---|---|
| #4@ 11.11 in | #4@ 22.22 in |
| #5@ 17.22 in | #5@ 34.44 in |
| #6@ 24.44 in | #6@ 48.89 in |

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# Restrained Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

## Summary of Forces on Footing : Slab RESISTS sliding, stem is PINNED at footing

### Forces acting on footing soil pressure

(taking moments about front of footing to find eccentricity)

| | | | | | |
|---|---|---|---|---|---|
| Surcharge Over Heel | = | lbs | ft | | ft-# |
| Axial Dead Load on Stem | = | 200.0 lbs | 0.83 ft | | 166.0 ft-# |
| Soil Over Toe | = | 27.3 lbs | 0.25 ft | | 6.8 ft-# |
| Adjacent Footing Load | = | 44.3 lbs | 1.41 ft | | 62.5 ft-# |
| Surcharge Over Toe | = | lbs | ft | | ft-# |
| Stem Weight | = | 1,100.0 lbs | 0.83 ft | | 913.0 ft-# |
| Soil Over Heel | = | 601.0 lbs | 1.41 ft | | 848.4 ft-# |
| Footing Weight | = | 207.5 lbs | 0.83 ft | | 172.2 ft-# |
| **Total Vertical Force** | = | 2,980.1 lbs | Moment = | | 2,168.9 ft-# |

**Net Mom. at Stem/Ftg Interface = 304.6 ft-#**

**Allow. Mom. @ Stem/Ftg Interface = 8,527.5 ft-#**

**Allow. Mom. Exceeds Applied Mom.? Yes**

**Therefore Uniform Soil Pressure = 1,795.2 psf**

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

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# Restrained Retaining Wall

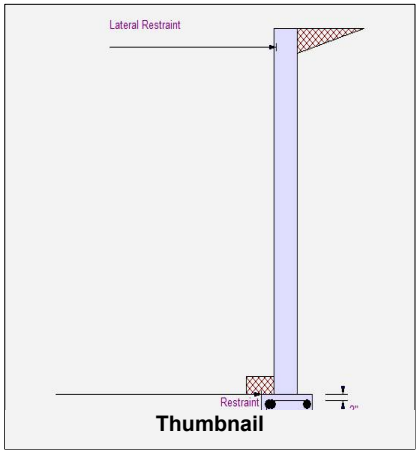
Code: IBC 2012,ACI 318-11,ACI 530-11

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 10.00 ft |
| Wall height above soil | = | 0.00 ft |
| Total Wall Height | = | 10.00 ft |
| Top Support Height | = | 9.50 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 5,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| At-rest Heel Pressure | = | 55.0 psf/ft |
| | = | |
| Passive Pressure | = | 250.0 psf/ft |
| Soil Density | = | 110.00 pcf |
| Footing\|\|Soil Frictior | = | 0.450 |
| Soil height to ignore for passive pressure | = | 12.00 in |



Thumbnail

## Surcharge Loads

Surcharge Over Heel = 0.0 psf
>>>Used To Resist Sliding & Overturning
Surcharge Over Toe = 0.0 psf
Used for Sliding & Overturning

## Axial Load Applied to Stem

| | | |
|---|---|---|
| Axial Dead Load | = | 200.0 lbs |
| Axial Live Load | = | 800.0 lbs |
| Axial Load Eccentricity | = | 0.0 in |

## Earth Pressure Seismic Load

## Stem Weight Seismic Load

## Uniform Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) (Strength Level) |
| Wind on Exposed Stem | = | 0.0 psf |

$K_h$ Soil Density Multiplier = 0.200 g — Added seismic per unit area = 0.0 psf

$F_p / W_p$ Weight Multiplier = 0.000 g — Added seismic per unit area = 0.0 psf

## Adjacent Footing Load

| | | |
|---|---|---|
| Adjacent Footing Load | = | 0.0 lbs |
| Footing Width | = | 1.80 ft |
| Eccentricity | = | 0.00 in |
| Wall to Ftg CL Dist | = | 6.00 ft |
| Footing Type | | Line Load |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

## Design Summary

| | | | |
|---|---|---|---|
| Total Bearing Load | = | 2,823 lbs | |
| ...resultant ecc. | = | 1.54 in | |
| Soil Pressure @ Toe | = | 1,700 psf | OK |
| Soil Pressure @ Heel | = | 1,700 psf | OK |
| Allowable | = | 5,000 psf | |
| Soil Pressure Less Than Allowable | | | |
| ACI Factored @ Toe | = | 3,269 psf | |
| ACI Factored @ Heel | = | 1,198 psf | |
| Footing Shear @ Toe | = | 0.5 psi | OK |
| Footing Shear @ Heel | = | 0.0 psi | OK |
| Allowable | = | 75.0 psi | |
| **Reaction at Top** | = | 962.8 lbs | |
| **Reaction at Bottom** | = | 2,362.6 lbs | |

**Sliding Calcs**
Lateral Sliding Force = 2,362.6 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

**Load Factors**

| | |
|---|---|
| Building Code | IBC 2012,ACI |
| Dead Load | 1.200 |
| Live Load | 1.600 |
| Earth, H | 1.600 |
| Wind, W | 1.000 |
| Seismic, E | 1.000 |

## Concrete Stem Construction

Thickness = 8.00 in — Fy = 60,000 psi
Wall Weight = 100.0 psf — f'c = 3,000 psi
Stem is FREE to rotate at top of footing

| | @ Top Support | Mmax Between Top & Base | @ Base of Wall |
|---|---|---|---|
| | Stem OK | Stem OK | Stem OK |
| **Design Height Above Ftg** = | 9.50 ft | 4.12 ft | 0.00 ft |
| Rebar Size = | # 4 | # 4 | # 4 |
| Rebar Spacing = | 6.00 in | 6.00 in | 6.00 in |
| Rebar Placed at = | Center | Center | Edge |
| Rebar Depth 'd' = | 4.00 in | 4.00 in | 5.50 in |
| **Design Data** | | | |
| fb/FB + fa/Fa = | 0.000 | 0.820 | 0.000 |
| Mu....Actual = | 1.8 ft-# | 5,324.8 ft-# | 0.0 ft-# |
| Mn * Phi.....Allowable = | 6,492.0 ft-# | 6,492.0 ft-# | 9,192.0 ft-# |
| Shear Force @ this height = | 1,532.9 lbs | | 2,856.1 lbs |
| Shear.....Actual = | 31.93 psi | | 43.27 psi |
| Shear.....Allowable = | 82.16 psi | | 82.16 psi |

**Other Acceptable Sizes & Spacings:**

| | | |
|---|---|---|
| Toe: # 7 @ 18.00 in | -or- | Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm |
| Heel:# 6 @ 16.00 in | -or- | Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm |
| Key: No key defined | -or- | No key defined |

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## Concrete Stem Rebar Area Details

| Top Support | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.0001 in2/ft | | |
| (4/3) * As : | 0.0001 in2/ft | Min Stem T&S Reinf Area 1.824 in2 | |
| 200bd/fy : 200(12)(4)/60000 : | 0.16 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.1728 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.6503 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

| Mmax Between Ends | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.3214 in2/ft | | |
| (4/3) * As : | 0.4286 in2/ft | Min Stem T&S Reinf Area 1.033 in2 | |
| 200bd/fy : 200(12)(4)/60000 : | 0.16 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.3214 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.6503 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

| Base Support | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0 in2/ft | | |
| (4/3) * As : | 0 in2/ft | Min Stem T&S Reinf Area 0.791 in2 | |
| 200bd/fy : 200(12)(5.5)/60000 : | 0.22 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.1728 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.8941 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

### Footing Strengths & Dimensions

| | | |
|---|---|---|
| Toe Width | = | 0.50 ft |
| Heel Width | = | 1.16 |
| Total Footing Width | = | 1.66 |
| Footing Thickness | = | 12.00 in |
| Key Width | = | 0.00 in |
| Key Depth | = | 0.00 in |
| Key Distance from Toe | = | 0.00 ft |

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top = 2.00 in @ Btm.= 3.00 in

### Footing Design Results

| | | Toe | Heel | |
|---|---|---|---|---|
| Factored Pressure | = | 3,269 | 1,198 | psf |
| Mu' : Upward | = | 378 | 173 | ft-# |
| Mu' : Downward | = | 30 | 185 | ft-# |
| Mu: Design | = | 347 | 12 | ft-# |
| Actual 1-Way Shear | = | 0.51 | 0.03 | psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 | psi |

Min footing T&S reinf Area 0.43 in2
Min footing T&S reinf Area per foot 0.26 in2 /ft

| If one layer of horizontal bars: | If two layers of horizontal bars: |
|---|---|
| #4@ 9.26 in | #4@ 18.52 in |
| #5@ 14.35 in | #5@ 28.70 in |
| #6@ 20.37 in | #6@ 40.74 in |

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# Restrained Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

## Summary of Forces on Footing : Slab RESISTS sliding, stem is PINNED at footing

### Forces acting on footing soil pressure

(taking moments about front of footing to find eccentricity)

| | | | | | |
|---|---|---|---|---|---|
| Surcharge Over Heel | = | lbs | ft | | ft-# |
| Axial Dead Load on Stem | = | 200.0 lbs | 0.83 ft | 166.0 | ft-# |
| Soil Over Toe | = | 27.3 lbs | 0.25 ft | 6.8 | ft-# |
| Adjacent Footing Load | = | lbs | ft | | ft-# |
| Surcharge Over Toe | = | lbs | ft | | ft-# |
| Stem Weight | = | 1,000.0 lbs | 0.83 ft | 830.0 | ft-# |
| Soil Over Heel | = | 546.3 lbs | 1.41 ft | 771.2 | ft-# |
| Footing Weight | = | 249.0 lbs | 0.83 ft | 206.7 | ft-# |
| **Total Vertical Force** | = | 2,822.7 lbs | Moment = | 1,980.7 | ft-# |

**Net Mom. at Stem/Ftg Interface = 362.1 ft-#**

**Allow. Mom. @ Stem/Ftg Interface = 5,745.0 ft-#**

**Allow. Mom. Exceeds Applied Mom.? Yes**

**Therefore Uniform Soil Pressure = 1,700.4 psf**

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

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# Restrained Retaining Wall

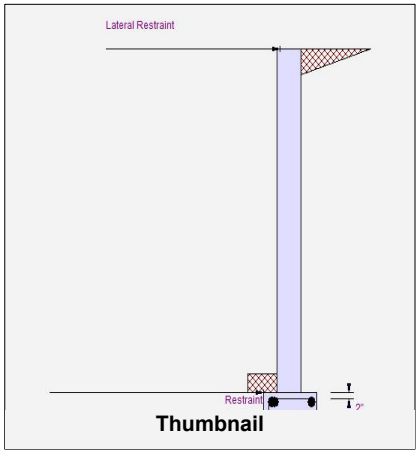
Code: IBC 2012,ACI 318-11,ACI 530-11

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 9.00 ft |
| Wall height above soil | = | 0.00 ft |
| Total Wall Height | = | 9.00 ft |
| Top Support Height | = | 9.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 5,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| At-rest Heel Pressure | = | 55.0 psf/ft |
| | = | |
| Passive Pressure | = | 250.0 psf/ft |
| Soil Density | = | 110.00 pcf |
| Footing\|\|Soil Frictior | = | 0.450 |
| Soil height to ignore for passive pressure | = | 12.00 in |



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## Surcharge Loads

Surcharge Over Heel = 0.0 psf
>>>Used To Resist Sliding & Overturning
Surcharge Over Toe = 0.0 psf
Used for Sliding & Overturning

## Axial Load Applied to Stem

| | | |
|---|---|---|
| Axial Dead Load | = | 200.0 lbs |
| Axial Live Load | = | 800.0 lbs |
| Axial Load Eccentricity | = | 0.0 in |

## Earth Pressure Seismic Load

## Stem Weight Seismic Load

## Uniform Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) (Strength Level) |
| Wind on Exposed Stem | = | 0.0 psf |

$K_h$ Soil Density Multiplier = 0.200 g Added seismic per unit area = 0.0 psf

$F_p / W_p$ Weight Multiplier = 0.000 g Added seismic per unit area = 0.0 psf

## Adjacent Footing Load

| | | |
|---|---|---|
| Adjacent Footing Load | = | 0.0 lbs |
| Footing Width | = | 1.80 ft |
| Eccentricity | = | 0.00 in |
| Wall to Ftg CL Dist | = | 6.00 ft |
| Footing Type | | Line Load |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

## Design Summary

| | | | |
|---|---|---|---|
| Total Bearing Load | = | 2,668 lbs | |
| ...resultant ecc. | = | 1.77 in | |
| Soil Pressure @ Toe | = | 1,607 psf | OK |
| Soil Pressure @ Heel | = | 1,607 psf | OK |
| Allowable | = | 5,000 psf | |
| Soil Pressure Less Than Allowable | | | |
| ACI Factored @ Toe | = | 3,253 psf | |
| ACI Factored @ Heel | = | 989 psf | |
| Footing Shear @ Toe | = | 0.5 psi | OK |
| Footing Shear @ Heel | = | 0.2 psi | OK |
| Allowable | = | 75.0 psi | |
| **Reaction at Top** | = | 741.5 lbs | |
| **Reaction at Bottom** | = | 2,007.5 lbs | |

**Sliding Calcs**
Lateral Sliding Force = 2,007.5 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

**Load Factors**

| | |
|---|---|
| Building Code | IBC 2012,ACI |
| Dead Load | 1.200 |
| Live Load | 1.600 |
| Earth, H | 1.600 |
| Wind, W | 1.000 |
| Seismic, E | 1.000 |

## Concrete Stem Construction

Thickness = 8.00 in Fy = 60,000 psi
Wall Weight = 100.0 psf f'c = 3,000 psi
Stem is FREE to rotate at top of footing

| | @ Top Support | Mmax Between Top & Base | @ Base of Wall |
|---|---|---|---|
| | Stem OK | Stem OK | Stem OK |
| **Design Height Above Ftg** = | 9.00 ft | 3.83 ft | 0.00 ft |
| Rebar Size = | # 4 | # 4 | # 4 |
| Rebar Spacing = | 6.00 in | 6.00 in | 6.00 in |
| Rebar Placed at = | Center | Center | Edge |
| Rebar Depth 'd' = | 4.00 in | 4.00 in | 5.50 in |
| **Design Data** | | | |
| fb/FB + fa/Fa = | 0.000 | 0.634 | 0.000 |
| Mu....Actual = | 0.0 ft-# | 4,115.4 ft-# | 0.0 ft-# |
| Mn * Phi.....Allowable = | 6,492.0 ft-# | 6,492.0 ft-# | 9,192.0 ft-# |
| Shear Force @ this height = | 1,188.0 lbs | | 2,376.0 lbs |
| Shear.....Actual = | 24.75 psi | | 36.00 psi |
| Shear.....Allowable = | 82.16 psi | | 82.16 psi |

**Other Acceptable Sizes & Spacings:**

| | | |
|---|---|---|
| Toe: # 7 @ 18.00 in | -or- | Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm |
| Heel:# 6 @ 16.00 in | -or- | Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm |
| Key: No key defined | -or- | No key defined |

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## Concrete Stem Rebar Area Details

| Top Support | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0 in2/ft | | |
| (4/3) * As : | 0 in2/ft | Min Stem T&S Reinf Area 1.728 in2 | |
| 200bd/fy : 200(12)(4)/60000 : | 0.16 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.1728 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.6503 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

| Mmax Between Ends | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.2484 in2/ft | | |
| (4/3) * As : | 0.3312 in2/ft | Min Stem T&S Reinf Area 0.992 in2 | |
| 200bd/fy : 200(12)(4)/60000 : | 0.16 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.2484 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.6503 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

| Base Support | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0 in2/ft | | |
| (4/3) * As : | 0 in2/ft | Min Stem T&S Reinf Area 0.736 in2 | |
| 200bd/fy : 200(12)(5.5)/60000 : | 0.22 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.1728 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.8941 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

### Footing Strengths & Dimensions

| | | |
|---|---|---|
| Toe Width | = | 0.50 ft |
| Heel Width | = | 1.16 |
| Total Footing Width | = | 1.66 |
| Footing Thickness | = | 12.00 in |
| Key Width | = | 0.00 in |
| Key Depth | = | 0.00 in |
| Key Distance from Toe | = | 0.00 ft |

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top = 2.00 in @ Btm.= 3.00 in

### Footing Design Results

| | | Toe | Heel | |
|---|---|---|---|---|
| Factored Pressure | = | 3,253 | 989 | psf |
| Mu' : Upward | = | 373 | 150 | ft-# |
| Mu' : Downward | = | 30 | 169 | ft-# |
| Mu: Design | = | 343 | 19 | ft-# |
| Actual 1-Way Shear | = | 0.51 | 0.17 | psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 | psi |

Min footing T&S reinf Area 0.43 in2
Min footing T&S reinf Area per foot 0.26 in2 /ft

If one layer of horizontal bars:
#4@ 9.26 in
#5@ 14.35 in
#6@ 20.37 in

If two layers of horizontal bars:
#4@ 18.52 in
#5@ 28.70 in
#6@ 40.74 in

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# Restrained Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

## Summary of Forces on Footing : Slab RESISTS sliding, stem is PINNED at footing

### Forces acting on footing soil pressure

(taking moments about front of footing to find eccentricity)

| | | | | | |
|---|---|---|---|---|---|
| Surcharge Over Heel | = | lbs | ft | | ft-# |
| Axial Dead Load on Stem | = | 200.0 lbs | 0.83 ft | 166.0 | ft-# |
| Soil Over Toe | = | 27.3 lbs | 0.25 ft | 6.8 | ft-# |
| Adjacent Footing Load | = | lbs | ft | | ft-# |
| Surcharge Over Toe | = | lbs | ft | | ft-# |
| Stem Weight | = | 900.0 lbs | 0.83 ft | 747.0 | ft-# |
| Soil Over Heel | = | 491.7 lbs | 1.41 ft | 694.1 | ft-# |
| Footing Weight | = | 249.0 lbs | 0.83 ft | 206.7 | ft-# |
| **Total Vertical Force** | = | 2,668.0 lbs | Moment = | 1,820.6 | ft-# |

**Net Mom. at Stem/Ftg Interface = 393.9 ft-#**

**Allow. Mom. @ Stem/Ftg Interface = 5,745.0 ft-#**

**Allow. Mom. Exceeds Applied Mom.? Yes**

**Therefore Uniform Soil Pressure = 1,607.2 psf**

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

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# Restrained Retaining Wall

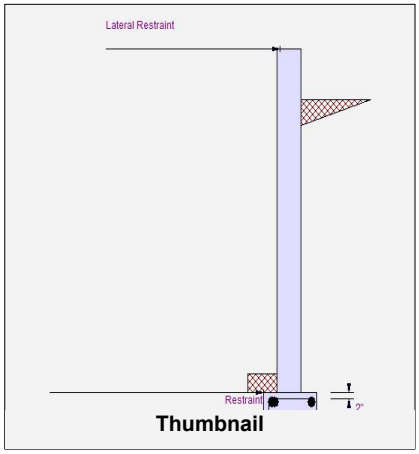
Code: IBC 2012,ACI 318-11,ACI 530-11

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 7.67 ft |
| Wall height above soil | = | 1.33 ft |
| Total Wall Height | = | 9.00 ft |
| Top Support Height | = | 9.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 5,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| At-rest Heel Pressure | = | 55.0 psf/ft |
| | = | |
| Passive Pressure | = | 250.0 psf/ft |
| Soil Density | = | 110.00 pcf |
| Footing\|\|Soil Frictior | = | 0.450 |
| Soil height to ignore for passive pressure | = | 12.00 in |



Thumbnail

## Surcharge Loads

Surcharge Over Heel = 0.0 psf
>>>Used To Resist Sliding & Overturning
Surcharge Over Toe = 0.0 psf
Used for Sliding & Overturning

## Axial Load Applied to Stem

| | | |
|---|---|---|
| Axial Dead Load | = | 200.0 lbs |
| Axial Live Load | = | 800.0 lbs |
| Axial Load Eccentricity | = | 0.0 in |

## Earth Pressure Seismic Load

## Stem Weight Seismic Load

## Uniform Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) (Strength Level) |
| Wind on Exposed Stem | = | 0.0 psf |

$K_h$ Soil Density Multiplier = 0.200 g — Added seismic per unit area = 0.0 psf

$F_p / W_p$ Weight Multiplier = 0.000 g — Added seismic per unit area = 0.0 psf

## Adjacent Footing Load

| | | |
|---|---|---|
| Adjacent Footing Load | = | 0.0 lbs |
| Footing Width | = | 1.80 ft |
| Eccentricity | = | 0.00 in |
| Wall to Ftg CL Dist | = | 6.00 ft |
| Footing Type | | Line Load |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

## Design Summary

| | | | |
|---|---|---|---|
| Total Bearing Load | = | 2,595 lbs | |
| ...resultant ecc. | = | 2.02 in | |
| Soil Pressure @ Toe | = | 1,563 psf | OK |
| Soil Pressure @ Heel | = | 1,563 psf | OK |
| Allowable | = | 5,000 psf | |
| Soil Pressure Less Than Allowable | | | |
| ACI Factored @ Toe | = | 3,326 psf | |
| ACI Factored @ Heel | = | 812 psf | |
| Footing Shear @ Toe | = | 0.5 psi | OK |
| Footing Shear @ Heel | = | 0.0 psi | OK |
| Allowable | = | 75.0 psi | |
| **Reaction at Top** | = | 458.4 lbs | |
| **Reaction at Bottom** | = | 1,607.2 lbs | |

**Sliding Calcs**
Lateral Sliding Force = 1,607.2 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

**Load Factors**

| | |
|---|---|
| Building Code | IBC 2012,ACI |
| Dead Load | 1.200 |
| Live Load | 1.600 |
| Earth, H | 1.600 |
| Wind, W | 1.000 |
| Seismic, E | 1.000 |

## Concrete Stem Construction

Thickness = 8.00 in — Fy = 60,000 psi
Wall Weight = 100.0 psf — f'c = 3,000 psi
Stem is FREE to rotate at top of footing

| | @ Top Support | Mmax Between Top & Base | @ Base of Wall |
|---|---|---|---|
| | Stem OK | Stem OK | Stem OK |
| **Design Height Above Ftg** | 9.00 ft | 3.61 ft | 0.00 ft |
| Rebar Size | # 4 | # 4 | # 4 |
| Rebar Spacing | 6.00 in | 6.00 in | 6.00 in |
| Rebar Placed at | Center | Center | Edge |
| Rebar Depth 'd' | 4.00 in | 4.00 in | 5.50 in |
| **Design Data** | | | |
| fb/FB + fa/Fa | 0.000 | 0.459 | 0.000 |
| Mu....Actual | 0.0 ft-# | 2,980.9 ft-# | 0.0 ft-# |
| Mn * Phi.....Allowable | 6,492.0 ft-# | 6,492.0 ft-# | 9,192.0 ft-# |
| Shear Force @ this height | 735.1 lbs | | 1,852.7 lbs |
| Shear.....Actual | 15.31 psi | | 28.07 psi |
| Shear.....Allowable | 82.16 psi | | 82.16 psi |

**Other Acceptable Sizes & Spacings:**

| | | |
|---|---|---|
| Toe: # 7 @ 18.00 in | -or- | Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm |
| Heel:# 6 @ 16.00 in | -or- | Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm |
| Key: No key defined | -or- | No key defined |

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# Restrained Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

## Concrete Stem Rebar Area Details

| Top Support | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0 in2/ft | | |
| (4/3) * As : | 0 in2/ft | Min Stem T&S Reinf Area 1.728 in2 | |
| 200bd/fy : 200(12)(4)/60000 : | 0.16 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.1728 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.6503 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

| Mmax Between Ends | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.1799 in2/ft | | |
| (4/3) * As : | 0.2399 in2/ft | Min Stem T&S Reinf Area 1.034 in2 | |
| 200bd/fy : 200(12)(4)/60000 : | 0.16 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.1799 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.6503 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

| Base Support | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0 in2/ft | | |
| (4/3) * As : | 0 in2/ft | Min Stem T&S Reinf Area 0.694 in2 | |
| 200bd/fy : 200(12)(5.5)/60000 : | 0.22 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.1728 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.8941 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

### Footing Strengths & Dimensions

| | | |
|---|---|---|
| Toe Width | = | 0.50 ft |
| Heel Width | = | 1.16 |
| Total Footing Width | = | 1.66 |
| Footing Thickness | = | 12.00 in |
| Key Width | = | 0.00 in |
| Key Depth | = | 0.00 in |
| Key Distance from Toe | = | 0.00 ft |

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top = 2.00 in @ Btm.= 3.00 in

### Footing Design Results

| | | Toe | Heel | |
|---|---|---|---|---|
| Factored Pressure | = | 3,326 | 812 | psf |
| Mu' : Upward | = | 379 | 131 | ft-# |
| Mu' : Downward | = | 30 | 147 | ft-# |
| Mu: Design | = | 349 | 16 | ft-# |
| Actual 1-Way Shear | = | 0.51 | 0.02 | psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 | psi |

Min footing T&S reinf Area 0.43 in2
Min footing T&S reinf Area per foot 0.26 in2 /ft

| If one layer of horizontal bars: | If two layers of horizontal bars: |
|---|---|
| #4@ 9.26 in | #4@ 18.52 in |
| #5@ 14.35 in | #5@ 28.70 in |
| #6@ 20.37 in | #6@ 40.74 in |

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# Restrained Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

## Summary of Forces on Footing : Slab RESISTS sliding, stem is PINNED at footing

### Forces acting on footing soil pressure

(taking moments about front of footing to find eccentricity)

| | | | | | |
|---|---|---|---|---|---|
| Surcharge Over Heel | = | lbs | ft | | ft-# |
| Axial Dead Load on Stem | = | 200.0 lbs | 0.83 ft | 166.0 | ft-# |
| Soil Over Toe | = | 27.3 lbs | 0.25 ft | 6.8 | ft-# |
| Adjacent Footing Load | = | lbs | ft | | ft-# |
| Surcharge Over Toe | = | lbs | ft | | ft-# |
| Stem Weight | = | 899.9 lbs | 0.83 ft | 746.9 | ft-# |
| Soil Over Heel | = | 419.0 lbs | 1.41 ft | 591.5 | ft-# |
| Footing Weight | = | 249.0 lbs | 0.83 ft | 206.7 | ft-# |
| **Total Vertical Force** | = | 2,595.2 lbs | Moment = | 1,717.8 | ft-# |

**Net Mom. at Stem/Ftg Interface = 436.2 ft-#**

**Allow. Mom. @ Stem/Ftg Interface = 5,745.0 ft-#**

**Allow. Mom. Exceeds Applied Mom.? Yes**

**Therefore Uniform Soil Pressure = 1,563.4 psf**

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

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# Restrained Retaining Wall

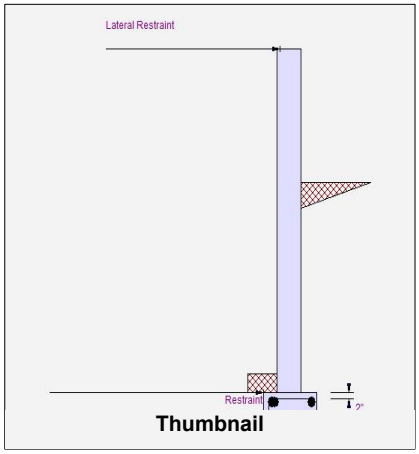
Code: IBC 2012,ACI 318-11,ACI 530-11

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 5.50 ft |
| Wall height above soil | = | 3.50 ft |
| Total Wall Height | = | 9.00 ft |
| Top Support Height | = | 9.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 5,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| At-rest Heel Pressure | = | 55.0 psf/ft |
| | = | |
| Passive Pressure | = | 250.0 psf/ft |
| Soil Density | = | 110.00 pcf |
| Footing\|\|Soil Frictior | = | 0.450 |
| Soil height to ignore for passive pressure | = | 12.00 in |



Thumbnail

## Surcharge Loads

Surcharge Over Heel = 0.0 psf
>>>Used To Resist Sliding & Overturning
Surcharge Over Toe = 0.0 psf
Used for Sliding & Overturning

## Axial Load Applied to Stem

| | | |
|---|---|---|
| Axial Dead Load | = | 200.0 lbs |
| Axial Live Load | = | 800.0 lbs |
| Axial Load Eccentricity | = | 0.0 in |

## Earth Pressure Seismic Load

## Stem Weight Seismic Load

## Uniform Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) (Strength Level) |
| Wind on Exposed Stem | = | 0.0 psf |

$K_h$ Soil Density Multiplier = 0.200 g — Added seismic per unit area = 0.0 psf

$F_p / W_p$ Weight Multiplier = 0.000 g — Added seismic per unit area = 0.0 psf

## Adjacent Footing Load

| | | |
|---|---|---|
| Adjacent Footing Load | = | 0.0 lbs |
| Footing Width | = | 1.80 ft |
| Eccentricity | = | 0.00 in |
| Wall to Ftg CL Dist | = | 6.00 ft |
| Footing Type | | Line Load |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

## Design Summary

| | | | |
|---|---|---|---|
| Total Bearing Load | = | 2,477 lbs | |
| ...resultant ecc. | = | 2.45 in | |
| Soil Pressure @ Toe | = | 1,492 psf | OK |
| Soil Pressure @ Heel | = | 1,492 psf | OK |
| Allowable | = | 5,000 psf | |
| Soil Pressure Less Than Allowable | | | |
| ACI Factored @ Toe | = | 3,445 psf | |
| ACI Factored @ Heel | = | 521 psf | |
| Footing Shear @ Toe | = | 0.5 psi | OK |
| Footing Shear @ Heel | = | 0.2 psi | OK |
| Allowable | = | 75.0 psi | |
| **Reaction at Top** | = | 168.5 lbs | |
| **Reaction at Bottom** | = | 992.4 lbs | |

**Sliding Calcs**
Lateral Sliding Force = 992.4 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

**Load Factors**

| | |
|---|---|
| Building Code | IBC 2012,ACI |
| Dead Load | 1.200 |
| Live Load | 1.600 |
| Earth, H | 1.600 |
| Wind, W | 1.000 |
| Seismic, E | 1.000 |

## Concrete Stem Construction

Thickness = 8.00 in — Fy = 60,000 psi
Wall Weight = 100.0 psf — f'c = 3,000 psi
Stem is FREE to rotate at top of footing

| | @ Top Support | Mmax Between Top & Base | @ Base of Wall |
|---|---|---|---|
| | Stem OK | Stem OK | Stem OK |
| **Design Height Above Ftg** = | 9.00 ft | 3.04 ft | 0.00 ft |
| Rebar Size = | # 4 | # 4 | # 4 |
| Rebar Spacing = | 6.00 in | 6.00 in | 6.00 in |
| Rebar Placed at = | Center | Center | Edge |
| Rebar Depth 'd' = | 4.00 in | 4.00 in | 5.50 in |
| **Design Data** | | | |
| fb/FB + fa/Fa = | 0.000 | 0.215 | 0.000 |
| Mu....Actual = | 0.0 ft-# | 1,397.6 ft-# | 0.0 ft-# |
| Mn * Phi.....Allowable = | 6,492.0 ft-# | 6,492.0 ft-# | 9,192.0 ft-# |
| Shear Force @ this height = | 271.1 lbs | | 1,059.9 lbs |
| Shear.....Actual = | 5.65 psi | | 16.06 psi |
| Shear.....Allowable = | 82.16 psi | | 82.16 psi |

**Other Acceptable Sizes & Spacings:**

| | | |
|---|---|---|
| Toe: # 7 @ 18.00 in | -or- | Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm |
| Heel:# 6 @ 16.00 in | -or- | Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm |
| Key: No key defined | -or- | No key defined |

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## Concrete Stem Rebar Area Details

| Top Support | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0 in2/ft | | |
| (4/3) * As : | 0 in2/ft | Min Stem T&S Reinf Area 1.728 in2 | |
| 200bd/fy : 200(12)(4)/60000 : | 0.16 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.1728 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.6503 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

| Mmax Between Ends | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.0844 in2/ft | | |
| (4/3) * As : | 0.1125 in2/ft | Min Stem T&S Reinf Area 1.145 in2 | |
| 200bd/fy : 200(12)(4)/60000 : | 0.16 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.1728 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.6503 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

| Base Support | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0 in2/ft | | |
| (4/3) * As : | 0 in2/ft | Min Stem T&S Reinf Area 0.583 in2 | |
| 200bd/fy : 200(12)(5.5)/60000 : | 0.22 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft | |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : | |
| | ========== | One layer of : | Two layers of : |
| Required Area : | 0.1728 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.8941 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

### Footing Strengths & Dimensions

| | | |
|---|---|---|
| Toe Width | = | 0.50 ft |
| Heel Width | = | 1.16 |
| Total Footing Width | = | 1.66 |
| Footing Thickness | = | 12.00 in |
| Key Width | = | 0.00 in |
| Key Depth | = | 0.00 in |
| Key Distance from Toe | = | 0.00 ft |

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top = 2.00 in @ Btm.= 3.00 in

### Footing Design Results

| | | Toe | Heel | |
|---|---|---|---|---|
| Factored Pressure | = | 3,445 | 521 | psf |
| Mu' : Upward | = | 389 | 100 | ft-# |
| Mu' : Downward | = | 30 | 112 | ft-# |
| Mu: Design | = | 359 | 11 | ft-# |
| Actual 1-Way Shear | = | 0.51 | 0.23 | psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 | psi |

Min footing T&S reinf Area 0.43 in2
Min footing T&S reinf Area per foot 0.26 in2 /ft

| If one layer of horizontal bars: | If two layers of horizontal bars: |
|---|---|
| #4@ 9.26 in | #4@ 18.52 in |
| #5@ 14.35 in | #5@ 28.70 in |
| #6@ 20.37 in | #6@ 40.74 in |

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# Restrained Retaining Wall

Code: IBC 2012,ACI 318-11,ACI 530-11

## Summary of Forces on Footing : Slab RESISTS sliding, stem is PINNED at footing

### Forces acting on footing soil pressure

(taking moments about front of footing to find eccentricity)

| | | | | | |
|---|---|---|---|---|---|
| Surcharge Over Heel | = | lbs | ft | | ft-# |
| Axial Dead Load on Stem | = | 200.0 lbs | 0.83 ft | 166.0 | ft-# |
| Soil Over Toe | = | 27.3 lbs | 0.25 ft | 6.8 | ft-# |
| Adjacent Footing Load | = | lbs | ft | | ft-# |
| Surcharge Over Toe | = | lbs | ft | | ft-# |
| Stem Weight | = | 900.0 lbs | 0.83 ft | 747.0 | ft-# |
| Soil Over Heel | = | 300.5 lbs | 1.41 ft | 424.2 | ft-# |
| Footing Weight | = | 249.0 lbs | 0.83 ft | 206.7 | ft-# |
| **Total Vertical Force** | = | 2,476.8 lbs | Moment = | 1,550.6 | ft-# |

**Net Mom. at Stem/Ftg Interface = 505.1 ft-#**

**Allow. Mom. @ Stem/Ftg Interface = 5,745.0 ft-#**

**Allow. Mom. Exceeds Applied Mom.? Yes**

**Therefore Uniform Soil Pressure = 1,492.0 psf**

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

# Special RC Shear Wall Checks per 18.10 (C-2ND)

$f'c := 2500$ $f_y := 60 \cdot ksi$ $\lambda := 1$ $d_b := .5\ in$ $\beta_1 := .85$

$t_w := 8\ in$ $l_w := 8\ ft$ $h_w := 8\ ft$ $\frac{h_w}{l_w} = 1$ $\alpha_c := 3$

$A_{cv} := l_w \cdot h_w = 64\ ft^2$

$\rho_{wmin} := .0025$

$A_{req} := \frac{t_w \cdot 12\ in \cdot \rho_{wmin}}{\left(\frac{\pi \cdot d_b^{\,2}}{4}\right)} = 1.222$ bars/ft

$s := 9\ in$

$\rho_w := \frac{\frac{12\ in}{s} \cdot \frac{\pi \cdot d_b^{\,2}}{4}}{t_w \cdot 12\ in} = 0.0027$

$V_u := 7232\ lbf = 7.232\ kip$

$V_n := A_{cv} \cdot \left(\alpha_c \cdot \lambda \cdot \sqrt{f'c} \cdot psi + \rho_w \cdot f_y\right) = 2890\ kip$

$2 \cdot A_{cv} \cdot \lambda \cdot \sqrt{f'c} \cdot psi = 922\ kip$ Greater than Vu, two curtains of reinf. not req. per 18.10.2.2

$S_{xw} := \frac{t_w \cdot l_w^{\,2}}{6} = 7.111\ ft^3$

$\sigma := \frac{V_u \cdot h_w}{S_{xw}} = 56.5\ psi$

$0.2 \cdot f'c \cdot psi = 500\ psi$ sigma<0.2f'c, no special boundary elements required

$T_w := \frac{V_u \cdot h_w}{l_w} = 7.232\ kip$

$A_{boundary} := \frac{T_w}{f_y \cdot .9} = 0.134\ in^2$

# Special RC Shear Wall Checks per 18.10 (1.2-1ST)

$t_w := 8\ in$ $l_w := 3\ ft + 10\ in$ $h_w := 9\ ft$ $\frac{h_w}{l_w} = 2.348$ $\alpha_c := 2$

$A_{cv} := l_w \cdot h_w = 34.5\ ft^2$ $A_s := .6 \cdot in^2$

$\rho_{wmin} := .0025$

$A_{req} := \frac{t_w \cdot 12\ in \cdot \rho_{wmin}}{\left(\frac{\pi \cdot d_b^{\,2}}{4}\right)} = 1.222$ bars/ft

$s := 9\ in$

$\rho_w := \frac{\frac{12\ in}{s} \cdot \frac{2\ \pi \cdot d_b^{\,2}}{4}}{t_w \cdot 12\ in} = 0.0055$

$V_u := 8513\ lbf = 8.513\ kip$

$V_n := A_{cv} \cdot \left(\alpha_c \cdot \lambda \cdot \sqrt{f'c} \cdot psi + \rho_w \cdot f_y\right) = 2123\ kip$

$2 \cdot A_{cv} \cdot \lambda \cdot \sqrt{f'c} \cdot psi = 497\ kip$ Greater than Vu, two curtains of reinf. not req. per 18.10.2.2, Two curtains are required per 10.10.2.2

$c := \frac{A_s \cdot f_y}{\beta_1 \cdot .85 \cdot f'c \cdot psi \cdot t_w} = 2.491\ in$

$\delta_u := 0.005 \cdot h_w$

$\frac{l_w}{600\left(1.5\ \frac{\delta_u}{h_w}\right)} = 10.222\ in$ Greater than c, no special boundary elements required per 18.10.6.2

$S_{xw} := \frac{t_w \cdot l_w^{\,2}}{6} = 1.633\ ft^3$

$\sigma := \frac{V_u \cdot h_w}{S_{xw}} = 325.876\ psi$

$0.2 \cdot f'c \cdot psi = 500\ psi$ sigma<0.2f'c, no special boundary elements required per 18.10.6.3

$T_w := \frac{V_u \cdot h_w}{l_w} = 19.987\ kip$

$A_{boundary} := \frac{T_w}{f_y \cdot .9} = 0.37\ in^2$