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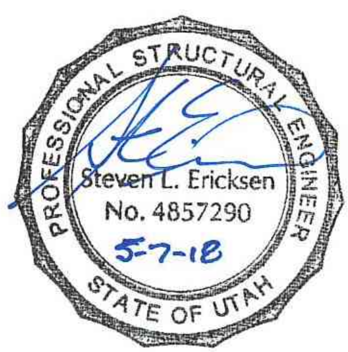
# Structural Calculations

**For**

## Kimberly Clark Warehouse Expansion

**Project Number: 18054**

**May 7, 2018**




**Prepared by**
**ARW Engineers**
**1594 West Park Circle**
**Ogden, Utah 84404**

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# STRUCTURAL CALCULATIONS

FOR

# Kimberly Clark Warehouse Addition

**Client:** Big-D Construction

**Project Number:** 18054

## DESIGN CRITERIA

**GOVERNING CODE: IBC 2015**

**GENERAL:** Risk Category = II

**SEISMIC:** Seismic Design Category = D
$I_E$ = 1.0 R = 3.25 (E-W), 6.0 (N-S)
$S_{DS}$= 0.998

**WIND:** Basic Wind Speed = 115 mph
Exposure Classification = C

**SOILS:** Site Class: D
Design Allowable Soil Pressure = 2500 psf
As per Soils Report by: GSH Geotechnical, Inc.
Dated: April 6, 2018

## DESIGN LOADS

**ROOFS:** DL = 13 psf SL = 30 psf

# CALCULATIONS INDEX


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# Calculation Criteria

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# PROJECT DESIGN CRITERIA

Governing Building Code : IBC2015

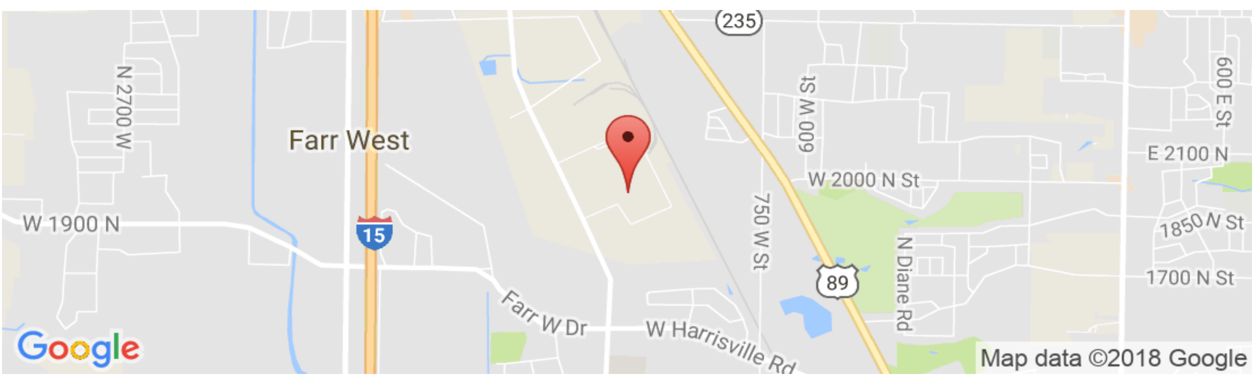
## WIND DESIGN

| | | |
|---|---|---|
| Basic Wind Speed, $V_{3s}$ : | 115 | mph |
| Wind Importance Factor, $I_w$ : | 1 | |
| Wind Exposure : | C | |

## SEISMIC DESIGN

| | | | |
|---|---|---|---|
| Seismic Importance Factor, $I_e$ : | 1 | Street: | 2010 Rulon White Blvd |
| USGS Design Code: | 2015 IBC | City: | Ogden |
| Site Class : | D | State: | UT |
| Seismic Risk Category : | II | | |
| | | Latitude : | 41.2940215 |
| | | Longitude : | -112.0065929 |

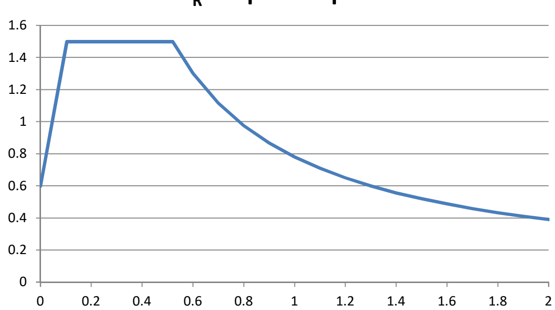
| | |
|---|---|
| Design Category : | D |
| Basic Seismic Force Resisting System : | Special Concrete Shearwall (N-S); OCBF (E-W) |
| Response Modification Factor, R : | 6(NS) 3.25(EW) |
| Type of Analysis : | STATIC |



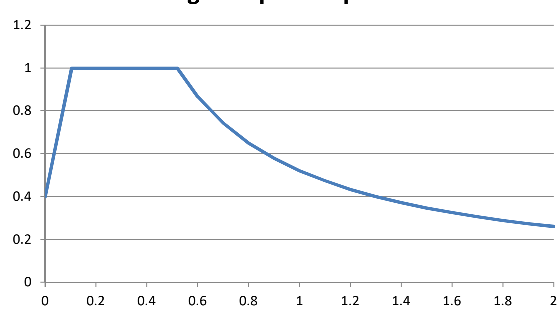

**USGS–Provided Output**

| | | | |
|---|---|---|---|
| $S_s$ = 1.498 g | $F_a$ = 1.000 | $S_{MS}$ = 1.498 g | $S_{DS}$ = 0.998 g |
| $S_1$ = 0.520 g | $F_v$ = 1.500 | $S_{M1}$ = 0.780 g | $S_{D1}$ = 0.520 g |

### $MCE_R$ Response Spectrum




### Design Response Spectrum



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# ROOF FRAMING

## ROOF A: DEAD LOADS

| | | | Comments |
|---|---|---|---|
| Roofing: | 2 | psf | |
| Batting/Blown Insulation: | 1 | psf | |
| Decking: | 2 | psf | |
| Framing: | 5 | psf | |
| Mechanical Ducts/Misc.: | 3 | psf | |
| **Total Dead Load:** | **13** | psf | |
| Seismic Roof Snow Load: | | psf | |
| **Seismic Mass Dead Load:** | **13** | psf | |

## ROOF B: DEAD LOADS

| | | | Comments |
|---|---|---|---|
| Roofing: | 2 | psf | |
| Batting/Blown Insulation: | 1 | psf | |
| Sheathing: | 2 | psf | |
| Framing: | 5 | psf | |
| Mechanical Ducts/Misc.: | 17 | psf | |
| **Total Dead Load:** | **27** | psf | |
| Seismic Roof Snow Load: | 0 | psf | |
| **Seismic Mass Dead Load:** | **27** | psf | |

| | | | Comments |
|---|---|---|---|
| **LIVE LOADS** | | psf | |

## SNOW LOADS

| | | |
|---|---|---|
| Ground Snow Load : | 43.0 | psf |
| Snow Exposure Factor, $C_e$ : | 1 | |
| Snow Load Importance Factor, $I_s$ : | 1 | |
| Thermal Factor, $C_t$ : | 1 | |
| Flat Roof Snow Load : | **30** | psf |

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# FLOOR FRAMING

## FLOOR A: DEAD LOADS

| | | | Comments |
|---|---|---|---|
| Floor Finish: | | psf | |
| Concrete Slab: | | psf | |
| Decking: | | psf | |
| Floor Framing: | | psf | |
| Fireproofing: | | psf | |
| Mechanical Ducts/Misc.: | | psf | |
| Fire Sprinkling: | | psf | |
| Ceilings: | | psf | |
| Additional Concrete due to 1/2" Beam Deflection: | | psf | |
| **Total Dead Load:** | **0** | psf | |
| **Seismic Mass Dead Load:** | **0** | psf | |
| **Construction Dead Load:** | **0** | psf | Only includes weight of concrete slab and decking |

## FLOOR B: DEAD LOADS

| | | | Comments |
|---|---|---|---|
| Floor Finish: | | psf | |
| Concrete Slab: | | psf | |
| Decking: | | psf | |
| Floor Framing: | | psf | |
| Fireproofing: | | psf | |
| Mechanical Ducts/Misc.: | | psf | |
| Fire Sprinkling: | | psf | |
| Ceilings: | | psf | |
| Additional Concrete due to 1/2" Beam Deflection: | | psf | |
| **Total Dead Load:** | **0** | psf | |
| **Seismic Mass Dead Load:** | **0** | psf | |
| **Construction Dead Load:** | **0** | psf | Only includes weight of concrete slab and decking |

## FLOOR C: DEAD LOADS

| | | | Comments |
|---|---|---|---|
| Floor Finish: | | psf | |
| Concrete Slab: | | psf | |
| Decking: | | psf | |
| Floor Framing: | | psf | |
| Fireproofing: | | psf | |
| Mechanical Ducts/Misc.: | | psf | |
| Fire Sprinkling: | | psf | |
| Ceilings: | | psf | |
| Additional Concrete due to 1/2" Beam Deflection: | | psf | |
| **Total Dead Load:** | **0** | psf | |
| **Seismic Mass Dead Load:** | **0** | psf | |
| **Construction Dead Load:** | **0** | psf | Only includes weight of concrete slab and decking |

## LIVE LOADS

| | | | |
|---|---|---|---|
| | 125 | psf | |
| | | psf | |
| | | psf | |
| | | psf | |

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# WALLS

## WALL A: DEAD LOAD

| | | | Comments |
|---|---|---|---|
| Framing: | | psf | |
| Batting/Blown Insulation: | | psf | |
| Sheathing: | | psf | |
| Veneer: | | psf | |
| Mechanical Ducts/Misc.: | | psf | |
| Gypsum Board: | | psf | |
| Collateral: | | psf | |
| **Total Dead Load:** | **0** | psf | |
| **Seismic Mass Dead Load:** | **0** | psf | |

## WALL B: DEAD LOAD

| | | | Comments |
|---|---|---|---|
| Framing: | | psf | |
| Batting/Blown Insulation: | | psf | |
| Sheathing: | | psf | |
| Veneer: | | psf | |
| Mechanical Ducts/Misc.: | | psf | |
| Gypsum Board: | | psf | |
| Collateral: | | psf | |
| **Total Dead Load:** | **0** | psf | |
| **Seismic Mass Dead Load:** | **0** | psf | |

## WALL C: DEAD LOAD

| | | | Comments |
|---|---|---|---|
| Framing: | | psf | |
| Batting/Blown Insulation: | | psf | |
| Sheathing: | | psf | |
| Veneer: | | psf | |
| Mechanical Ducts/Misc.: | | psf | |
| Gypsum Board: | | psf | |
| Collateral: | | psf | |
| **Total Dead Load:** | **0** | psf | |
| **Seismic Mass Dead Load:** | **0** | psf | |

## WALL D: DEAD LOAD

| | | | Comments |
|---|---|---|---|
| Framing: | | psf | |
| Batting/Blown Insulation: | | psf | |
| Sheathing: | | psf | |
| Veneer: | | psf | |
| Mechanical Ducts/Misc.: | | psf | |
| Gypsum Board: | | psf | |
| Collateral: | | psf | |
| **Total Dead Load:** | **0** | psf | |
| **Seismic Mass Dead Load:** | **0** | psf | |

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# SOILS INFORMATION

| | | |
|---|---|---|
| Net Bearing Pressure : | 2500 | psf |
| Frost Depth : | 30 | inches |
| Friction Coefficient : | | |
| Subgrade Modulus, k : | | |

| Uniform Lateral Pressures | | | | |
|---|---|---|---|---|
| Wall Height (ft.) | Active Pressures Case (psf) | Moderately Yielding Case (psf) | At Rest/Non-Yielding Case (psf) | Passive Case (psf) |
| | | | | |
| | | | | |
| | | | | |

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| Project | | | | Job Ref. | |
|---|---|---|---|---|---|
| Kimberly Clark Addition | | | | 18054 | |
| Section | | | | Sheet no./rev. | |
| C&C Wind Loads | | | | 1 | |
| Calc. by | Date | Chk'd by | Date | App'd by | Date |
| SJV | 4/12/2018 | | | | |

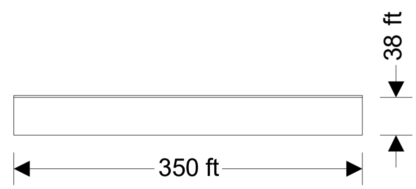
**WIND LOADING (ASCE7-10)**

**In accordance with ASCE7-10 incorporating Errata No. 1 and Errata No. 2**

**Using the components and cladding design method**

Tedds calculation version 2.0.20

Plan



Elevation

**Building data**

| | |
|---|---|
| Type of roof | Flat |
| Length of building | b = **639.00** ft |
| Width of building | d = **350.00** ft |
| Height to eaves | H = **38.00** ft |
| Height of parapet | $h_p$ = **2.00** ft |
| Mean height | h = **38.00** ft |

**General wind load requirements**

| | |
|---|---|
| Basic wind speed | V = **115.0** mph |
| Risk category | II |
| Velocity pressure exponent coeff (Table 26.6-1) | $K_d$ = **0.85** |
| Exposure category (cl.26.7.3) | C |
| Enclosure classification (cl.26.10) | Enclosed buildings |
| Internal pressure coef +ve (Table 26.11-1) | $GC_{pi\_p}$ = **0.18** |
| Internal pressure coef –ve (Table 26.11-1) | $GC_{pi\_n}$ = **-0.18** |
| Parapet internal pressure coef +ve (Table 26.11-1) | $GC_{pi\_pp}$ = **0.18** |
| Parapet internal pressure coef –ve (Table 26.11-1) | $GC_{pi\_np}$ = **-0.18** |
| Gust effect factor | $G_f$ = **0.85** |

**Topography**

| | |
|---|---|
| Topography factor not significant | $K_{zt}$ = 1.0 |

**Velocity pressure**

| | |
|---|---|
| Velocity pressure coefficient (T.30.3-1) | $K_z$ = **1.03** |

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| Section | | | | Sheet no./rev. | |
| C&C Wind Loads | | | | 2 | |
| Calc. by | Date | Chk'd by | Date | App'd by | Date |
| SJV | 4/12/2018 | | | | |

Velocity pressure $q_h = 0.00256 \times K_z \times K_{zt} \times K_d \times V^2 \times 1\text{psf/mph}^2 =$ **29.6** psf

**Velocity pressure at parapet**

Velocity pressure coefficient (T.30.3-1) $K_z =$ **1.04**

Velocity pressure $q_p = 0.00256 \times K_z \times K_{zt} \times K_d \times V^2 \times 1\text{psf/mph}^2 =$ **29.9** psf

**Peak velocity pressure for internal pressure**

Peak velocity pressure – internal (as roof press.) $q_i =$ **29.58** psf

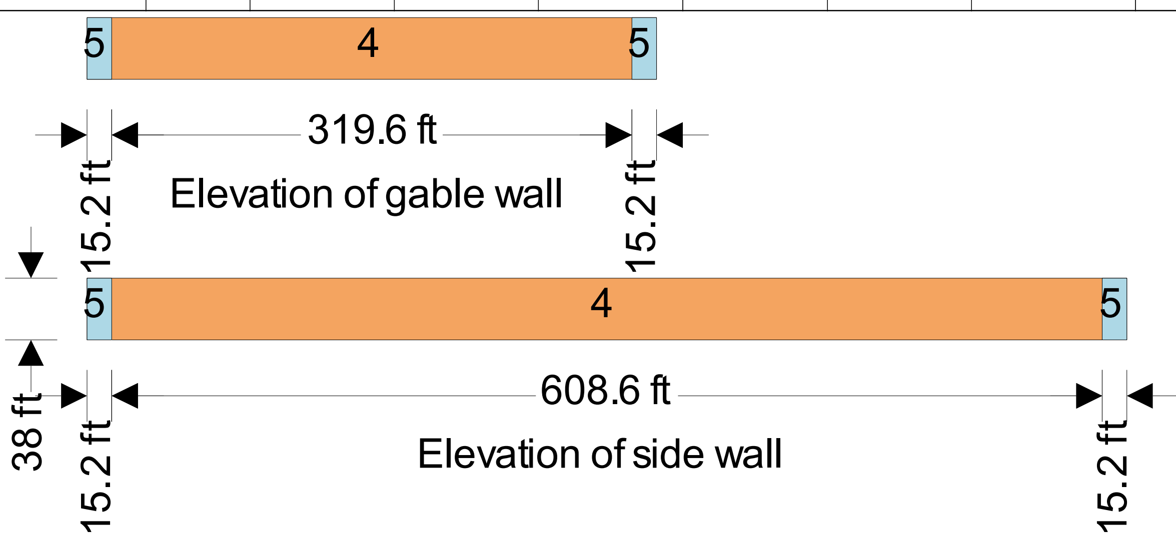
**Equations used in tables**

Net pressure $p = q_h \times [GC_p - GC_{pi}]$

Parapet net pressure $p = q_p \times [GC_p - GC_{pi\_p}]$

**Components and cladding pressures - Wall (Figure 30.4-1 and Figure 30.4-2A)**

| Component | Zone | Length (ft) | Width (ft) | Eff. area (ft$^2$) | +GC$_p$ | -GC$_p$ | Pres (+ve) (psf) | Pres (-ve) (psf) |
|---|---|---|---|---|---|---|---|---|
| <10sf | 4 | - | - | 10.0 | 0.90 | -0.99 | 32.0 | -34.6 |
| 50sf | 4 | - | - | 50.0 | 0.79 | -0.88 | 28.7 | -31.3 |
| 200sf | 4 | - | - | 200.0 | 0.69 | -0.78 | 25.8 | -28.5 |
| >500sf | 4 | - | - | 500.0 | 0.63 | -0.72 | 24.0 | -26.6 |
| <10sf | 5 | - | - | 10.0 | 0.90 | -1.26 | 32.0 | -42.6 |
| 50sf | 5 | - | - | 50.0 | 0.79 | -1.04 | 28.7 | -36.0 |
| 200sf | 5 | - | - | 200.0 | 0.69 | -0.85 | 25.8 | -30.4 |
| >500sf | 5 | - | - | 500.0 | 0.63 | -0.72 | 24.0 | -26.6 |




**Components and cladding pressures - Roof (Figure 30.4-2A)**

| Component | Zone | Length (ft) | Width (ft) | Eff. area (ft$^2$) | +GC$_p$ | -GC$_p$ | Pres (+ve) (psf) | Pres (-ve) (psf) |
|---|---|---|---|---|---|---|---|---|
| <10sf | 1 | - | - | 10.0 | 0.30 | -1.00 | 14.2 # | -34.9 |
| 25sf | 1 | - | - | 25.0 | 0.26 | -0.96 | 13.0 # | -33.7 |

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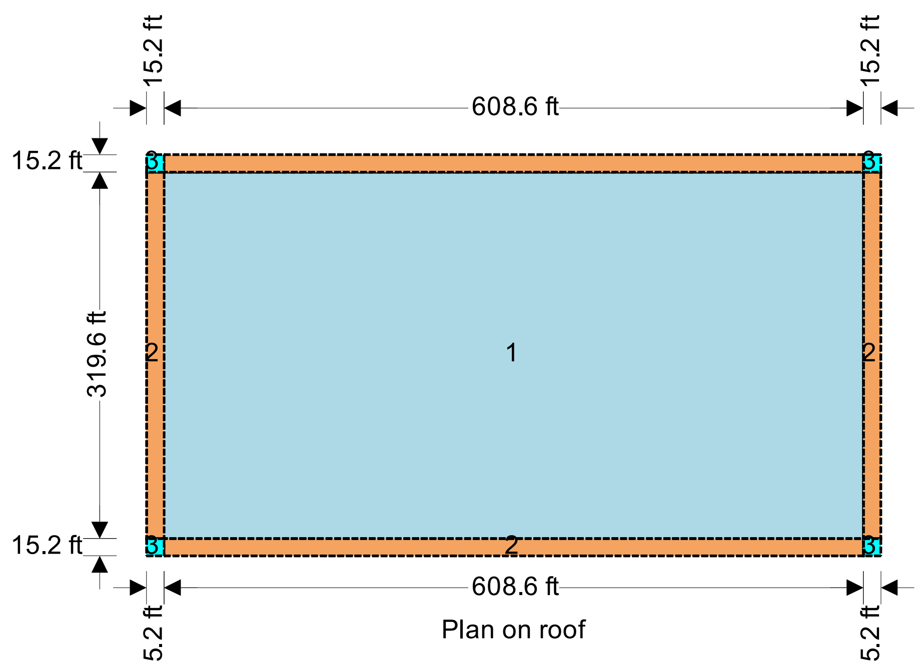
Ogden, Utah 84404
(801) 782-6008

| Project | | Job Ref. | |
|---|---|---|---|
| Kimberly Clark Addition | | 18054 | |
| Section | | Sheet no./rev. | |
| C&C Wind Loads | | 3 | |

| Calc. by | Date | Chk'd by | Date | App'd by | Date |
|---|---|---|---|---|---|
| SJV | 4/12/2018 | | | | |

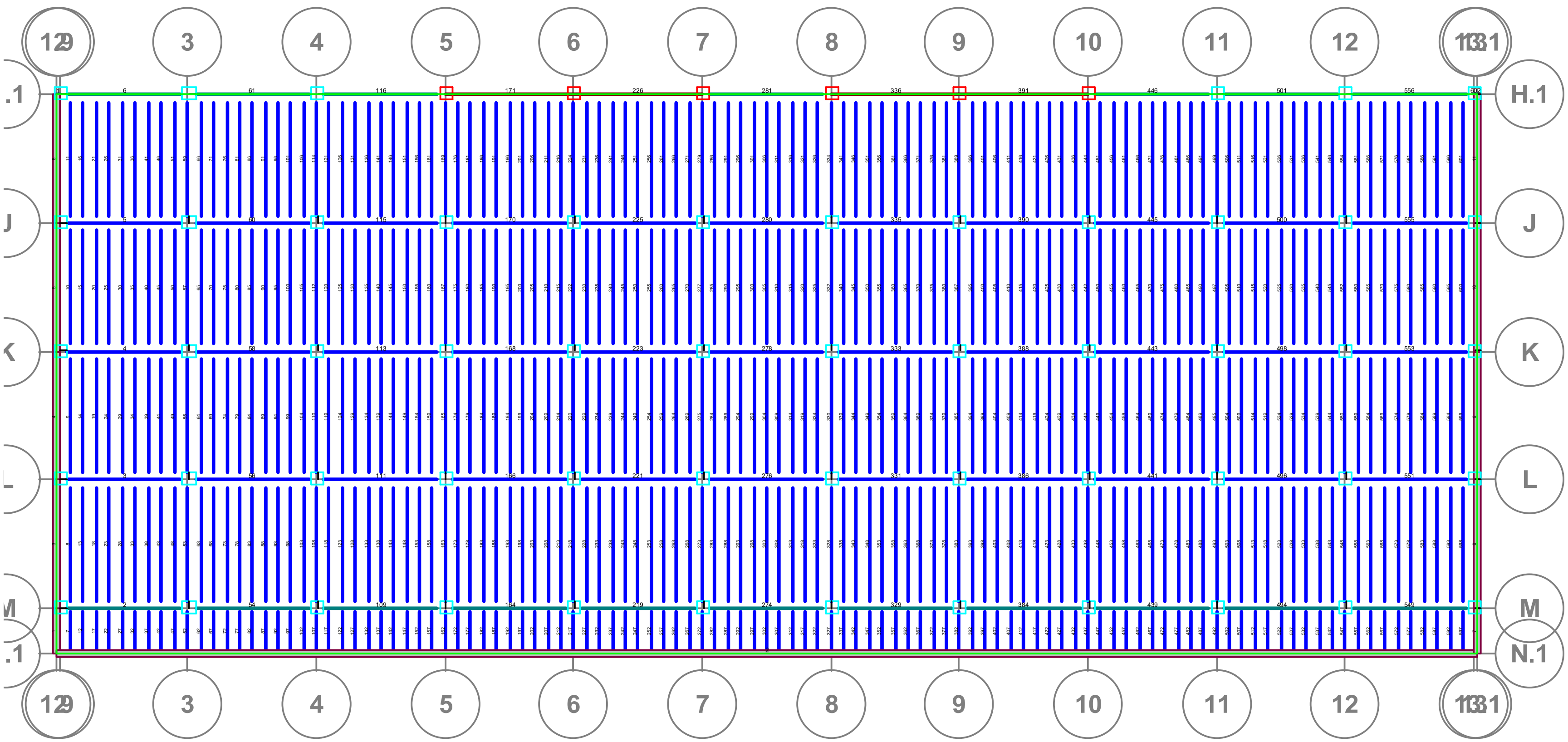
| Component | Zone | Length (ft) | Width (ft) | Eff. area ($ft^2$) | +$GC_p$ | -$GC_p$ | Pres (+ve) (psf) | Pres (-ve) (psf) |
|---|---|---|---|---|---|---|---|---|
| 50sf | 1 | - | - | 50.0 | 0.23 | -0.93 | 12.1 # | -32.8 |
| >100sf | 1 | - | - | 100.0 | 0.20 | -0.90 | 11.2 # | -32.0 |
| <10sf | 2 | - | - | 10.0 | 0.30 | -1.80 | 14.2 # | -58.6 |
| 25sf | 2 | - | - | 25.0 | 0.26 | -1.52 | 13.0 # | -50.3 |
| 50sf | 2 | - | - | 50.0 | 0.23 | -1.31 | 12.1 # | -44.1 |
| >100sf | 2 | - | - | 100.0 | 0.20 | -1.10 | 11.2 # | -37.9 |
| <10sf | 3 | - | - | 10.0 | 0.30 | -2.80 | 14.2 # | -88.2 |
| 25sf | 3 | - | - | 25.0 | 0.26 | -2.12 | 13.0 # | -68.1 |
| 50sf | 3 | - | - | 50.0 | 0.23 | -1.61 | 12.1 # | -53.0 |
| >100sf | 3 | - | - | 100.0 | 0.20 | -1.10 | 11.2 # | -37.9 |

# The final net design wind pressure, including all permitted reductions, used in the design shall not be less than 16psf acting in either direction




Plan on roof

# Roof Framing


3
4
5
6
7
8
9
10
11
12
H.1
J
K
L
M
N.1

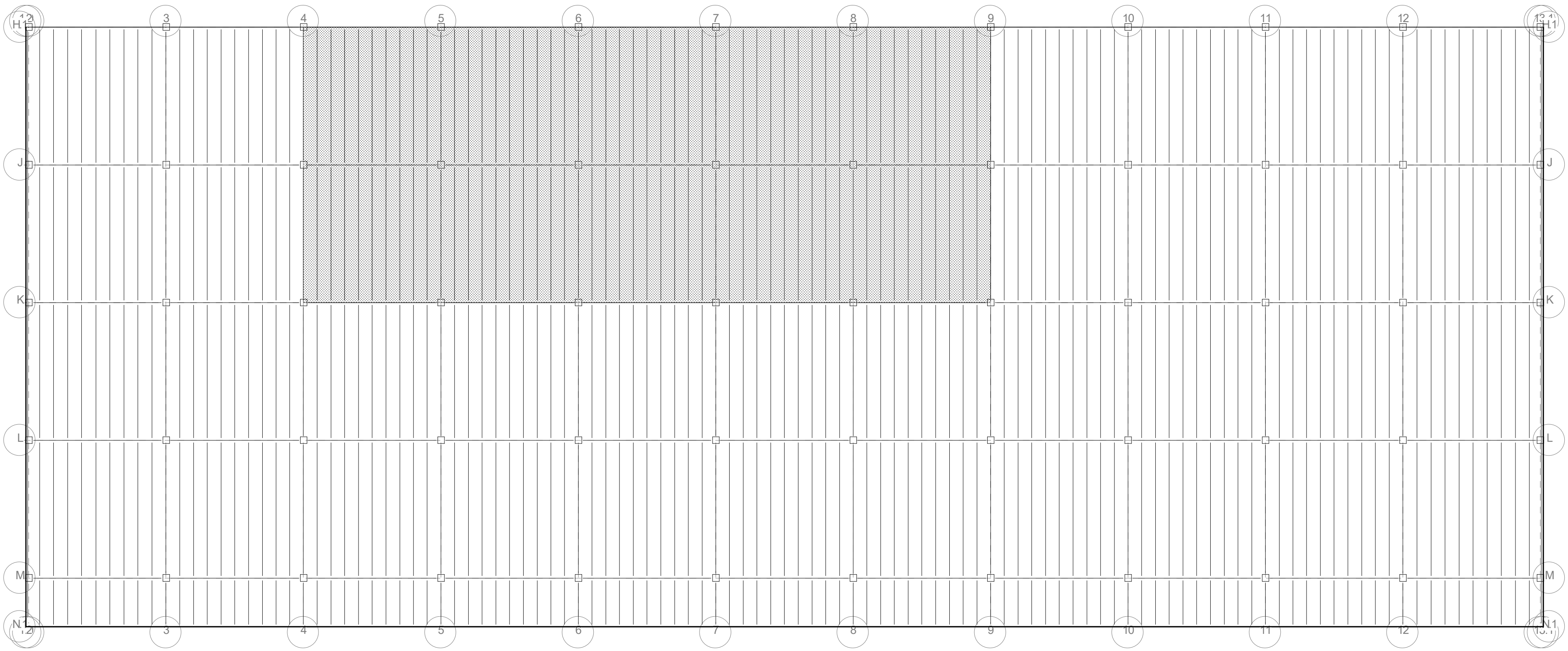
# Floor Map

RAM Structural System
Bentley

RAM Steel 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416
Building Code: IBC

05/07/18 14:02:24
Steel Code: AISC 360-10 ASD

**Floor Type: Roof**



# Floor Map

RAM Structural System
Bentley

| | |
|---|---|
| RAM Steel 15.08.00.37 | Page 2/2 |
| DataBase: 18054_Kimberly Clark Addition_20180416 | 05/07/18 14:02:24 |
| Building Code: IBC | Steel Code: AISC 360-10 ASD |

**Surface Loads**

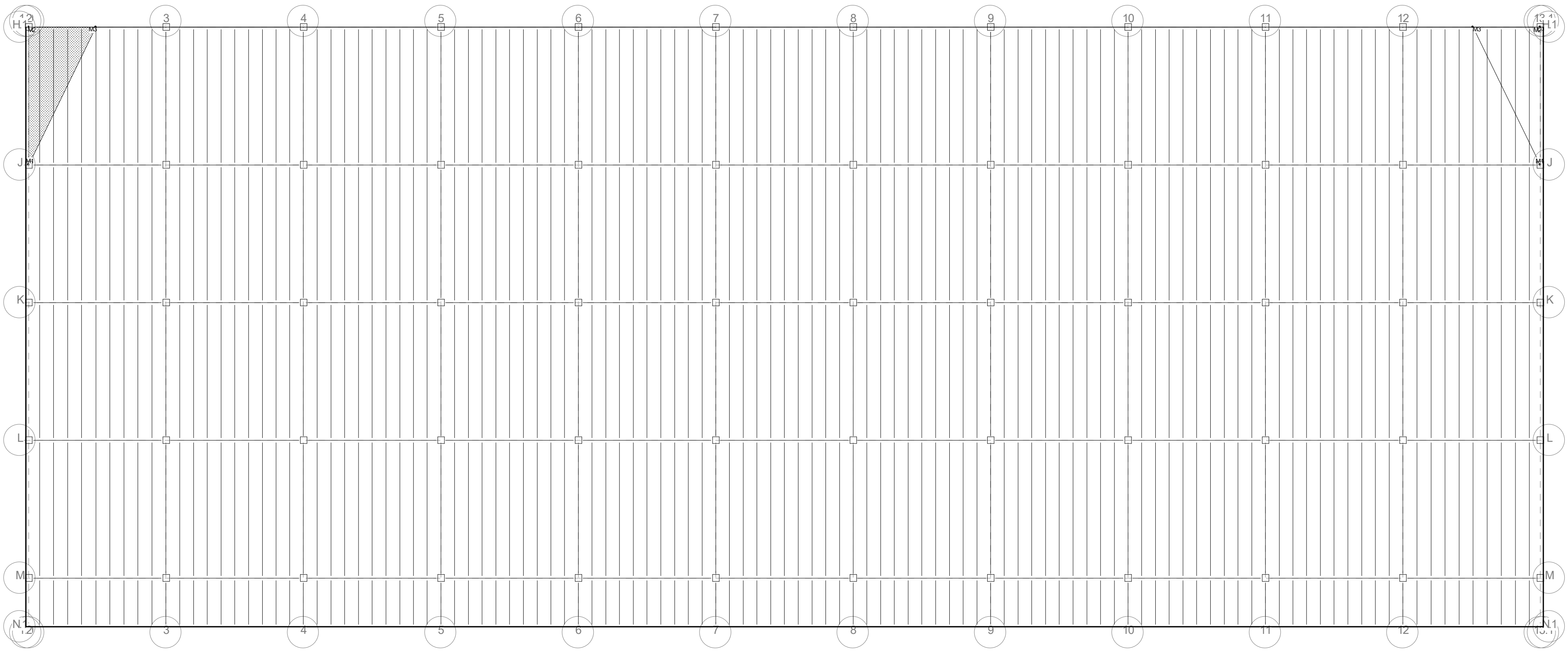
| Label | DL psf | CDL psf | LL psf | Reduction Type | PLL psf | CLL psf | Mass DL psf |
|---|---|---|---|---|---|---|---|
| Normal Dead | 13.0 | 0.0 | 20.0 | Roof | 0.0 | 0.0 | 13.0 |
| Conveyor Dead | 27.0 | 0.0 | 13.0 | Unreducible | 0.0 | 0.0 | 27.0 |

# Floor Map

RAM Structural System
Bentley
RAM Steel 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416
Building Code: IBC

05/07/18 14:02:24
Steel Code: AISC 360-10 ASD

## Floor Type: Roof



# Floor Map



**Snow Loads**

| | Label | Type | Magnitude 1 psf | Magnitude 2 psf | Magnitude 3 psf |
|---|---|---|---|---|---|
| | Flat Roof Snow | Constant | 30.000 | --- | --- |
| | Drift Snow | Drift | 30.000 | 155.000 | 30.000 |
| | Drift Snow | Drift | 30.000 | 155.000 | 30.000 |

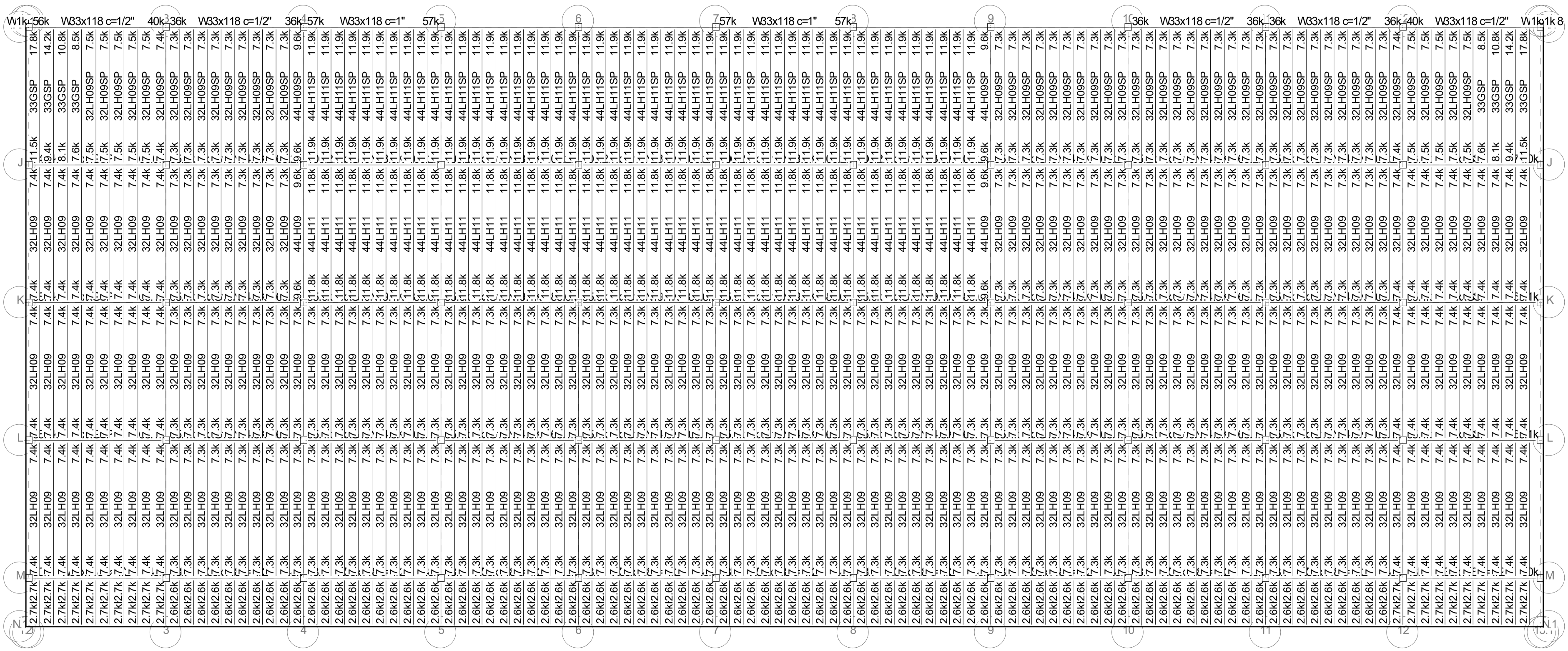
# Floor Map

RAM Steel 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416
Building Code: IBC

05/07/18 14:02:24
Steel Code: AISC 360-10 ASD

## Floor Type: Roof

## Beam Designs

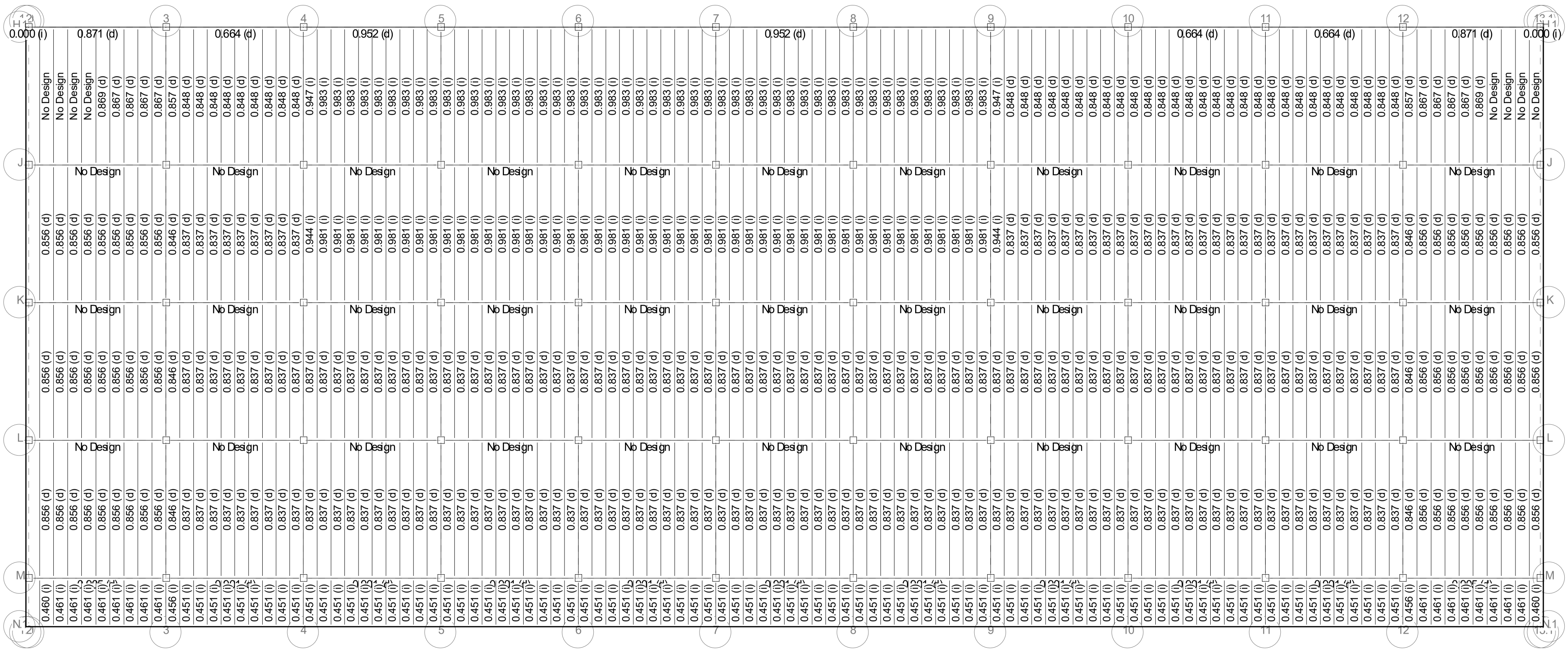


# Floor Map

RAM Structural System
Bentley

RAM Steel 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416 05/07/18 14:02:24
Building Code: IBC Steel Code: AISC 360-10 ASD

**Floor Type: Roof** **Demand / Capacity Ratios: Controlling**



# Gravity Beam Design

RAM Structural System
Bentley

RAM Steel 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416 05/07/18 14:02:24
Building Code: IBC Steel Code: AISC 360-10 ASD

**Floor Type: Roof** **Beam Number = 61**

**SPAN INFORMATION (ft): I-End (58.00,251.33) J-End (116.00,251.33)**

Beam Size (User Selected) = W33X118 Fy = 50.0 ksi
Total Beam Length (ft) = 58.00
Mp (kip-ft) = 1729.1
7

**POINT LOADS (kips):**

| Dist | DL | RedLL | Red% | NonRLL | StorLL | Red% | RoofLL | Red% | PartL |
|---|---|---|---|---|---|---|---|---|---|
| 5.800 | 2.20 | 0.00 | 0.0 | 0.00 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |
| 11.600 | 2.20 | 0.00 | 0.0 | 0.00 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |
| 17.400 | 2.20 | 0.00 | 0.0 | 0.00 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |
| 23.200 | 2.20 | 0.00 | 0.0 | 0.00 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |
| 29.000 | 2.20 | 0.00 | 0.0 | 0.00 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |
| 34.800 | 2.20 | 0.00 | 0.0 | 0.00 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |
| 40.600 | 2.20 | 0.00 | 0.0 | 0.00 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |
| 46.400 | 2.20 | 0.00 | 0.0 | 0.00 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |
| 52.200 | 2.20 | 0.00 | 0.0 | 0.00 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |

**LINE LOADS (k/ft):**

| Load | Dist | DL | LL | Red% | Type | PartL |
|---|---|---|---|---|---|---|
| 1 | 0.000 | 0.000 | 0.000 | --- | NonR | 0.000 |
| | 58.000 | 0.000 | 0.000 | | | 0.000 |
| 2 | 0.000 | 0.118 | 0.000 | --- | NonR | 0.000 |
| | 58.000 | 0.118 | 0.000 | | | 0.000 |

**SHEAR: Max Va (DL+LL) = 36.04 kips Vn/1.67 = 325.06 kips**

**MOMENTS:**

| Span | Cond | LoadCombo | Ma | @ | Lb | Cb | Ω | Mn / Ω |
|---|---|---|---|---|---|---|---|---|
| | | | kip-ft | ft | ft | | | kip-ft |
| Center | Max + | DL+LL | 575.2 | 29.0 | 5.8 | 1.02 | 1.67 | 1035.43 |
| Controlling | | DL+LL | 575.2 | 29.0 | 5.8 | 1.02 | 1.67 | 1035.43 |

**REACTIONS (kips):**

| | **Left** | **Right** |
|---|---|---|
| DL reaction | 13.34 | 13.34 |
| Max +LL reaction | 22.71 | 22.71 |
| Max +total reaction | 36.04 | 36.04 |

**DEFLECTIONS: (Camber = 1/2)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Dead load (in) | at | 29.00 ft | = | -0.736 | L/D | = | 945 |
| Live load (in) | at | 29.00 ft | = | -1.284 | L/D | = | 542 |
| Net Total load (in) | at | 29.00 ft | = | -1.521 | L/D | = | 458 |

# Gravity Beam Design

RAM Structural System
Bentley

RAM Steel 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416 05/07/18 14:02:24
Building Code: IBC Steel Code: AISC 360-10 ASD

**Floor Type: Roof** **Beam Number = 226**

**SPAN INFORMATION (ft): I-End (232.00,251.33) J-End (290.00,251.33)**

Beam Size (User Selected) = W33X118 Fy = 50.0 ksi
Total Beam Length (ft) = 58.00
Mp (kip-ft) = 1729.1
7

**POINT LOADS (kips):**

| Dist | DL | RedLL | Red% | NonRLL | StorLL | Red% | RoofLL | Red% | PartL |
|---|---|---|---|---|---|---|---|---|---|
| 5.800 | 4.57 | 0.00 | 0.0 | 2.19 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |
| 11.600 | 4.57 | 0.00 | 0.0 | 2.19 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |
| 17.400 | 4.57 | 0.00 | 0.0 | 2.19 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |
| 23.200 | 4.57 | 0.00 | 0.0 | 2.19 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |
| 29.000 | 4.57 | 0.00 | 0.0 | 2.19 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |
| 34.800 | 4.57 | 0.00 | 0.0 | 2.19 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |
| 40.600 | 4.57 | 0.00 | 0.0 | 2.19 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |
| 46.400 | 4.57 | 0.00 | 0.0 | 2.19 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |
| 52.200 | 4.57 | 0.00 | 0.0 | 2.19 | 0.00 | 0.0 | 5.05 | Snow | 0.00 |

**LINE LOADS (k/ft):**

| Load | Dist | DL | LL | Red% | Type | PartL |
|---|---|---|---|---|---|---|
| 1 | 0.000 | 0.000 | 0.000 | --- | NonR | 0.000 |
| | 58.000 | 0.000 | 0.000 | | | 0.000 |
| 2 | 0.000 | 0.118 | 0.000 | --- | NonR | 0.000 |
| | 58.000 | 0.118 | 0.000 | | | 0.000 |

**SHEAR: Max Va (DL+LL) = 56.55 kips Vn/1.67 = 325.06 kips**

**MOMENTS:**

| Span | Cond | LoadCombo | Ma | @ | Lb | Cb | Ω | Mn / Ω |
|---|---|---|---|---|---|---|---|---|
| | | | kip-ft | ft | ft | | | kip-ft |
| Center | Max + | DL+LL | 905.6 | 29.0 | 5.8 | 1.02 | 1.67 | 1035.43 |
| Controlling | | DL+LL | 905.6 | 29.0 | 5.8 | 1.02 | 1.67 | 1035.43 |

**REACTIONS (kips):**

| | **Left** | **Right** |
|---|---|---|
| DL reaction | 24.01 | 24.01 |
| Max +LL reaction | 32.55 | 32.55 |
| Max +total reaction | 56.55 | 56.55 |

**DEFLECTIONS: (Camber = 1)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Dead load (in) | at | 29.00 ft | = | -1.340 | L/D | = | 519 |
| Live load (in) | at | 29.00 ft | = | -1.841 | L/D | = | 378 |
| Net Total load (in) | at | 29.00 ft | = | -2.181 | L/D | = | 319 |

# Beam Summary

RAM Structural System
Bentley
RAM Steel 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416 05/07/18 14:02:24
Building Code: IBC Steel Code: AISC 360-10 ASD

**STEEL BEAM DESIGN SUMMARY:**

**Floor Type: Roof**

| Bm # | Length ft | +Ma kip-ft | -Ma kip-ft | Mn/Ω kip-ft | Fy ksi | Beam Size | Studs |
|---|---|---|---|---|---|---|---|
| 1 | 1.33 | 0.0 | 0.0 | 1035.4 | 50.0 | W33X118 u | |
| 2 | 58.00 | 763.0 | 0.0 | 1035.4 | 50.0 | W33X118 | |
| 6 | 58.00 | 678.8 | 0.0 | 1035.4 | 50.0 | W33X118 u | |
| 54 | 58.00 | 760.8 | 0.0 | 1035.4 | 50.0 | W33X118 | |
| 61 | 58.00 | 575.2 | 0.0 | 1035.4 | 50.0 | W33X118 u | |
| 109 | 58.00 | 760.8 | 0.0 | 1035.4 | 50.0 | W33X118 | |
| 116 | 58.00 | 905.6 | 0.0 | 1035.4 | 50.0 | W33X118 u | |
| 164 | 58.00 | 760.8 | 0.0 | 1035.4 | 50.0 | W33X118 | |
| 219 | 58.00 | 760.8 | 0.0 | 1035.4 | 50.0 | W33X118 | |
| 274 | 58.00 | 760.8 | 0.0 | 1035.4 | 50.0 | W33X118 | |
| 281 | 58.00 | 905.6 | 0.0 | 1035.4 | 50.0 | W33X118 u | |
| 329 | 58.00 | 760.8 | 0.0 | 1035.4 | 50.0 | W33X118 | |
| 384 | 58.00 | 760.8 | 0.0 | 1035.4 | 50.0 | W33X118 | |
| 439 | 58.00 | 760.8 | 0.0 | 1035.4 | 50.0 | W33X118 | |
| 446 | 58.00 | 575.2 | 0.0 | 1035.4 | 50.0 | W33X118 u | |
| 494 | 58.00 | 760.8 | 0.0 | 1035.4 | 50.0 | W33X118 | |
| 501 | 58.00 | 575.2 | 0.0 | 1035.4 | 50.0 | W33X118 u | |
| 549 | 58.00 | 763.0 | 0.0 | 1035.4 | 50.0 | W33X118 | |
| 556 | 58.00 | 678.8 | 0.0 | 1035.4 | 50.0 | W33X118 u | |
| 602 | 1.33 | 0.0 | 0.0 | 1035.4 | 50.0 | W33X118 u | |

* after Size denotes beam failed stress/capacity criteria.
# after Size denotes beam failed deflection criteria.
u after Size denotes this size has been assigned by the User.

# Beam Summary



**JOIST SELECTION SUMMARY:**

**Floor Type: Roof**

**Standard Joists:**

| Joist # | Length | WDL | WLL | WTL | Joist | |
|---|---|---|---|---|---|---|
| 7 | 20.67 | 76.4 | 178.0 | 254.4 | 18LH02 | u |
| 8 | 58.00 | 76.4 | 178.0 | 254.4 | 32LH09 | |
| 9 | 58.00 | 76.4 | 178.0 | 254.4 | 32LH09 | |
| 10 | 58.00 | 76.4 | 178.0 | 254.4 | 32LH09 | |
| 12 | 20.67 | 77.1 | 178.0 | 255.1 | 18LH02 | u |
| 13 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 14 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 15 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 17 | 20.67 | 77.1 | 178.0 | 255.1 | 18LH02 | u |
| 18 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 19 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 20 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 22 | 20.67 | 77.1 | 178.0 | 255.1 | 18LH02 | u |
| 23 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 24 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 25 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 27 | 20.67 | 77.1 | 178.0 | 255.1 | 18LH02 | u |
| 28 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 29 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 30 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 31 | 58.42 | 77.1 | 177.0 | 256.7 | 32LH09SP | |
| 32 | 20.67 | 77.1 | 178.0 | 255.1 | 18LH02 | u |
| 33 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 34 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 35 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 36 | 58.42 | 77.1 | 176.7 | 253.8 | 32LH09SP | |
| 37 | 20.67 | 77.1 | 178.0 | 255.1 | 18LH02 | u |
| 38 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 39 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 40 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 41 | 58.42 | 77.1 | 176.7 | 253.8 | 32LH09SP | |
| 42 | 20.67 | 77.1 | 178.0 | 255.1 | 18LH02 | u |
| 43 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 44 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 45 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 46 | 58.42 | 77.1 | 176.7 | 253.8 | 32LH09SP | |
| 47 | 20.67 | 77.1 | 178.0 | 255.1 | 18LH02 | u |
| 48 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 49 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 50 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |

# Beam Summary



| Joist # | Length | WDL | WLL | WTL | Joist | |
|---|---|---|---|---|---|---|
| 51 | 58.42 | 77.1 | 176.7 | 253.8 | 32LH09SP | |
| 52 | 20.67 | 76.3 | 176.0 | 252.3 | 18LH02 | u |
| 53 | 58.00 | 76.3 | 176.0 | 252.3 | 32LH09 | |
| 55 | 58.00 | 76.3 | 176.0 | 252.3 | 32LH09 | |
| 57 | 58.00 | 76.3 | 176.0 | 252.3 | 32LH09 | |
| 59 | 58.42 | 76.3 | 174.7 | 251.0 | 32LH09SP | |
| 62 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 63 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 64 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 65 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 66 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 67 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 68 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 69 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 70 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 71 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 72 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 73 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 74 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 75 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 76 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 77 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 78 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 79 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 80 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 81 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 82 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 83 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 84 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 85 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 86 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 87 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 88 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 89 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 90 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 91 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 92 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 93 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 94 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 95 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 96 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 97 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 98 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 99 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 100 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |

# Beam Summary



| Joist # | Length | WDL | WLL | WTL | Joist | |
|---|---|---|---|---|---|---|
| 101 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 102 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 103 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 104 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 105 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 106 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 107 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 108 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 110 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 112 | 58.00 | 116.0 | 211.7 | 327.7 | 44LH09 | |
| 114 | 58.42 | 116.0 | 210.2 | 326.2 | 44LH09SP | |
| 117 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 118 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 119 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 120 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 121 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 122 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 123 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 124 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 125 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 126 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 127 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 128 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 129 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 130 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 131 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 132 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 133 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 134 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 135 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 136 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 137 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 138 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 139 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 140 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 141 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 142 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 143 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 144 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 145 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 146 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 147 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 148 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 149 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 150 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |

# Beam Summary

RAM Steel 15.08.00.37 | Page 5/15
DataBase: 18054_Kimberly Clark Addition_20180416 | 05/07/18 14:02:24
Building Code: IBC | Steel Code: AISC 360-10 ASD

| Joist # | Length | WDL | WLL | WTL | Joist | |
|---|---|---|---|---|---|---|
| 151 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 152 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 153 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 154 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 155 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 156 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 157 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 158 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 159 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 160 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 161 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 162 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 163 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 165 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 167 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 169 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 172 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 173 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 174 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 175 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 176 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 177 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 178 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 179 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 180 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 181 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 182 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 183 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 184 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 185 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 186 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 187 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 188 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 189 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 190 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 191 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 192 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 193 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 194 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 195 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 196 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 197 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 198 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 199 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 200 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |

# Beam Summary

RAM Steel 15.08.00.37 — Page 6/15
DataBase: 18054_Kimberly Clark Addition_20180416 — 05/07/18 14:02:24
Building Code: IBC — Steel Code: AISC 360-10 ASD

| Joist # | Length | WDL | WLL | WTL | Joist | |
|---|---|---|---|---|---|---|
| 201 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 202 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 203 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 204 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 205 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 206 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 207 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 208 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 209 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 210 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 211 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 212 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 213 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 214 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 215 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 216 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 217 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 218 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 220 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 222 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 224 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 227 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 228 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 229 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 230 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 231 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 232 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 233 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 234 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 235 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 236 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 237 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 238 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 239 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 240 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 241 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 242 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 243 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 244 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 245 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 246 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 247 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 248 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 249 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 250 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |

# Beam Summary

RAM Steel 15.08.00.37 | Page 7/15
DataBase: 18054_Kimberly Clark Addition_20180416 | 05/07/18 14:02:24
Building Code: IBC | Steel Code: AISC 360-10 ASD

| Joist # | Length | WDL | WLL | WTL | Joist | |
|---|---|---|---|---|---|---|
| 251 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 252 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 253 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 254 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 255 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 256 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 257 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 258 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 259 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 260 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 261 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 262 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 263 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 264 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 265 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 266 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 267 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 268 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 269 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 270 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 271 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 272 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 273 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 275 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 277 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 279 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 282 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 283 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 284 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 285 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 286 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 287 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 288 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 289 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 290 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 291 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 292 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 293 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 294 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 295 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 296 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 297 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 298 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 299 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 300 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |

# Beam Summary

RAM Structural System
Bentley

RAM Steel 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416
Building Code: IBC


05/07/18 14:02:24
Steel Code: AISC 360-10 ASD

| Joist # | Length | WDL | WLL | WTL | Joist | |
|---|---|---|---|---|---|---|
| 301 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 302 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 303 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 304 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 305 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 306 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 307 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 308 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 309 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 310 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 311 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 312 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 313 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 314 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 315 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 316 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 317 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 318 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 319 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 320 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 321 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 322 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 323 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 324 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 325 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 326 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 327 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 328 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 330 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 332 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 334 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 337 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 338 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 339 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 340 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 341 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 342 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 343 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 344 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 345 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 346 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 347 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 348 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 349 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 350 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |

# Beam Summary

RAM Steel 15.08.00.37 | Page 9/15
DataBase: 18054_Kimberly Clark Addition_20180416 | 05/07/18 14:02:24
Building Code: IBC | Steel Code: AISC 360-10 ASD

| Joist # | Length | WDL | WLL | WTL | Joist | |
|---|---|---|---|---|---|---|
| 351 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 352 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 353 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 354 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 355 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 356 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 357 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 358 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 359 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 360 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 361 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 362 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 363 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 364 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 365 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 366 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 367 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 368 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 369 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 370 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 371 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 372 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 373 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 374 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 375 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 376 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 377 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 378 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 379 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 380 | 58.00 | 156.6 | 249.4 | 406.0 | 44LH11 | |
| 381 | 58.42 | 156.6 | 247.6 | 404.2 | 44LH11SP | |
| 382 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 383 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 385 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 387 | 58.00 | 116.0 | 211.7 | 327.7 | 44LH09 | |
| 389 | 58.42 | 116.0 | 210.2 | 326.2 | 44LH09SP | |
| 392 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 393 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 394 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 395 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 396 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 397 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 398 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 399 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 400 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |

# Beam Summary



| Joist # | Length | WDL | WLL | WTL | Joist | |
|---|---|---|---|---|---|---|
| 401 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 402 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 403 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 404 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 405 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 406 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 407 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 408 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 409 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 410 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 411 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 412 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 413 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 414 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 415 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 416 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 417 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 418 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 419 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 420 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 421 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 422 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 423 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 424 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 425 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 426 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 427 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 428 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 429 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 430 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 431 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 432 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 433 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 434 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 435 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 436 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 437 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 438 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 440 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 442 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 444 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 447 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 448 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 449 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 450 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |

# Beam Summary

RAM Steel 15.08.00.37 | Page 11/15
DataBase: 18054_Kimberly Clark Addition_20180416 | 05/07/18 14:02:24
Building Code: IBC | Steel Code: AISC 360-10 ASD

| Joist # | Length | WDL | WLL | WTL | Joist | |
|---|---|---|---|---|---|---|
| 451 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 452 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 453 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 454 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 455 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 456 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 457 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 458 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 459 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 460 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 461 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 462 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 463 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 464 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 465 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 466 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 467 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 468 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 469 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 470 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 471 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 472 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 473 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 474 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 475 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 476 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 477 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 478 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 479 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 480 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 481 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 482 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 483 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 484 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 485 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 486 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 487 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 488 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 489 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 490 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 491 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 492 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 493 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 495 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 497 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |

# Beam Summary

RAM Steel 15.08.00.37 Page 12/15
DataBase: 18054_Kimberly Clark Addition_20180416 05/07/18 14:02:24
Building Code: IBC Steel Code: AISC 360-10 ASD

| Joist # | Length | WDL | WLL | WTL | Joist | |
|---|---|---|---|---|---|---|
| 499 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 502 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 503 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 504 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 505 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 506 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 507 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 508 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 509 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 510 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 511 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 512 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 513 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 514 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 515 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 516 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 517 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 518 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 519 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 520 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 521 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 522 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 523 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 524 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 525 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 526 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 527 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 528 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 529 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 530 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 531 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 532 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 533 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 534 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 535 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 536 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 537 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 538 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 539 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 540 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 541 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 542 | 20.67 | 75.4 | 174.0 | 249.4 | 18LH02 | u |
| 543 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 544 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |
| 545 | 58.00 | 75.4 | 174.0 | 249.4 | 32LH09 | |

# Beam Summary

RAM Steel 15.08.00.37 Page 13/15
DataBase: 18054_Kimberly Clark Addition_20180416 05/07/18 14:02:24
Building Code: IBC Steel Code: AISC 360-10 ASD

| Joist # | Length | WDL | WLL | WTL | Joist | |
|---|---|---|---|---|---|---|
| 546 | 58.42 | 75.4 | 172.7 | 248.1 | 32LH09SP | |
| 547 | 20.67 | 76.3 | 176.0 | 252.3 | 18LH02 | u |
| 548 | 58.00 | 76.3 | 176.0 | 252.3 | 32LH09 | |
| 550 | 58.00 | 76.3 | 176.0 | 252.3 | 32LH09 | |
| 552 | 58.00 | 76.3 | 176.0 | 252.3 | 32LH09 | |
| 554 | 58.42 | 76.3 | 174.7 | 251.0 | 32LH09SP | |
| 557 | 20.67 | 77.1 | 178.0 | 255.1 | 18LH02 | u |
| 558 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 559 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 560 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 561 | 58.42 | 77.1 | 176.7 | 253.8 | 32LH09SP | |
| 562 | 20.67 | 77.1 | 178.0 | 255.1 | 18LH02 | u |
| 563 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 564 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 565 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 566 | 58.42 | 77.1 | 176.7 | 253.8 | 32LH09SP | |
| 567 | 20.67 | 77.1 | 178.0 | 255.1 | 18LH02 | u |
| 568 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 569 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 570 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 571 | 58.42 | 77.1 | 176.7 | 253.8 | 32LH09SP | |
| 572 | 20.67 | 77.1 | 178.0 | 255.1 | 18LH02 | u |
| 573 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 574 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 575 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 576 | 58.42 | 77.1 | 176.7 | 253.8 | 32LH09SP | |
| 577 | 20.67 | 77.1 | 178.0 | 255.1 | 18LH02 | u |
| 578 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 579 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 580 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 581 | 58.42 | 77.1 | 177.0 | 256.7 | 32LH09SP | |
| 582 | 20.67 | 77.1 | 178.0 | 255.1 | 18LH02 | u |
| 583 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 584 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 585 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 587 | 20.67 | 77.1 | 178.0 | 255.1 | 18LH02 | u |
| 588 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 589 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 590 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 592 | 20.67 | 77.1 | 178.0 | 255.1 | 18LH02 | u |
| 593 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 594 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 595 | 58.00 | 77.1 | 178.0 | 255.1 | 32LH09 | |
| 597 | 20.67 | 76.4 | 178.0 | 254.4 | 18LH02 | u |
| 598 | 58.00 | 76.4 | 178.0 | 254.4 | 32LH09 | |

# Beam Summary



| Joist # | Length | WDL | WLL | WTL | Joist |
|---|---|---|---|---|---|
| 599 | 58.00 | 76.4 | 178.0 | 254.4 | 32LH09 |
| 600 | 58.00 | 76.4 | 178.0 | 254.4 | 32LH09 |

**Joist Girders:**

| Joist # | Length | #Panels | PDL | PLL | PTL | Joist |
|---|---|---|---|---|---|---|
| 56 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |
| 58 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |
| 60 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |
| 111 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |
| 113 | 58.00 | 10 | 6.7 | 12.3 | 19.0 | XXG10N19.1K |
| 115 | 58.00 | 10 | 9.1 | 14.5 | 23.6 | XXG10N23.6K |
| 166 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |
| 168 | 58.00 | 10 | 6.7 | 12.3 | 19.0 | XXG10N19.1K |
| 170 | 58.00 | 10 | 9.1 | 14.5 | 23.6 | XXG10N23.6K |
| 221 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |
| 223 | 58.00 | 10 | 6.7 | 12.3 | 19.0 | XXG10N19.1K |
| 225 | 58.00 | 10 | 9.1 | 14.5 | 23.6 | XXG10N23.6K |
| 276 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |
| 278 | 58.00 | 10 | 6.7 | 12.3 | 19.0 | XXG10N19.1K |
| 280 | 58.00 | 10 | 9.1 | 14.5 | 23.6 | XXG10N23.6K |
| 331 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |
| 333 | 58.00 | 10 | 6.7 | 12.3 | 19.0 | XXG10N19.1K |
| 335 | 58.00 | 10 | 9.1 | 14.5 | 23.6 | XXG10N23.6K |
| 386 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |
| 388 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |
| 390 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |
| 441 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |
| 443 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |
| 445 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |
| 496 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |
| 498 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |
| 500 | 58.00 | 10 | 4.4 | 10.1 | 14.5 | XXG10N14.5K |

**Special Joists:**

| Joist # | Length | +M | -M | Joist Size |
|---|---|---|---|---|
| 3 | 58.00 | 1052.0 | 0.0 | XXGSP |
| 4 | 58.00 | 1052.0 | 0.0 | XXGSP |
| 5 | 58.00 | 1079.1 | 0.0 | XXGSP |
| 11 | 58.42 | 212.6 | 0.0 | 33GSP |
| 16 | 58.42 | 163.8 | 0.0 | 33GSP |
| 21 | 58.42 | 126.4 | 0.0 | 33GSP |
| 26 | 58.42 | 111.3 | 0.0 | 33GSP |
| 551 | 58.00 | 1052.0 | 0.0 | XXGSP |
| 553 | 58.00 | 1052.0 | 0.0 | XXGSP |

# Beam Summary



| Joist # | Length | +M | -M | Joist Size |
|---|---|---|---|---|
| 555 | 58.00 | 1079.1 | 0.0 | XXGSP |
| 586 | 58.42 | 111.3 | 0.0 | 33GSP |
| 591 | 58.42 | 126.4 | 0.0 | 33GSP |
| 596 | 58.42 | 163.8 | 0.0 | 33GSP |
| 601 | 58.42 | 212.6 | 0.0 | 33GSP |

* after Size denotes joist is inadequate.
u after Size denotes this size has been assigned by the User.

# Steel Beam



Description : Electrical Room Roof Beams

## *CODE REFERENCES*

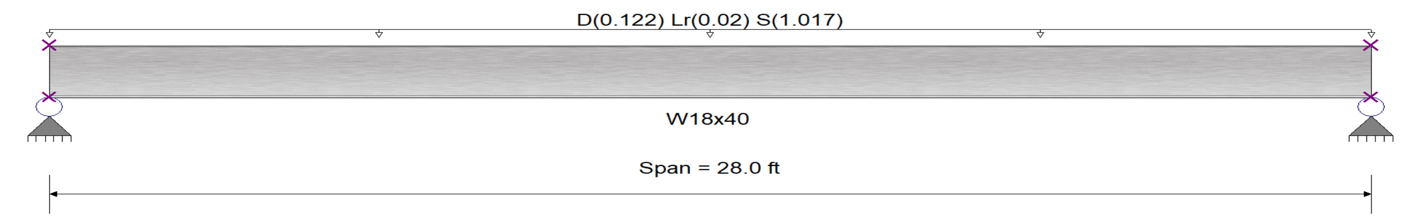
Calculations per AISC 360-10, IBC 2015, ASCE 7-10
Load Combination Set : IBC 2015

## Material Properties

| | | | |
|---|---|---|---|
| Analysis Method : | Allowable Strength Design | Fy : Steel Yield : | 50.0 ksi |
| Beam Bracing : | Beam bracing is defined as a set spacing over all spans | E: Modulus : | 29,000.0 ksi |
| Bending Axis : | Major Axis Bending | | |

## Unbraced Lengths

First Brace starts at  ft from Left-Most support
Regular spacing of lateral supports on length of beam = 4.0 ft




## Applied Loads

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

Beam self weight calculated and added to loading
Uniform Load : D = 0.1220, Lr = 0.020, S = 1.017 k/ft, Tributary Width = 1.0 ft

## *DESIGN SUMMARY*

**Design OK**

| | | | |
|---|---|---|---|
| Maximum Bending Stress Ratio = | **0.591** : 1 | Maximum Shear Stress Ratio = | **0.146** : 1 |
| Section used for this span | **W18x40** | Section used for this span | **W18x40** |
| Ma : Applied | 115.542 k-ft | Va : Applied | 16.506 k |
| Mn / Omega : Allowable | 195.609 k-ft | Vn/Omega : Allowable | 112.770 k |
| Load Combination | +D+S | Load Combination | +D+S |
| Location of maximum on span | 14.000 ft | Location of maximum on span | 0.000 ft |
| Span # where maximum occurs | Span # 1 | Span # where maximum occurs | Span # 1 |

Maximum Deflection

| | | | |
|---|---|---|---|
| Max Downward Transient Deflection | 0.794 in | Ratio = | 422 >=360 |
| Max Upward Transient Deflection | 0.794 in | Ratio = | 422 >=360 |
| Max Downward Total Deflection | 0.923 in | Ratio = | 364 >=180 |
| Max Upward Total Deflection | 0.000 in | Ratio = | 0 <180 |

## Maximum Forces & Stresses for Load Combinations

| Load Combination | | Max Stress Ratios | | Summary of Moment Values | | | | | | | Summary of Shear Values | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Segment Length | Span # | M | V | Mmax + | Mmax - | Ma Max | Mnx | Mnx/Omega | Cb | Rm | Va Max | Vnx | Vnx/Omega |
| D Only | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.040 | 0.020 | 7.78 | | 7.78 | 326.67 | 195.61 | 1.60 | 1.00 | 2.27 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.066 | 0.014 | 12.96 | 7.78 | 12.96 | 326.67 | 195.61 | 1.17 | 1.00 | 1.62 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.080 | 0.009 | 15.55 | 12.96 | 15.55 | 326.67 | 195.61 | 1.06 | 1.00 | 0.97 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.081 | 0.003 | 15.88 | 15.55 | 15.88 | 326.67 | 195.61 | 1.00 | 1.00 | 0.32 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.080 | 0.009 | 15.55 | 12.96 | 15.55 | 326.67 | 195.61 | 1.06 | 1.00 | 0.97 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.066 | 0.014 | 12.96 | 7.78 | 12.96 | 326.67 | 195.61 | 1.16 | 1.00 | 1.62 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.040 | 0.020 | 7.78 | | 7.78 | 326.67 | 195.61 | 1.58 | 1.00 | 2.27 | 169.16 | 112.77 |
| +D+Lr | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.045 | 0.023 | 8.74 | | 8.74 | 326.67 | 195.61 | 1.60 | 1.00 | 2.55 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.074 | 0.016 | 14.56 | 8.74 | 14.56 | 326.67 | 195.61 | 1.17 | 1.00 | 1.82 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.089 | 0.010 | 17.47 | 14.56 | 17.47 | 326.67 | 195.61 | 1.06 | 1.00 | 1.09 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.091 | 0.003 | 17.84 | 17.47 | 17.84 | 326.67 | 195.61 | 1.00 | 1.00 | 0.36 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.089 | 0.010 | 17.47 | 14.56 | 17.47 | 326.67 | 195.61 | 1.06 | 1.00 | 1.09 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.074 | 0.016 | 14.56 | 8.74 | 14.56 | 326.67 | 195.61 | 1.16 | 1.00 | 1.82 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.045 | 0.023 | 8.74 | | 8.74 | 326.67 | 195.61 | 1.58 | 1.00 | 2.55 | 169.16 | 112.77 |
| +D+S | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.289 | 0.146 | 56.59 | | 56.59 | 326.67 | 195.61 | 1.60 | 1.00 | 16.51 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.482 | 0.105 | 94.32 | 56.59 | 94.32 | 326.67 | 195.61 | 1.17 | 1.00 | 11.79 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.579 | 0.063 | 113.18 | 94.32 | 113.18 | 326.67 | 195.61 | 1.06 | 1.00 | 7.07 | 169.16 | 112.77 |

## Steel Beam



Description : Electrical Room Roof Beams

| Load Combination | | Max Stress Ratios | | Summary of Moment Values | | | | | | | Summary of Shear Values | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Segment Length | Span # | M | V | Mmax + | Mmax - | Ma Max | Mnx | Mnx/Omega | Cb | Rm | Va Max | Vnx | Vnx/Omega |
| Dsgn. L = 4.00 ft | 1 | 0.591 | 0.021 | 115.54 | 113.18 | 115.54 | 326.67 | 195.61 | 1.00 | 1.00 | 2.36 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.579 | 0.063 | 113.18 | 94.32 | 113.18 | 326.67 | 195.61 | 1.06 | 1.00 | 7.07 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.482 | 0.105 | 94.32 | 56.59 | 94.32 | 326.67 | 195.61 | 1.16 | 1.00 | 11.79 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.289 | 0.146 | 56.59 | | 56.59 | 326.67 | 195.61 | 1.58 | 1.00 | 16.51 | 169.16 | 112.77 |
| +D+0.750Lr | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.043 | 0.022 | 8.50 | | 8.50 | 326.67 | 195.61 | 1.60 | 1.00 | 2.48 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.072 | 0.016 | 14.16 | 8.50 | 14.16 | 326.67 | 195.61 | 1.17 | 1.00 | 1.77 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.087 | 0.009 | 16.99 | 14.16 | 16.99 | 326.67 | 195.61 | 1.06 | 1.00 | 1.06 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.089 | 0.003 | 17.35 | 16.99 | 17.35 | 326.67 | 195.61 | 1.00 | 1.00 | 0.35 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.087 | 0.009 | 16.99 | 14.16 | 16.99 | 326.67 | 195.61 | 1.06 | 1.00 | 1.06 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.072 | 0.016 | 14.16 | 8.50 | 14.16 | 326.67 | 195.61 | 1.16 | 1.00 | 1.77 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.043 | 0.022 | 8.50 | | 8.50 | 326.67 | 195.61 | 1.58 | 1.00 | 2.48 | 169.16 | 112.77 |
| +D+0.750S | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.227 | 0.115 | 44.39 | | 44.39 | 326.67 | 195.61 | 1.60 | 1.00 | 12.95 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.378 | 0.082 | 73.98 | 44.39 | 73.98 | 326.67 | 195.61 | 1.17 | 1.00 | 9.25 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.454 | 0.049 | 88.78 | 73.98 | 88.78 | 326.67 | 195.61 | 1.06 | 1.00 | 5.55 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.463 | 0.016 | 90.63 | 88.78 | 90.63 | 326.67 | 195.61 | 1.00 | 1.00 | 1.85 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.454 | 0.049 | 88.78 | 73.98 | 88.78 | 326.67 | 195.61 | 1.06 | 1.00 | 5.55 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.378 | 0.082 | 73.98 | 44.39 | 73.98 | 326.67 | 195.61 | 1.16 | 1.00 | 9.25 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.227 | 0.115 | 44.39 | | 44.39 | 326.67 | 195.61 | 1.58 | 1.00 | 12.95 | 169.16 | 112.77 |
| +1.140D | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.045 | 0.023 | 8.86 | | 8.86 | 326.67 | 195.61 | 1.60 | 1.00 | 2.58 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.076 | 0.016 | 14.77 | 8.86 | 14.77 | 326.67 | 195.61 | 1.17 | 1.00 | 1.85 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.091 | 0.010 | 17.72 | 14.77 | 17.72 | 326.67 | 195.61 | 1.06 | 1.00 | 1.11 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.093 | 0.003 | 18.09 | 17.72 | 18.09 | 326.67 | 195.61 | 1.00 | 1.00 | 0.37 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.091 | 0.010 | 17.72 | 14.77 | 17.72 | 326.67 | 195.61 | 1.06 | 1.00 | 1.11 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.076 | 0.016 | 14.77 | 8.86 | 14.77 | 326.67 | 195.61 | 1.16 | 1.00 | 1.85 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.045 | 0.023 | 8.86 | | 8.86 | 326.67 | 195.61 | 1.58 | 1.00 | 2.58 | 169.16 | 112.77 |
| +1.105D+0.750S | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.231 | 0.117 | 45.20 | | 45.20 | 326.67 | 195.61 | 1.60 | 1.00 | 13.18 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.385 | 0.084 | 75.34 | 45.20 | 75.34 | 326.67 | 195.61 | 1.17 | 1.00 | 9.42 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.462 | 0.050 | 90.41 | 75.34 | 90.41 | 326.67 | 195.61 | 1.06 | 1.00 | 5.65 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.472 | 0.017 | 92.29 | 90.41 | 92.29 | 326.67 | 195.61 | 1.00 | 1.00 | 1.88 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.462 | 0.050 | 90.41 | 75.34 | 90.41 | 326.67 | 195.61 | 1.06 | 1.00 | 5.65 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.385 | 0.084 | 75.34 | 45.20 | 75.34 | 326.67 | 195.61 | 1.16 | 1.00 | 9.42 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.231 | 0.117 | 45.20 | | 45.20 | 326.67 | 195.61 | 1.58 | 1.00 | 13.18 | 169.16 | 112.77 |
| +0.60D | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.024 | 0.012 | 4.67 | | 4.67 | 326.67 | 195.61 | 1.60 | 1.00 | 1.36 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.040 | 0.009 | 7.78 | 4.67 | 7.78 | 326.67 | 195.61 | 1.17 | 1.00 | 0.97 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.048 | 0.005 | 9.33 | 7.78 | 9.33 | 326.67 | 195.61 | 1.06 | 1.00 | 0.58 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.049 | 0.002 | 9.53 | 9.33 | 9.53 | 326.67 | 195.61 | 1.00 | 1.00 | 0.19 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.048 | 0.005 | 9.33 | 7.78 | 9.33 | 326.67 | 195.61 | 1.06 | 1.00 | 0.58 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.040 | 0.009 | 7.78 | 4.67 | 7.78 | 326.67 | 195.61 | 1.16 | 1.00 | 0.97 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.024 | 0.012 | 4.67 | | 4.67 | 326.67 | 195.61 | 1.58 | 1.00 | 1.36 | 169.16 | 112.77 |
| +0.4603D | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.018 | 0.009 | 3.58 | | 3.58 | 326.67 | 195.61 | 1.60 | 1.00 | 1.04 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.030 | 0.007 | 5.97 | 3.58 | 5.97 | 326.67 | 195.61 | 1.17 | 1.00 | 0.75 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.037 | 0.004 | 7.16 | 5.97 | 7.16 | 326.67 | 195.61 | 1.06 | 1.00 | 0.45 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.037 | 0.001 | 7.31 | 7.16 | 7.31 | 326.67 | 195.61 | 1.00 | 1.00 | 0.15 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.037 | 0.004 | 7.16 | 5.97 | 7.16 | 326.67 | 195.61 | 1.06 | 1.00 | 0.45 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.030 | 0.007 | 5.97 | 3.58 | 5.97 | 326.67 | 195.61 | 1.16 | 1.00 | 0.75 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.018 | 0.009 | 3.58 | | 3.58 | 326.67 | 195.61 | 1.58 | 1.00 | 1.04 | 169.16 | 112.77 |

### Vertical Reactions

Support notation : Far left is #1 Values in KIPS

| Load Combination | Support 1 | Support 2 |
|---|---|---|
| Overall MAXimum | 16.506 | 16.506 |
| Overall MINimum | 0.280 | 0.280 |
| D Only | 2.268 | 2.268 |
| +D+Lr | 2.548 | 2.548 |
| +D+S | 16.506 | 16.506 |
| +D+0.750Lr | 2.478 | 2.478 |
| +D+0.750S | 12.947 | 12.947 |
| +0.60D | 1.361 | 1.361 |
| Lr Only | 0.280 | 0.280 |
| S Only | 14.238 | 14.238 |

## Steel Beam

Projects 2018\18054 - Kimberly Clark 20000SF Addition\Engineering\Calculations\Other\18054_Kimberly Clark.ec6
ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

**Lic. # : KW-06002489** **Licensee : ARW ENGINEERS**

Description : Electrical Room Roof Beams

### *CODE REFERENCES*

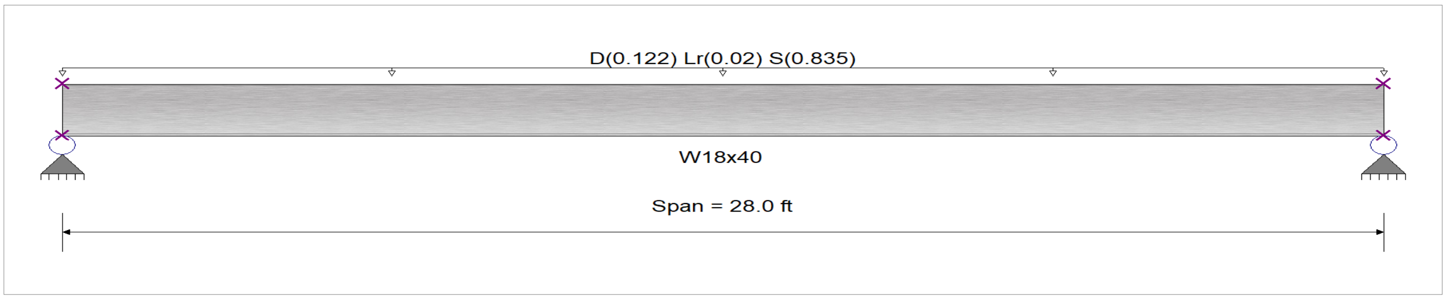
Calculations per AISC 360-10, IBC 2015, ASCE 7-10
Load Combination Set : IBC 2015

### Material Properties

| | | | |
|---|---|---|---|
| Analysis Method : | Allowable Strength Design | Fy : Steel Yield : | 50.0 ksi |
| Beam Bracing : | Beam bracing is defined as a set spacing over all spans | E: Modulus : | 29,000.0 ksi |
| Bending Axis : | Major Axis Bending | | |

### Unbraced Lengths

First Brace starts at 0.0 ft from Left-Most support
Regular spacing of lateral supports on length of beam = 4.0 ft




### Applied Loads

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

Beam self weight calculated and added to loading
Uniform Load : D = 0.1220, Lr = 0.020, S = 0.8350 k/ft, Tributary Width = 1.0 ft

### *DESIGN SUMMARY*

**Design OK**

| | | | |
|---|---|---|---|
| Maximum Bending Stress Ratio = | **0.499** : 1 | Maximum Shear Stress Ratio = | **0.124** : 1 |
| Section used for this span | **W18x40** | Section used for this span | **W18x40** |
| Ma : Applied | 97.706 k-ft | Va : Applied | 13.958 k |
| Mn / Omega : Allowable | 195.609 k-ft | Vn/Omega : Allowable | 112.770 k |
| Load Combination | +D+S | Load Combination | +D+S |
| Location of maximum on span | 14.000 ft | Location of maximum on span | 0.000 ft |
| Span # where maximum occurs | Span # 1 | Span # where maximum occurs | Span # 1 |

**Maximum Deflection**

| | | | |
|---|---|---|---|
| Max Downward Transient Deflection | 0.653 in | Ratio = | 514 >=360 |
| Max Upward Transient Deflection | 0.653 in | Ratio = | 514 >=360 |
| Max Downward Total Deflection | 0.780 in | Ratio = | 431 >=180 |
| Max Upward Total Deflection | 0.000 in | Ratio = | 0 <180 |

### Maximum Forces & Stresses for Load Combinations

| Load Combination | | Max Stress Ratios | | Summary of Moment Values | | | | | | | Summary of Shear Values | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Segment Length | Span # | M | V | Mmax + | Mmax - | Ma Max | Mnx | Mnx/Omega | Cb | Rm | Va Max | Vnx | Vnx/Omega |
| D Only | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.040 | 0.020 | 7.78 | | 7.78 | 326.67 | 195.61 | 1.60 | 1.00 | 2.27 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.066 | 0.014 | 12.96 | 7.78 | 12.96 | 326.67 | 195.61 | 1.17 | 1.00 | 1.62 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.080 | 0.009 | 15.55 | 12.96 | 15.55 | 326.67 | 195.61 | 1.06 | 1.00 | 0.97 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.081 | 0.003 | 15.88 | 15.55 | 15.88 | 326.67 | 195.61 | 1.00 | 1.00 | 0.32 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.080 | 0.009 | 15.55 | 12.96 | 15.55 | 326.67 | 195.61 | 1.06 | 1.00 | 0.97 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.066 | 0.014 | 12.96 | 7.78 | 12.96 | 326.67 | 195.61 | 1.16 | 1.00 | 1.62 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.040 | 0.020 | 7.78 | | 7.78 | 326.67 | 195.61 | 1.58 | 1.00 | 2.27 | 169.16 | 112.77 |
| +D+Lr | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.045 | 0.023 | 8.74 | | 8.74 | 326.67 | 195.61 | 1.60 | 1.00 | 2.55 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.074 | 0.016 | 14.56 | 8.74 | 14.56 | 326.67 | 195.61 | 1.17 | 1.00 | 1.82 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.089 | 0.010 | 17.47 | 14.56 | 17.47 | 326.67 | 195.61 | 1.06 | 1.00 | 1.09 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.091 | 0.003 | 17.84 | 17.47 | 17.84 | 326.67 | 195.61 | 1.00 | 1.00 | 0.36 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.089 | 0.010 | 17.47 | 14.56 | 17.47 | 326.67 | 195.61 | 1.06 | 1.00 | 1.09 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.074 | 0.016 | 14.56 | 8.74 | 14.56 | 326.67 | 195.61 | 1.16 | 1.00 | 1.82 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.045 | 0.023 | 8.74 | | 8.74 | 326.67 | 195.61 | 1.58 | 1.00 | 2.55 | 169.16 | 112.77 |
| +D+S | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.245 | 0.124 | 47.86 | | 47.86 | 326.67 | 195.61 | 1.60 | 1.00 | 13.96 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.408 | 0.088 | 79.76 | 47.86 | 79.76 | 326.67 | 195.61 | 1.17 | 1.00 | 9.97 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.489 | 0.053 | 95.71 | 79.76 | 95.71 | 326.67 | 195.61 | 1.06 | 1.00 | 5.98 | 169.16 | 112.77 |

## Steel Beam



Description : Electrical Room Roof Beams

| Load Combination | | Max Stress Ratios | | Summary of Moment Values | | | | | | | Summary of Shear Values | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Segment Length | Span # | M | V | Mmax + | Mmax - | Ma Max | Mnx | Mnx/Omega | Cb | Rm | Va Max | Vnx | Vnx/Omega |
| Dsgn. L = 4.00 ft | 1 | 0.499 | 0.018 | 97.71 | 95.71 | 97.71 | 326.67 | 195.61 | 1.00 | 1.00 | 1.99 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.489 | 0.053 | 95.71 | 79.76 | 95.71 | 326.67 | 195.61 | 1.06 | 1.00 | 5.98 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.408 | 0.088 | 79.76 | 47.86 | 79.76 | 326.67 | 195.61 | 1.16 | 1.00 | 9.97 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.245 | 0.124 | 47.86 | | 47.86 | 326.67 | 195.61 | 1.58 | 1.00 | 13.96 | 169.16 | 112.77 |
| +D+0.750Lr | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.043 | 0.022 | 8.50 | | 8.50 | 326.67 | 195.61 | 1.60 | 1.00 | 2.48 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.072 | 0.016 | 14.16 | 8.50 | 14.16 | 326.67 | 195.61 | 1.17 | 1.00 | 1.77 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.087 | 0.009 | 16.99 | 14.16 | 16.99 | 326.67 | 195.61 | 1.06 | 1.00 | 1.06 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.089 | 0.003 | 17.35 | 16.99 | 17.35 | 326.67 | 195.61 | 1.00 | 1.00 | 0.35 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.087 | 0.009 | 16.99 | 14.16 | 16.99 | 326.67 | 195.61 | 1.06 | 1.00 | 1.06 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.072 | 0.016 | 14.16 | 8.50 | 14.16 | 326.67 | 195.61 | 1.16 | 1.00 | 1.77 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.043 | 0.022 | 8.50 | | 8.50 | 326.67 | 195.61 | 1.58 | 1.00 | 2.48 | 169.16 | 112.77 |
| +D+0.750S | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.193 | 0.098 | 37.84 | | 37.84 | 326.67 | 195.61 | 1.60 | 1.00 | 11.04 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.322 | 0.070 | 63.06 | 37.84 | 63.06 | 326.67 | 195.61 | 1.17 | 1.00 | 7.88 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.387 | 0.042 | 75.67 | 63.06 | 75.67 | 326.67 | 195.61 | 1.06 | 1.00 | 4.73 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.395 | 0.014 | 77.25 | 75.67 | 77.25 | 326.67 | 195.61 | 1.00 | 1.00 | 1.58 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.387 | 0.042 | 75.67 | 63.06 | 75.67 | 326.67 | 195.61 | 1.06 | 1.00 | 4.73 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.322 | 0.070 | 63.06 | 37.84 | 63.06 | 326.67 | 195.61 | 1.16 | 1.00 | 7.88 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.193 | 0.098 | 37.84 | | 37.84 | 326.67 | 195.61 | 1.58 | 1.00 | 11.04 | 169.16 | 112.77 |
| +1.140D | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.045 | 0.023 | 8.86 | | 8.86 | 326.67 | 195.61 | 1.60 | 1.00 | 2.58 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.076 | 0.016 | 14.77 | 8.86 | 14.77 | 326.67 | 195.61 | 1.17 | 1.00 | 1.85 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.091 | 0.010 | 17.72 | 14.77 | 17.72 | 326.67 | 195.61 | 1.06 | 1.00 | 1.11 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.093 | 0.003 | 18.09 | 17.72 | 18.09 | 326.67 | 195.61 | 1.00 | 1.00 | 0.37 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.091 | 0.010 | 17.72 | 14.77 | 17.72 | 326.67 | 195.61 | 1.06 | 1.00 | 1.11 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.076 | 0.016 | 14.77 | 8.86 | 14.77 | 326.67 | 195.61 | 1.16 | 1.00 | 1.85 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.045 | 0.023 | 8.86 | | 8.86 | 326.67 | 195.61 | 1.58 | 1.00 | 2.58 | 169.16 | 112.77 |
| +1.105D+0.750S | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.198 | 0.100 | 38.65 | | 38.65 | 326.67 | 195.61 | 1.60 | 1.00 | 11.27 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.329 | 0.071 | 64.42 | 38.65 | 64.42 | 326.67 | 195.61 | 1.17 | 1.00 | 8.05 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.395 | 0.043 | 77.30 | 64.42 | 77.30 | 326.67 | 195.61 | 1.06 | 1.00 | 4.83 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.403 | 0.014 | 78.91 | 77.30 | 78.91 | 326.67 | 195.61 | 1.00 | 1.00 | 1.61 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.395 | 0.043 | 77.30 | 64.42 | 77.30 | 326.67 | 195.61 | 1.06 | 1.00 | 4.83 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.329 | 0.071 | 64.42 | 38.65 | 64.42 | 326.67 | 195.61 | 1.16 | 1.00 | 8.05 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.198 | 0.100 | 38.65 | | 38.65 | 326.67 | 195.61 | 1.58 | 1.00 | 11.27 | 169.16 | 112.77 |
| +0.60D | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.024 | 0.012 | 4.67 | | 4.67 | 326.67 | 195.61 | 1.60 | 1.00 | 1.36 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.040 | 0.009 | 7.78 | 4.67 | 7.78 | 326.67 | 195.61 | 1.17 | 1.00 | 0.97 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.048 | 0.005 | 9.33 | 7.78 | 9.33 | 326.67 | 195.61 | 1.06 | 1.00 | 0.58 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.049 | 0.002 | 9.53 | 9.33 | 9.53 | 326.67 | 195.61 | 1.00 | 1.00 | 0.19 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.048 | 0.005 | 9.33 | 7.78 | 9.33 | 326.67 | 195.61 | 1.06 | 1.00 | 0.58 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.040 | 0.009 | 7.78 | 4.67 | 7.78 | 326.67 | 195.61 | 1.16 | 1.00 | 0.97 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.024 | 0.012 | 4.67 | | 4.67 | 326.67 | 195.61 | 1.58 | 1.00 | 1.36 | 169.16 | 112.77 |
| +0.4603D | | | | | | | | | | | | | |
| Dsgn. L = 4.00 ft | 1 | 0.018 | 0.009 | 3.58 | | 3.58 | 326.67 | 195.61 | 1.60 | 1.00 | 1.04 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.030 | 0.007 | 5.97 | 3.58 | 5.97 | 326.67 | 195.61 | 1.17 | 1.00 | 0.75 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.037 | 0.004 | 7.16 | 5.97 | 7.16 | 326.67 | 195.61 | 1.06 | 1.00 | 0.45 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.037 | 0.001 | 7.31 | 7.16 | 7.31 | 326.67 | 195.61 | 1.00 | 1.00 | 0.15 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.037 | 0.004 | 7.16 | 5.97 | 7.16 | 326.67 | 195.61 | 1.06 | 1.00 | 0.45 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.030 | 0.007 | 5.97 | 3.58 | 5.97 | 326.67 | 195.61 | 1.16 | 1.00 | 0.75 | 169.16 | 112.77 |
| Dsgn. L = 4.00 ft | 1 | 0.018 | 0.009 | 3.58 | | 3.58 | 326.67 | 195.61 | 1.58 | 1.00 | 1.04 | 169.16 | 112.77 |

### Vertical Reactions

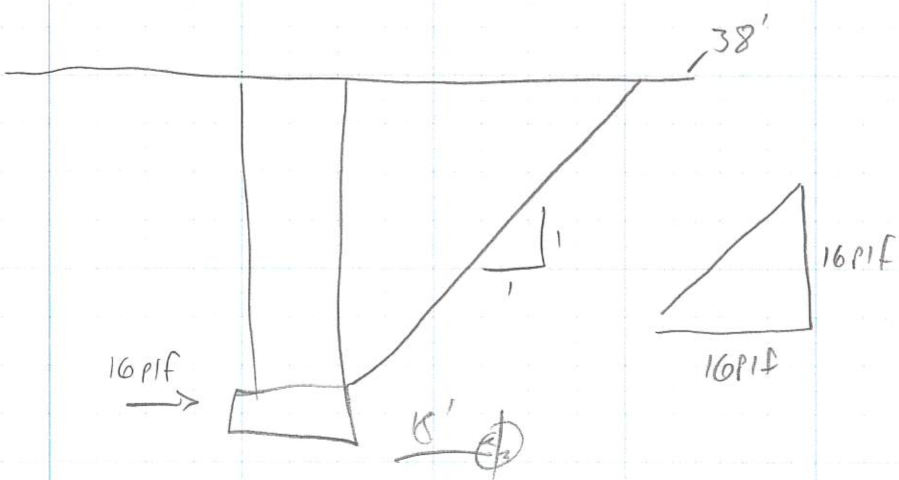
Support notation : Far left is #1 Values in KIPS

| Load Combination | Support 1 | Support 2 |
|---|---|---|
| Overall MAXimum | 13.958 | 13.958 |
| Overall MINimum | 0.280 | 0.280 |
| D Only | 2.268 | 2.268 |
| +D+Lr | 2.548 | 2.548 |
| +D+S | 13.958 | 13.958 |
| +D+0.750Lr | 2.478 | 2.478 |
| +D+0.750S | 11.036 | 11.036 |
| +0.60D | 1.361 | 1.361 |
| Lr Only | 0.280 | 0.280 |
| S Only | 11.690 | 11.690 |

Conveyor vertical Seismic loads

$a_p = 1 \quad R_p = 2.5 \quad \Omega = 2.5$

$$F_P = \frac{0.4(1)(0.998)(600\#)}{\frac{2.5}{1.0}}\left(1+2\frac{18}{38}\right) = 187\# \text{ @ } 12' \text{ o.c.} = 16 \text{ plf (ult)}$$




Joists to be designed for 16 plf ↕ (ult)

Conveyor loads

Dead

600# @ 11'7" o.c. = 52 plf

width = 4' : 13 psf Dead

Live load = 25 plf/4' = 6.25 psf

## FM Global Wind Uplift

Wind Speed = 90 MPH Exp. = C Mean roof HT = 38'

From table 10

Zone 4 Outward Pressure = 24.33 psf
Zone 5 Outward Pressure = 24.33(1.22) = 29.7 psf

From table 14

Zone 4 inward pressure : 19.33 psf (ext) / 4 psf (int)
= 19.33(1.0) + 4(1.0) = 23.33 psf

Roof zone 1 (table 4) = 24.1 psf

table 6

Zone 1 - 24.1 psf (1.0) = 24.1 psf
Zone 2 - 24.1 psf (1.68) = 40.5 psf
Zone 3 - 24.1 psf (2.53) = 61.0 psf

| ARW Engineers<br>1954 W. Park Circle<br>Ogden, Utah 84404<br>(801) 782-6008 | Project<br>Kimberly Clark Addition | | | | Job Ref.<br>18054 | |
|---|---|---|---|---|---|---|
| | Section<br>Snow Drift | | | | Sheet no./rev.<br>1 | |
| | Calc. by<br>SJV | Date<br>5/7/2018 | Chk'd by | Date | App'd by | Date |

**SNOW LOADING (ASCE7-10)**

Tedds calculation version 1.0.06

**Building details**

| | |
|---|---|
| Roof type | Flat |
| Width of roof | b = **640.00** ft |

**Ground snow load**

| | |
|---|---|
| Ground snow load | $p_g$ = **43.00** lb/ft$^2$ |
| Density of snow | $\gamma = \min(0.13 \times p_g / 1\text{ft} + 14\text{lb/ft}^3, 30\text{lb/ft}^3)$ = **19.59** lb/ft$^3$ |
| Terrain type | C |
| Exposure condition (Table 7-2) | Partially exposed |
| Exposure factor (Table 7-2) | $C_e$ = **1.00** |
| Thermal condition (Table 7-3) | All |
| Thermal factor (Table 7-3) | $C_t$ = **1.00** |
| Importance category (Table 1-1) | II |
| Importance factor (Table 7-4) | $I_s$ = **1.00** |
| Min snow load for low slope roofs (Sect 7.3.4) | $p_{f\_min} = I_s \times 20$ lb/ft$^2$ = **20.00** lb/ft$^2$ |
| Flat roof snow load (Sect 7.3) | $p_f = 0.7 \times C_e \times C_t \times I_s \times p_g$ = **30.10** lb/ft$^2$ |

**Left parapet**

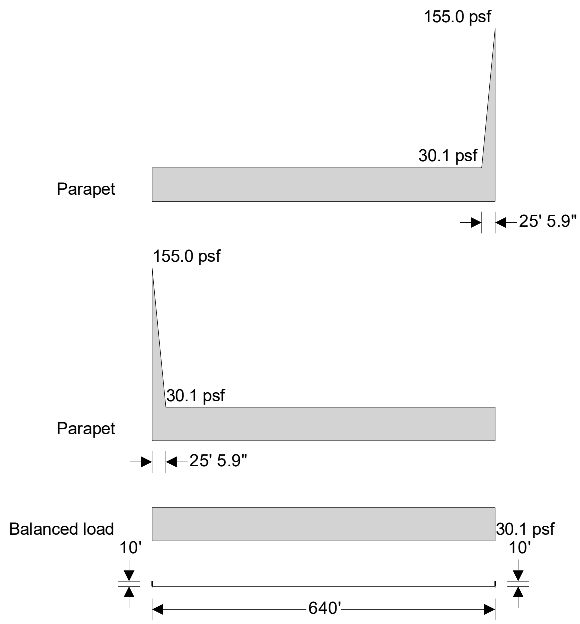
| | |
|---|---|
| Balanced snow load height | $h_b = p_f / \gamma$ = **1.54** ft |
| Height of left parapet | $h_{pptL}$ = **10.00** ft |
| Height from balance load to top of left parapet | $h_{c\_pptL} = h_{pptL} - h_b$ = **8.46** ft |
| Length of roof - left parapet | $l_{u\_pptL} = b$ = **640.00** ft |
| Drift height windward drift - left parpet | $h_{d\_l\_pptL} = 0.75 \times (0.43 \times (\max(20\text{ ft}, l_{u\_pptL}) \times 1\text{ft}^2)^{1/3} \times (p_g / 1\text{lb/ft}^2 + 10)^{1/4} - 1.5\text{ft})$ = **6.37** ft |
| Drift height - left parapet | $h_{d\_pptL} = \min(h_{d\_l\_pptL}, h_{pptL} - h_b)$ = **6.37** ft |
| Drift width | $W_{d\_pptL} = \min(4 \times h_{d\_pptL}, 8 \times (h_{pptL} - h_b))$ = **25.50** ft |
| Drift surcharge load - left parapet | $p_{d\_pptL} = h_{d\_pptL} \times \gamma$ = **124.86** lb/ft$^2$ |

**Right parapet**

| | |
|---|---|
| Height of right parapet | $h_{pptR}$ = **10.00** ft |
| Height from balance load to top of right parapet | $h_{c\_pptR} = h_{pptR} - h_b$ = **8.46** ft |
| Length of roof - right parapet | $l_{u\_pptR} = b$ = **640.00** ft |
| Drift height windward drift - right parpet | $h_{d\_l\_pptR} = 0.75 \times (0.43 \times (\max(20\text{ ft}, l_{u\_pptR}) \times 1\text{ft}^2)^{1/3} \times (p_g / 1\text{lb/ft}^2 + 10)^{1/4} - 1.5\text{ft})$ = **6.37** ft |
| Drift height - right parapet | $h_{d\_pptR} = \min(h_{d\_l\_pptR}, h_{pptR} - h_b)$ = **6.37** ft |
| Drift width | $W_{d\_pptR} = \min(4 \times h_{d\_pptR}, 8 \times (h_{pptR} - h_b))$ = **25.50** ft |
| Drift surcharge load - right parapet | $p_{d\_pptR} = h_{d\_pptR} \times \gamma$ = **124.86** lb/ft$^2$ |

ARW Engineers
1954 W. Park Circle
Ogden, Utah 84404
(801) 782-6008

| Project | | | | Job Ref. | |
|---|---|---|---|---|---|
| Kimberly Clark Addition | | | | 18054 | |
| Section | | | | Sheet no./rev. | |
| Snow Drift | | | | 2 | |
| Calc. by | Date | Chk'd by | Date | App'd by | Date |
| SJV | 5/7/2018 | | | | |




Roof elevation

7-May-18
3:43 PM

## ASCE 7-10 SNOW DRIFT ANALYSIS

Version Date: March 6, 2017

JOB TITLE: Kimberly Clark Addition
DRIFT LOCATION: Electrical Room
JOB #: 18054

*User Note: To analyze multiple drift locations, do not copy tabs within this file. The cell references will be incorrect. Instead create a new file for each drift location.*

### DATA USED IN ANALYSIS

| | | | |
|---|---|---|---|
| Ground Snow Load | $P_g$ : | 43 | psf |
| Exposure Factor | $C_e$ : | 1.0 | |
| Thermal Factor | $C_t$ : | 1.0 | |
| Importance Factor | $I_s$ : | 1.0 | |

| | | | |
|---|---|---|---|
| Horizontal Dimension of High Roof | $L_u$ : | 640 | ft |
| Horizontal Dimension of Low Roof | $L_l$ : | 24 | ft |
| Vertical Distance Between Upper and Lower Roof | $h_r$ : | 24 | ft |

Type of Roof Step : Normal

| | | |
|---|---|---|
| Roof Dead Load | 20 | psf |
| Joist Span | 28 | ft |
| Distance from $P_m$ to $P_z$ | 0 | ft |

Distances between joists

| | | | | | |
|---|---|---|---|---|---|
| $P_z$ to JS1 | 6.1 | ft | JS4 to JS5 | 0 | ft |
| JS1 to JS2 | 6.1 | ft | JS5 to JS6 | 0 | ft |
| JS2 to JS3 | 6.1 | ft | JS6 to JS7 | 0 | ft |
| JS3 to JS4 | 6.1 | ft | JS7 to JS8 | 0 | ft |

### RESULTS OF ANALYSIS

| | | | |
|---|---|---|---|
| Roof Snow Load | $P_f$ : | 30.1 | psf |
| Depth of Uniform Load | $h_b$ : | 1.54 | ft |
| Density of Snow | D : | 19.59 | pcf |
| | $h_c = (h_r - h_b)$ : | 22.46 | ft |
| | $h_c/h_b$ : | 14.62 | **> 0.2 Drifting Needs to be Considered** |

Height of Snow Drift

| | | | | |
|---|---|---|---|---|
| $h_d$ : | 8.50 | ft | Leeward | **Controls Width Drift Calc** |
| $h_d$ : | 1.38 | ft | Windward | |

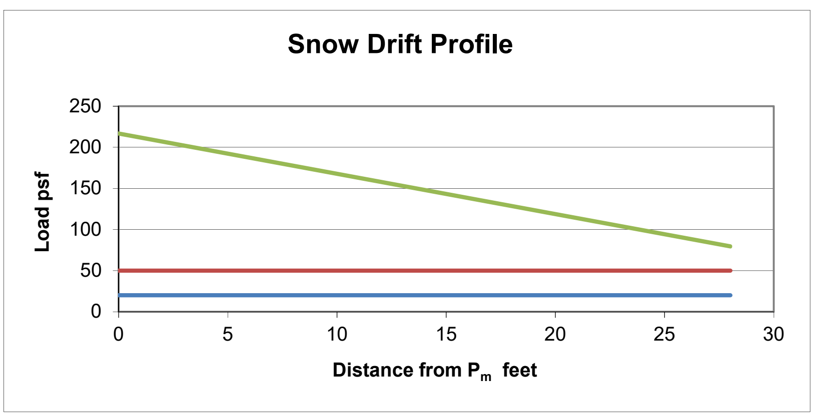
| | | | |
|---|---|---|---|
| Width of Snow Drift | w : | **34.0** | ft |
| Height of Snow Drift | $h_d$ : | **8.50** | ft |
| | $P_d$ : | **166.5** | psf |

**Equation used (4hd)**

| | | | |
|---|---|---|---|
| Intensity of Drift at | $P_z$ : | **166.5** | psf |
| Intensity of Drift at | $P_e$ : | **29.4** | psf |

### DRIFT CAUSING UNIFORM LOAD ON JOISTS

| Joist Name | Distance from $P_m$ feet | $\omega_{DL}$ plf | $\omega_{SL}$ plf | $\omega_{DRIFT}$ plf | Joist DL Reaction kips | Joist SL+DRIFT Reaction kips | Joist TOTAL Reaction kips | Joist Maximum Moment k-ft | Total Joist Load kips | Equivalent Uniform Load, plf | DL Uniform | LL Uniform |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wall | 0 | 61 | 92 | 485 | 0.85 | 8.08 | 8.93 | 62.50 | 18 | 638 | 61 | 577 |
| JS1 | 6.1 | 122 | 184 | 833 | 1.71 | 14.24 | 15.94 | 111.61 | 32 | 1139 | 122 | 1017 |
| JS2 | 12.2 | 122 | 184 | 651 | 1.71 | 11.69 | 13.39 | 93.76 | 27 | 957 | 122 | 835 |
| JS3 | 18.3 | 122 | 184 | 469 | 1.71 | 9.13 | 10.84 | 75.90 | 22 | 775 | 122 | 652 |
| JS4 | 24.4 | 61 | 92 | 166 | 0.85 | 3.61 | 4.46 | 31.25 | 9 | 319 | 61 | 258 |
| JS5 | 24.4 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| JS6 | 24.4 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| JS7 | 24.4 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |




**Definitions**

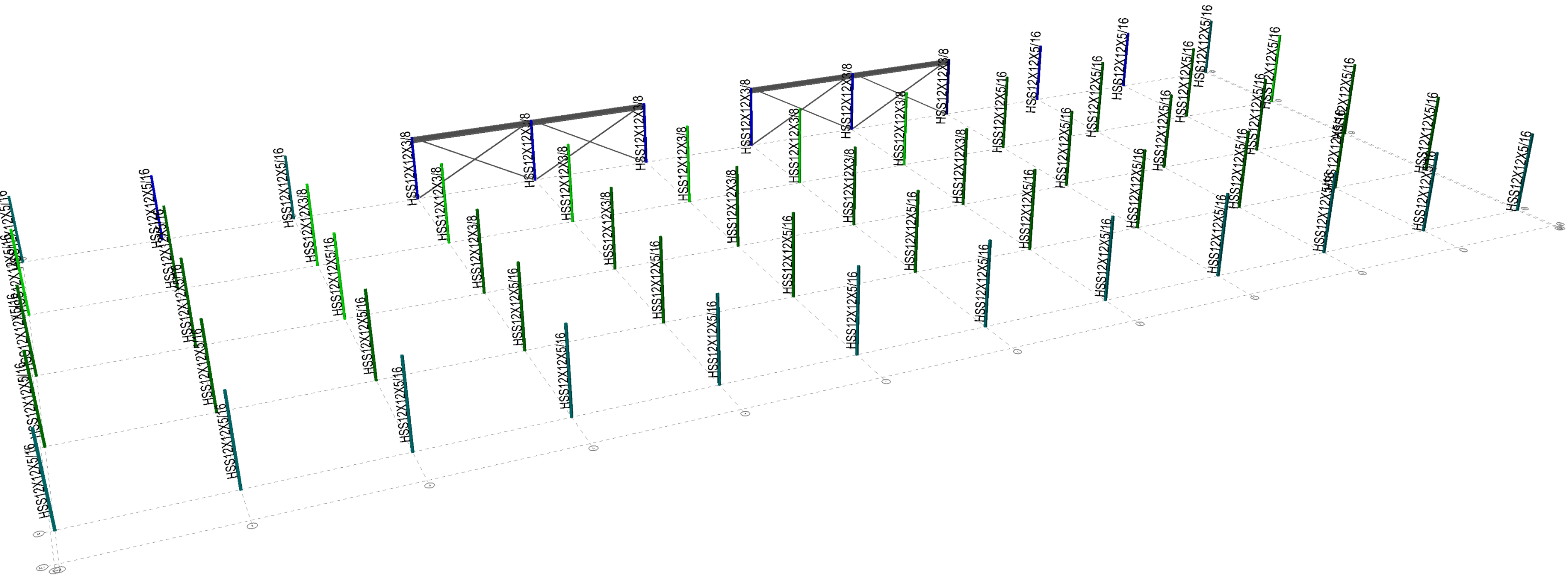
$P_m$ : Maximum Magnitude of Snow Drift
$P_z$ : Maximum Magnitude of Snow Drift at 0 feet away from Pm
$P_e$ : Magnitude of Drift at End of Joist

**Equation of Snow Drift Line**

y = -4.8975 * X + 166.483764384354

Distance X is in feet from $P_m$

# Columns


HSS12X12X5/16
HSS12X12X3/8

# Gravity Column Design Summary

RAM Steel 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416 05/07/18 14:09:46
Building Code: IBC Steel Code: AISC 360-10 ASD

**Column Line 2-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 51.0 | 35.1 | 0.0 | 1 | 0.73 Eq (H1-1a) | 0.0 | 46 | HSS12X12X1/4 |

**Column Line 2-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 69.8 | 48.2 | 0.0 | 1 | 0.74 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |

**Column Line 2-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 69.8 | 48.2 | 0.0 | 1 | 0.74 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |

**Column Line 2-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 75.6 | 52.4 | 0.0 | 1 | 0.80 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |

**Column Line 2-H.1**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 57.2 | 39.4 | 0.0 | 1 | 0.55 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |

**Column Line 3-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.8 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |

**Column Line 3-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 96.0 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 3-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 96.0 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 3-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 97.0 | 3.6 | -32.8 | 17 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 3-H.1**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 61.5 | -18.5 | 5.2 | 12 | 0.45 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |

**Column Line 4-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.7 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |

**Column Line 4-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 4-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 153.1 | 6.4 | 10.9 | 8 | 0.90 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 4-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 161.7 | 0.0 | 32.3 | 1 | 0.85 Eq (H1-1a) | 90.0 | 50 | HSS12X12X3/8 |

**Column Line 4-H.1**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 71.2 | 24.9 | 5.7 | 8 | 0.54 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |

**Column Line 5-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.7 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |

**Column Line 5-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 5-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 124.5 | 1.9 | 36.8 | 6 | 0.91 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 5-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 152.9 | 0.0 | 41.3 | 6 | 0.87 Eq (H1-1a) | 90.0 | 50 | HSS12X12X3/8 |

**Column Line 6-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.7 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |

**Column Line 6-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

# Gravity Column Design Summary



**Column Line 6-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 124.5 | 1.9 | 36.8 | 6 | 0.91 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 6-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 152.9 | 0.0 | 41.3 | 6 | 0.87 Eq (H1-1a) | 90.0 | 50 | HSS12X12X3/8 |

**Column Line 7-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.7 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |

**Column Line 7-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 7-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 124.5 | 1.9 | 36.8 | 6 | 0.91 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 7-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 152.9 | 0.0 | 41.3 | 6 | 0.87 Eq (H1-1a) | 90.0 | 50 | HSS12X12X3/8 |

**Column Line 8-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.7 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |

**Column Line 8-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 8-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 124.5 | 1.9 | 36.8 | 6 | 0.91 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 8-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 152.9 | 0.0 | 41.3 | 6 | 0.87 Eq (H1-1a) | 90.0 | 50 | HSS12X12X3/8 |

**Column Line 9-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|

# Gravity Column Design Summary



| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.7 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |

**Column Line 9-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 9-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 153.1 | 6.4 | -10.9 | 8 | 0.90 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 9-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 161.7 | 0.0 | -32.3 | 1 | 0.85 Eq (H1-1a) | 90.0 | 50 | HSS12X12X3/8 |

**Column Line 10-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.7 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |

**Column Line 10-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 10-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 10-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 96.1 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 11-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.7 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |

**Column Line 11-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 11-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

# Gravity Column Design Summary



**Column Line 11-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 96.1 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 11-H.1**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 58.0 | 16.1 | 5.1 | 8 | 0.41 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |

**Column Line 12-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.8 | 4.6 | -21.8 | 17 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |

**Column Line 12-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 96.0 | -3.6 | -32.2 | 16 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 12-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 96.0 | -3.6 | -32.2 | 16 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 12-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 97.0 | 3.6 | 32.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

**Column Line 12-H.1**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 61.5 | 18.5 | 5.2 | 8 | 0.45 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |

**Column Line 13-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 51.0 | -35.1 | 0.0 | 1 | 0.73 Eq (H1-1a) | 0.0 | 46 | HSS12X12X1/4 |

**Column Line 13-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 69.8 | -48.2 | 0.0 | 1 | 0.74 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |

**Column Line 13-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 69.8 | -48.2 | 0.0 | 1 | 0.74 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |

**Column Line 13-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Roof | 75.6 | -52.4 | 0.0 | 1 | 0.80 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |

**Column Line 13-H.1**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 57.2 | -39.4 | 0.0 | 1 | 0.55 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |

# Gravity Column Design

RAM Steel 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416 05/07/18 14:19:00
Building Code: IBC Steel Code: AISC 360-10 ASD

**Story level Roof, Column Line 6-J, Column # 24**

| | | | |
|---|---|---|---|
| Fy (ksi) | = 50.00 | Column Size | = HSS12X12X3/8 |
| Orientation (deg.) | = 90.0 | | |

**INPUT DESIGN PARAMETERS:**

| | | X-Axis | Y-Axis |
|---|---|---|---|
| Lu (ft) | | 38.00 | 38.00 |
| K | | 1 | 1 |
| Braced Against Joint Translation | | Yes | Yes |
| Column Eccentricity (in) | Top | 8.50 | 8.50 |
| | Bottom | 0.00 | 0.00 |

**CONTROLLING AXIAL COLUMN LOADS - Skip-Load Case 1:**

| | Dead | Live | Roof |
|---|---|---|---|
| Axial (kip) | 93.23 | 43.73 | 100.92 |

**DEMAND CAPACITY RATIO: (DL + 0.75LL + 0.75RF)**

| | | | | | |
|---|---|---|---|---|---|
| Pa (kip) = | 201.71 | Pnx/1.67 (kip) = | 242.35 | Pa/(Pnx/1.67) = | 0.832 |
| | | Pny/1.67 (kip) = | 242.35 | Pa/(Pny/1.67) = | 0.832 |
| | | Pn/1.67 (kip) = | 242.35 | Pa/(Pn/1.67) = | 0.832 |

**CONTROLLING COMBINED COLUMN LOADS - Skip-Load Case 6:**

| | | | Dead | Live | Roof |
|---|---|---|---|---|---|
| Axial (kip) | | | 93.23 | 24.05 | 55.51 |
| Moments | Top | Mx (kip-ft) | 0.02 | -0.00 | -0.00 |
| | | My (kip-ft) | 0.00 | 13.94 | 32.17 |
| | Bot | Mx (kip-ft) | 0.00 | 0.00 | 0.00 |
| | | My (kip-ft) | 0.00 | 0.00 | 0.00 |

Single curvature about X-Axis
Single curvature about Y-Axis

**CALCULATED PARAMETERS: (DL + 0.75LL + 0.75RF)**

| | | | |
|---|---|---|---|
| Pa (kip) = | 152.89 | Pn/1.67 (kip) = | 242.35 |
| Max (kip-ft) = | 0.03 | Mnx/1.67 (kip-ft) = | 156.87 |
| May (kip-ft) = | 41.32 | Mny/1.67 (kip-ft) = | 156.87 |
| Rm = | 1.00 | | |
| Cbx = | 1.67 | Cby = | 1.67 |
| Cmx = | 0.60 | Cmy = | 0.60 |
| Pex (kip) = | 491.40 | Pey (kip) = | 491.40 |
| B1x = | 1.19 | B1y = | 1.19 |

**INTERACTION EQUATION**

Pa/(Pn/1.67)) = 0.631
Eq H1-1a: 0.631 + 0.000 + 0.234 = 0.865

# Gravity Column Design

RAM Structural System
Bentley

RAM Steel 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416 05/07/18 14:19:19
Building Code: IBC Steel Code: AISC 360-10 ASD

**Story level Roof, Column Line 5-L, Column # 17**

| | | | | | |
|---|---|---|---|---|---|
| Fy (ksi) | = | 50.00 | Column Size | = | HSS12X12X5/16 |
| Orientation (deg.) | = | 90.0 | | | |

**INPUT DESIGN PARAMETERS:**

| | | X-Axis | Y-Axis |
|---|---|---|---|
| Lu (ft) | | 38.00 | 38.00 |
| K | | 1 | 1 |
| Braced Against Joint Translation | | Yes | Yes |
| Column Eccentricity (in) | Top | 8.50 | 8.50 |
| | Bottom | 0.00 | 0.00 |

**CONTROLLING AXIAL COLUMN LOADS - Skip-Load Case 1:**

| | Dead | Live | Roof |
|---|---|---|---|
| Axial (kip) | 45.46 | 0.00 | 100.92 |

**DEMAND CAPACITY RATIO: (DL + RF)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Pa (kip) | = | 146.38 | Pnx/1.67 (kip) | = | 199.45 | Pa/(Pnx/1.67) | = | 0.734 |
| | | | Pny/1.67 (kip) | = | 199.45 | Pa/(Pny/1.67) | = | 0.734 |
| | | | Pn/1.67 (kip) | = | 199.45 | Pa/(Pn/1.67) | = | 0.734 |

**CONTROLLING COMBINED COLUMN LOADS - Skip-Load Case 14:**

| | | | Dead | Live | Roof |
|---|---|---|---|---|---|
| Axial (kip) | | | 45.46 | 0.00 | 50.46 |
| Moments | Top | Mx (kip-ft) | 0.00 | 0.00 | 3.57 |
| | | My (kip-ft) | 0.00 | 0.00 | 32.17 |
| | Bot | Mx (kip-ft) | 0.00 | 0.00 | 0.00 |
| | | My (kip-ft) | 0.00 | 0.00 | 0.00 |

Single curvature about X-Axis
Single curvature about Y-Axis

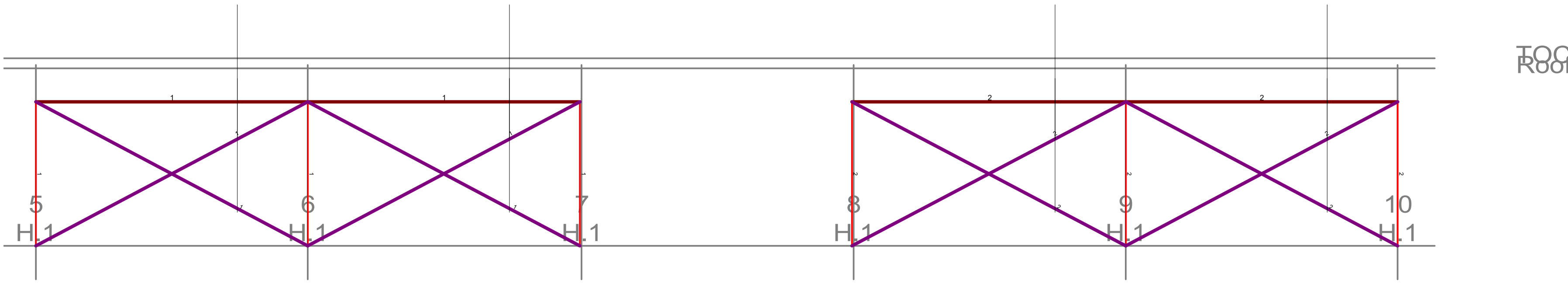
**CALCULATED PARAMETERS: (DL + RF)**

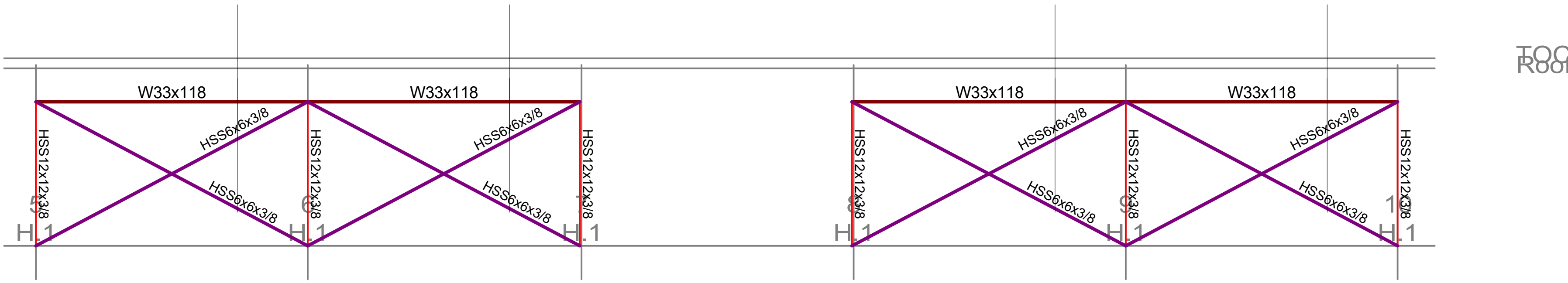
| | | | | | |
|---|---|---|---|---|---|
| Pa (kip) | = | 95.92 | Pn/1.67 (kip) | = | 199.45 |
| Max (kip-ft) | = | 3.57 | Mnx/1.67 (kip-ft) | = | 119.02 |
| May (kip-ft) | = | 32.17 | Mny/1.67 (kip-ft) | = | 119.02 |
| Rm | = | 1.00 | | | |
| Cbx | = | 1.67 | Cby | = | 1.67 |
| Cmx | = | 0.60 | Cmy | = | 0.60 |
| Pex (kip) | = | 418.45 | Pey (kip) | = | 418.45 |
| B1x | = | 1.00 | B1y | = | 1.00 |

**INTERACTION EQUATION**

Pa/(Pn/1.67)) = 0.481
Eq H1-1a: 0.481 + 0.027 + 0.240 = 0.748

# Lateral Analysis


TOC
Roof
5
H.1
6
H.1
7
H.1
8
H.1
9
H.1
10
H.1


W33x118
W33x118
W33x118
W33x118
HSS6x6x3/8
HSS6x6x3/8
HSS6x6x3/8
HSS6x6x3/8
HSS6x6x3/8
HSS6x6x3/8
HSS6x6x3/8
HSS6x6x3/8
HSS12x12x3/8
HSS12x12x3/8
HSS12x12x3/8
HSS12x12x3/8
HSS12x12x3/8
HSS12x12x3/8
H.1
H.1
H.1
H.1
H.1
H.1
TOC
Roof

# Criteria, Mass and Exposure Data

RAM Structural System
Bentley
RAM Frame 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416 05/07/18 14:22:01

**CRITERIA:**

Rigid End Zones: Ignore Effects
Member Force Output: At Face of Joint
P-Delta: Yes Scale Factor: 1.00
Ground Level: Base
Mesh Criteria :
Max. Distance Between Nodes on Mesh Line (ft) : 4.00
Merge Node Tolerance (in) : 0.0100
Geometry Tolerance (in) : 0.0050
Walls Out-of-plane Stiffness Included in Analysis.
Rotational Fixities Released at Wall Foundation Nodes.
Sign considered for Dynamic Load Case Results.
Rigid Links Included at Fixed Beam-to-Wall Locations
Eigenvalue Analysis : Eigen Vectors (Subspace Iteration)

**DIAPHRAGM DATA:**

| Story | Diaph # | Diaph Type |
|---|---|---|
| Roof | 1 | Pseudo - Flexible |

Disconnect Internal Nodes of Beams: Yes
Disconnect Nodes outside Slab Boundary: Yes

**STORY MASS DATA:**

**Includes Self Mass of:**
Columns (Half mass of columns above and below)
Walls (Half mass of walls above and below)
Slabs/Deck

**Calculated Values:**

| Story | Diaph # | Weight kips | Mass k-s2/ft | MMI ft-k-s2 | Xm ft | Ym ft | EccX ft | EccY ft |
|---|---|---|---|---|---|---|---|---|
| TOC | None | 155.98 | 4.84 | 383204 | 319.00 | 79.65 | -- | -- |
| Roof | 1 | 5087.73 | 158.00 | 8695907 | 313.60 | 99.38 | 32.03 | 12.63 |

| Story | Diaph # | Combine |
|---|---|---|
| TOC | None | 1-Roof |
| Roof | 1 | None |

**Combined/Merged Values:**

| Story | Diaph # | Weight kips | Mass k-s2/ft | MMI ft-k-s2 | Xm ft | Ym ft | EccX ft | EccY ft |
|---|---|---|---|---|---|---|---|---|
| Roof | 1 | 5243.7 | 162.85 | 9081078 | 313.76 | 98.79 | 32.03 | 12.63 |

**WIND EXPOSURE DATA:**

**Calculated Values:**

| Story | Diaph # | Building Extents (ft) Min X | Max X | Min Y | Max Y | Expose | Parapet ft |
|---|---|---|---|---|---|---|---|
| Roof | 1 | -1.33 | 639.33 | -1.33 | 251.33 | Full | 1.00 |

**STORY GRAVITY LOADS DATA:**

**Includes Weight of:**

Beams
Columns
Walls
Slabs/Deck

**Live Load Reduction (Calculated)**

Reducible : 0.00 %
Storage : 0.00 %

**Calculated Values:**

| Story | Diaph # | Dead kips | Xc ft | Yc ft | Live kips | Xc ft | Yc ft |
|---|---|---|---|---|---|---|---|
| TOC | None | 311.96 | 319.00 | 79.65 | 0.00 | 0.00 | 0.00 |
| Roof | 1 | 7439.42 | 315.29 | 87.73 | 437.32 | 261.00 | 193.33 |

| Story | Diaph # | Snow kips | Xc ft | Yc ft | Combine |
|---|---|---|---|---|---|
| TOC | None | 0.00 | 0.00 | 0.00 | 1-Roof |
| Roof | 1 | 4924.72 | 319.00 | 126.49 | None |

**User Specified Values:**

| Story | Diaph # | Dead kips | Xc ft | Yc ft | Live kips | Xc ft | Yc ft |
|---|---|---|---|---|---|---|---|
| Roof | 1 | 7751.38 | 315.44 | 87.40 | 437.32 | 261.00 | 193.33 |

| Story | Diaph # | Snow kips | Xc ft | Yc ft |
|---|---|---|---|---|
| Roof | 1 | 4924.7 | 319.00 | 126.49 |

# Loads and Applied Forces



**LOAD CASE: Wind**

Wind ASCE 7-10
Exposure: C
Basic Wind Speed (mph): 115.0
Apply Directionality Factor, Kd = 0.85
Use Topography Factor, Kzt: 1.00
Use Calculated Frequency for X-Dir.
Use Calculated Frequency for Y-Dir.
Gust Factor for Rigid Structures, G: Use Calculated G for X-Dir.
Gust Factor for Rigid Structures, G: Use Calculated G for Y-Dir.
Damping Ratio for Flexible Structures= 0.01
Mean Roof Height (ft): Top Story Height + Parapet = 40.00
Ground Level: Base

**WIND PRESSURES:**

X-Direction: Natural Frequency = 1.787 Structure is Rigid
Y-Direction: Natural Frequency = 1.787 Structure is Rigid
CpWindward = 0.80 qLeeward (qh) = 30.03 psf
GCpn (Parapet): Windward = 1.50 Leeward = -1.00

| Height | Kz | Kzt | qz | Gust Factor G | | CpLeeward | | Pressure (psf) | |
|---|---|---|---|---|---|---|---|---|---|
| ft | | | psf | X | Y | X | Y | X | Y |
| 39.00 | 1.038 | 1.000 | 29.872 | ---- | ---- | ---- | ---- | 74.680 | 74.680 |
| 38.00 | 1.032 | 1.000 | 29.709 | 0.836 | 0.796 | -0.273 | -0.500 | 26.737 | 30.871 |
| 0.00 | 0.849 | 1.000 | 24.429 | 0.836 | 0.796 | -0.273 | -0.500 | 23.205 | 27.508 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_1_X

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | 141.57 | 0.00 | 319.00 | 125.00 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_1_X

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | 141.57 | 0.00 |
| | | 141.57 | 0.00 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_1_-X

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|

| | | ft | kips | kips | ft | ft |
|---|---|---|---|---|---|---|
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | -141.57 | 0.00 | 319.00 | 125.00 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_1_-X

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | -141.57 | 0.00 |
| | | -141.57 | 0.00 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_1_Y

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | 0.00 | 409.98 | 319.00 | 125.00 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_1_Y

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | 0.00 | 409.98 |
| | | 0.00 | 409.98 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_1_-Y

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | -0.00 | -409.98 | 319.00 | 125.00 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_1_-Y

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | -0.00 | -409.98 |

| | | | |
|---|---|---|---|
| | | -0.00 | -409.98 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_2_X+E

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | 106.18 | 0.00 | 319.00 | 162.90 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_2_X+E

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | 106.18 | 0.00 |
| | | 106.18 | 0.00 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_2_X-E

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | 106.18 | 0.00 | 319.00 | 87.10 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_2_X-E

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | 106.18 | 0.00 |
| | | 106.18 | 0.00 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_2_-X+E

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | -106.18 | 0.00 | 319.00 | 162.90 |

# Loads and Applied Forces



**APPLIED STORY FORCES**

Type: Wind_ASCE710_2_-X+E

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | -106.18 | 0.00 |
| | | -106.18 | 0.00 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_2_-X-E

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | -106.18 | 0.00 | 319.00 | 87.10 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_2_-X-E

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | -106.18 | 0.00 |
| | | -106.18 | 0.00 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_2_Y+E

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | 0.00 | 307.48 | 415.10 | 125.00 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_2_Y+E

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | 0.00 | 307.48 |
| | | 0.00 | 307.48 |

# Loads and Applied Forces



**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_2_Y-E

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | 0.00 | 307.48 | 222.90 | 125.00 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_2_Y-E

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | 0.00 | 307.48 |
| | | 0.00 | 307.48 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_2_-Y+E

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | -0.00 | -307.48 | 415.10 | 125.00 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_2_-Y+E

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | -0.00 | -307.48 |
| | | -0.00 | -307.48 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_2_-Y-E

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | -0.00 | -307.48 | 222.90 | 125.00 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_2_-Y-E

| Level | Ht | Fx | Fy |
|---|---|---|---|

| | ft | kips | kips |
|---|---|---|---|
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | -0.00 | -307.48 |
| | | -0.00 | -307.48 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_3_X+Y

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | 106.18 | 307.48 | 319.00 | 125.00 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_3_X+Y

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | 106.18 | 307.48 |
| | | 106.18 | 307.48 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_3_-X-Y

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | -106.18 | -307.48 | 319.00 | 125.00 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_3_-X-Y

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | -106.18 | -307.48 |
| | | -106.18 | -307.48 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_3_X-Y

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|

| | | ft | kips | kips | ft | ft |
|---|---|---|---|---|---|---|
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | 106.18 | -307.48 | 319.00 | 125.00 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_3_X-Y

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | 106.18 | -307.48 |
| | | 106.18 | -307.48 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_3_-X+Y

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | -106.18 | 307.48 | 319.00 | 125.00 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_3_-X+Y

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | -106.18 | 307.48 |
| | | -106.18 | 307.48 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_4_X+Y_CW

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | 79.63 | 230.61 | 222.90 | 162.90 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_4_X+Y_CW

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | 79.63 | 230.61 |

| | | |
|---|---|---|
| | 79.63 | 230.61 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_4_-X-Y_CCW

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | -79.63 | -230.61 | 222.90 | 162.90 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_4_-X-Y_CCW

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | -79.63 | -230.61 |
| | | -79.63 | -230.61 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_4_X+Y_CCW

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | 79.63 | 230.61 | 415.10 | 87.10 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_4_X+Y_CCW

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | 79.63 | 230.61 |
| | | 79.63 | 230.61 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_4_-X-Y_CW

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | -79.63 | -230.61 | 415.10 | 87.10 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_4_-X-Y_CW

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | -79.63 | -230.61 |
| | | -79.63 | -230.61 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_4_X-Y_CW

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | 79.63 | -230.61 | 415.10 | 162.90 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_4_X-Y_CW

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | 79.63 | -230.61 |
| | | 79.63 | -230.61 |

**APPLIED DIAPHRAGM FORCES**

Type: Wind_ASCE710_4_-X+Y_CCW

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | -79.63 | 230.61 | 415.10 | 162.90 |

**APPLIED STORY FORCES**

Type: Wind_ASCE710_4_-X+Y_CCW

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | -79.63 | 230.61 |
| | | -79.63 | 230.61 |

## APPLIED DIAPHRAGM FORCES

Type: Wind_ASCE710_4_X-Y_CCW

| Level | Diaph.# | Ht ft | Fx kips | Fy kips | X ft | Y ft |
|---|---|---|---|---|---|---|
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | 79.63 | -230.61 | 222.90 | 87.10 |

## APPLIED STORY FORCES

Type: Wind_ASCE710_4_X-Y_CCW

| Level | Ht ft | Fx kips | Fy kips |
|---|---|---|---|
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | 79.63 | -230.61 |
| | | 79.63 | -230.61 |

## APPLIED DIAPHRAGM FORCES

Type: Wind_ASCE710_4_-X+Y_CW

| Level | Diaph.# | Ht ft | Fx kips | Fy kips | X ft | Y ft |
|---|---|---|---|---|---|---|
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | -79.63 | 230.61 | 222.90 | 87.10 |

## APPLIED STORY FORCES

Type: Wind_ASCE710_4_-X+Y_CW

| Level | Ht ft | Fx kips | Fy kips |
|---|---|---|---|
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | -79.63 | 230.61 |
| | | -79.63 | 230.61 |

**LOAD CASE: EQX**

Seismic ASCE 7-10 Equivalent Lateral Force
Site Class: D Importance Factor: 1.00 Ss: 1.498 g S1: 0.520 g TL: 8.00 s
Fa: 1.000 Fv: 1.500 SDs: 0.999 g SD1: 0.520 g
Occupancy Category: II Seismic Design Category: D
Provisions for: Force
Ground Level: Base

| Dir | Eccent | R | Ta Equation | Building Period-T |
|---|---|---|---|---|
| X | + And - | 3.3 | Std,Ct=0.030,x=0.75 | Calculated |

| Dir | Ta | Cu | T | T-used | Cs<br>Eq12.8-2 | Cs(max)<br>Eq12.8-3 | Cs(min)<br>Eq12.8-5 | Cs-used | k |
|---|---|---|---|---|---|---|---|---|---|
| X | 0.459 | 1.400 | 0.560 | 0.560 | 0.307 | 0.286 | 0.044 | 0.286 | 1.030 |

Total Building Weight (kips) = 5243.71

**APPLIED DIAPHRAGM FORCES**

Type: EQ_ASCE710_X_+E_F

| Level | Diaph.# | Ht<br>ft | Fx<br>kips | Fy<br>kips | X<br>ft | Y<br>ft |
|---|---|---|---|---|---|---|
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | 1499.22 | 0.00 | 313.76 | 111.42 |

**APPLIED STORY FORCES**

Type: EQ_ASCE710_X_+E_F

| Level | Ht<br>ft | Fx<br>kips | Fy<br>kips |
|---|---|---|---|
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | 1499.22 | 0.00 |
| | | 1499.22 | 0.00 |

**APPLIED DIAPHRAGM FORCES**

Type: EQ_ASCE710_X_-E_F

| Level | Diaph.# | Ht<br>ft | Fx<br>kips | Fy<br>kips | X<br>ft | Y<br>ft |
|---|---|---|---|---|---|---|
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | 1499.22 | 0.00 | 313.76 | 86.16 |

**APPLIED STORY FORCES**

Type: EQ_ASCE710_X_-E_F

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | 1499.22 | 0.00 |
| | | 1499.22 | 0.00 |

**APPLIED DIAPHRAGM FORCES**

Type: EQ_ASCE710_-X_+E_F

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | -1499.22 | 0.00 | 313.76 | 111.42 |

**APPLIED STORY FORCES**

Type: EQ_ASCE710_-X_+E_F

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | -1499.22 | 0.00 |
| | | -1499.22 | 0.00 |

**APPLIED DIAPHRAGM FORCES**

Type: EQ_ASCE710_-X_-E_F

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | -1499.22 | 0.00 | 313.76 | 86.16 |

**APPLIED STORY FORCES**

Type: EQ_ASCE710_-X_-E_F

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | -1499.22 | 0.00 |
| | | -1499.22 | 0.00 |

# Loads and Applied Forces



**LOAD CASE: EQY**

Seismic ASCE 7-10 Equivalent Lateral Force
Site Class: D Importance Factor: 1.00 Ss: 1.498 g S1: 0.520 g TL: 8.00 s
Fa: 1.000 Fv: 1.500 SDs: 0.999 g SD1: 0.520 g
Occupancy Category: II Seismic Design Category: D
Provisions for: Force
Ground Level: Base

| Dir | Eccent | R | Ta Equation | Building Period-T |
|---|---|---|---|---|
| Y | + And - | 6.0 | Std,Ct=0.030,x=0.75 | Calculated |

| Dir | Ta | Cu | T | T-used | Cs | Cs(max) | Cs(min) | Cs-used | k |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Eq12.8-2 | Eq12.8-3 | Eq12.8-5 | | |
| Y | 0.459 | 1.400 | 0.560 | 0.560 | 0.166 | 0.155 | 0.044 | 0.155 | 1.030 |

Total Building Weight (kips) = 5243.71

**APPLIED DIAPHRAGM FORCES**

Type: EQ_ASCE710_Y_+E_F

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | 0.00 | 812.08 | 345.79 | 98.79 |

**APPLIED STORY FORCES**

Type: EQ_ASCE710_Y_+E_F

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | 0.00 | 812.08 |
| | | 0.00 | 812.08 |

**APPLIED DIAPHRAGM FORCES**

Type: EQ_ASCE710_Y_-E_F

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | 0.00 | 812.08 | 281.72 | 98.79 |

**APPLIED STORY FORCES**

Type: EQ_ASCE710_Y_-E_F

| Level | Ht | Fx | Fy |
|---|---|---|---|

| | | | |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | 0.00 | 812.08 |
| | | 0.00 | 812.08 |

**APPLIED DIAPHRAGM FORCES**

Type: EQ_ASCE710_-Y_+E_F

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | -0.00 | -812.08 | 345.79 | 98.79 |

**APPLIED STORY FORCES**

Type: EQ_ASCE710_-Y_+E_F

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | -0.00 | -812.08 |
| | | -0.00 | -812.08 |

**APPLIED DIAPHRAGM FORCES**

Type: EQ_ASCE710_-Y_-E_F

| Level | Diaph.# | Ht | Fx | Fy | X | Y |
|---|---|---|---|---|---|---|
| | | ft | kips | kips | ft | ft |
| TOC | --- | --- | --- | --- | --- | --- |
| Roof | 1 | 38.00 | -0.00 | -812.08 | 281.72 | 98.79 |

**APPLIED STORY FORCES**

Type: EQ_ASCE710_-Y_-E_F

| Level | Ht | Fx | Fy |
|---|---|---|---|
| | ft | kips | kips |
| TOC | 40.00 | --- | --- |
| Roof | 38.00 | -0.00 | -812.08 |
| | | -0.00 | -812.08 |

# Member Code Check

RAM Structural System
Bentley
RAM Frame 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416 05/07/18 14:31:49
Building Code: IBC Steel Code: AISC360-10 ASD

**COLUMN INFORMATION:**

| | | | | |
|---|---|---|---|---|
| Story Level = Roof | | Frame Number = 1 | | Column Number = 20 |
| Fy (ksi) = 46.00 | | | | |
| Column Size = HSS12X12X3/8 | | | | |

**INPUT DESIGN PARAMETERS:**

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 31.00 | 31.00 |
| Lu for Bending (ft) | 31.00 | 31.00 |
| K | 1.00 | 1.00 |

**CONTROLLING COLUMN FORCES - SHEAR**

**Load Combination: 1.000 D**

| | | | |
|---|---|---|---|
| Shear | Top | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |
| Shear | Bot. | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |

**SHEAR CHECK:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Vax (kip) | = | 0.00 | Vnx/1.67 (kip) | = | 126.35 | Vax/(Vnx/1.67) | = | 0.000 |
| Vay (kip) | = | 0.00 | Vny/1.67 (kip) | = | 126.35 | Vay/(Vny/1.67) | = | 0.000 |

**CONTROLLING COLUMN FORCES - AXIAL**

**Load Combination: 1.140 D + 0.700 E3**

**AXIAL CHECK:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Pa (kip) | = | 129.98 | Pnx/1.67 (kip) | = | 290.38 | Pa/(Pnx/1.67) | = | 0.448 |
| | | | Pny/1.67 (kip) | = | 290.38 | Pa/(Pny/1.67) | = | 0.448 |
| | | | Pn/1.67 (kip) | = | 290.38 | Pa/(Pn/1.67) | = | 0.448 |

**CONTROLLING COLUMN FORCES - FLEXURE**

**Load Combination: 1.140 D + 0.700 E3**

| | | | |
|---|---|---|---|
| Axial | | Load (kip) | 129.98 |
| Moment | Top | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |
| Moment | Bot. | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |

**CALCULATED PARAMETERS:**

| | | | | | |
|---|---|---|---|---|---|
| Pa (kip) | = | 129.98 | Pn/1.67 (kip) | = | 290.38 |
| Max (kip-ft) | = | 0.00 | Mnx/1.67 (kip-ft) | = | 148.55 |
| May (kip-ft) | = | 0.00 | Mny/1.67 (kip-ft) | = | 148.55 |
| KL/Rx | = | 78.75 | KL/Ry | = | 78.75 |
| Cbx | = | 1.00 | | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.448

Eq H1-1a: 0.448 + 8/9(0.000 + 0.000) = 0.448

# Member Code Check



## COLUMN INFORMATION:

| | | | | | |
|---|---|---|---|---|---|
| Story Level | = Roof | Frame Number | = 1 | Column Number | = 25 |
| Fy (ksi) | = 46.00 | | | | |
| Column Size | = HSS12X12X3/8 | | | | |

## INPUT DESIGN PARAMETERS:

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 31.00 | 31.00 |
| Lu for Bending (ft) | 31.00 | 31.00 |
| K | 1.00 | 1.00 |

## CONTROLLING COLUMN FORCES - SHEAR

**Load Combination: 1.000 D**

| | | | |
|---|---|---|---|
| Shear | Top | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |
| Shear | Bot. | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |

**SHEAR CHECK:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Vax (kip) | = 0.00 | Vnx/1.67 (kip) | = | 126.35 | Vax/(Vnx/1.67) | = | 0.000 |
| Vay (kip) | = 0.00 | Vny/1.67 (kip) | = | 126.35 | Vay/(Vny/1.67) | = | 0.000 |

## CONTROLLING COLUMN FORCES - AXIAL

**Load Combination: 1.140 D + 0.700 E1**

**AXIAL CHECK:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pa (kip) | = 133.98 | Pnx/1.67 (kip) | = | 290.38 | Pa/(Pnx/1.67) | = | 0.461 |
| | | Pny/1.67 (kip) | = | 290.38 | Pa/(Pny/1.67) | = | 0.461 |
| | | Pn/1.67 (kip) | = | 290.38 | Pa/(Pn/1.67) | = | 0.461 |

## CONTROLLING COLUMN FORCES - FLEXURE

**Load Combination: 1.140 D + 0.700 E1**

| | | | |
|---|---|---|---|
| Axial | | Load (kip) | 133.98 |
| Moment | Top | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |
| Moment | Bot. | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |

**CALCULATED PARAMETERS:**

| | | | | | |
|---|---|---|---|---|---|
| Pa (kip) | = | 133.98 | Pn/1.67 (kip) | = | 290.38 |
| Max (kip-ft) | = | 0.00 | Mnx/1.67 (kip-ft) | = | 148.55 |
| May (kip-ft) | = | 0.00 | Mny/1.67 (kip-ft) | = | 148.55 |
| KL/Rx | = | 78.75 | KL/Ry | = | 78.75 |
| Cbx | = | 1.00 | | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.461

Eq H1-1a: 0.461 + 8/9(0.000 + 0.000) = 0.461

# Member Code Check



**COLUMN INFORMATION:**

| | | | | |
|---|---|---|---|---|
| Story Level = Roof | | Frame Number = 1 | | Column Number = 30 |
| Fy (ksi) = 46.00 | | | | |
| Column Size = HSS12X12X3/8 | | | | |

**INPUT DESIGN PARAMETERS:**

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 31.00 | 31.00 |
| Lu for Bending (ft) | 31.00 | 31.00 |
| K | 1.00 | 1.00 |

**CONTROLLING COLUMN FORCES - SHEAR**

**Load Combination: 1.000 D**

| | | | |
|---|---|---|---|
| Shear | Top | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |
| Shear | Bot. | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |

**SHEAR CHECK:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Vax (kip) | = | 0.00 | Vnx/1.67 (kip) | = | 126.35 | Vax/(Vnx/1.67) | = | 0.000 |
| Vay (kip) | = | 0.00 | Vny/1.67 (kip) | = | 126.35 | Vay/(Vny/1.67) | = | 0.000 |

**CONTROLLING COLUMN FORCES - AXIAL**

**Load Combination: 1.140 D + 0.700 E1**

**AXIAL CHECK:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Pa (kip) | = | 129.98 | Pnx/1.67 (kip) | = | 290.38 | Pa/(Pnx/1.67) | = | 0.448 |
| | | | Pny/1.67 (kip) | = | 290.38 | Pa/(Pny/1.67) | = | 0.448 |
| | | | Pn/1.67 (kip) | = | 290.38 | Pa/(Pn/1.67) | = | 0.448 |

**CONTROLLING COLUMN FORCES - FLEXURE**

**Load Combination: 1.140 D + 0.700 E1**

| | | | |
|---|---|---|---|
| Axial | | Load (kip) | 129.98 |
| Moment | Top | Mmajor (kip-ft) | -0.00 |
| | | Mminor (kip-ft) | 0.00 |
| Moment | Bot. | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |

**CALCULATED PARAMETERS:**

| | | | | | |
|---|---|---|---|---|---|
| Pa (kip) | = | 129.98 | Pn/1.67 (kip) | = | 290.38 |
| Max (kip-ft) | = | -0.00 | Mnx/1.67 (kip-ft) | = | 148.55 |
| May (kip-ft) | = | 0.00 | Mny/1.67 (kip-ft) | = | 148.55 |
| KL/Rx | = | 78.75 | KL/Ry | = | 78.75 |
| Cbx | = | 1.00 | | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.448

Eq H1-1a: 0.448 + 8/9(0.000 + 0.000) = 0.448

# Member Code Check



**BEAM INFORMATION:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Story Level | = | Roof | Frame Number | = | 1 | Beam Number = | 171 |
| Fy (ksi) | = | 50.00 | | | | | |
| Beam Size | = | W33X118 | | | | | |

**INPUT DESIGN PARAMETERS:**

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 58.00 | 18.00 |
| Lu for Bending (ft) | 58.00 | 18.00 |
| K | 1.00 | 1.00 |
| Top Flange Continuously Braced | No | |
| Bottom Flange Continuously Braced | No | |

**CONTROLLING BEAM SEGMENT FORCES - SHEAR**

**Load Combination: 1.000 D + 0.750 Lp + 0.750 Sp**

| | |
|---|---|
| Segment distance (ft) i - end | 0.00 |
| j - end | 58.00 |

**SHEAR CHECK:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Vax (kip) | = | -48.42 | Vnx/1.67 (kip) | = | 325.06 | Vax/(Vnx/1.67) | = | 0.149 |
| Vay (kip) | = | 0.00 | Vny/1.67 (kip) | = | 305.75 | Vay/(Vny/1.67) | = | 0.000 |

**CONTROLLING BEAM SEGMENT FORCES - AXIAL**

**Load Combination: 0.460 D + 0.700 E1**

| | |
|---|---|
| Segment distance (ft) i - end | 0.00 |
| j - end | 5.80 |

**AXIAL CHECK:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Pa (kip) | = | 74.96 | Pnx/1.67 (kip) | = | 818.95 | Pa/(Pnx/1.67) | = | 0.092 |
| | | | Pny/1.67 (kip) | = | 543.94 | Pa/(Pny/1.67) | = | 0.138 |
| | | | Pn/1.67 (kip) | = | 543.94 | Pa/(Pn/1.67) | = | 0.138 |

**CONTROLLING BEAM SEGMENT FORCES - FLEXURE**

**Load Combination: 1.000 D + 0.750 Lp + 0.750 Sp + 0.450 W1**

| | |
|---|---|
| Segment distance (ft) i - end | 23.20 |
| j - end | 29.00 |

**CALCULATED PARAMETERS:**

| | | | | | |
|---|---|---|---|---|---|
| Pa ( kip) | = | 4.55 | Pnx/1.67 ( kip) | = | 818.95 |
| | | | Pny/1.67 ( kip) | = | 543.94 |
| Max (kip-ft) | = | 774.55 | Mnx/1.67 (kip-ft) | = | 785.57 |
| May (kip-ft) | = | 0.00 | Mny/1.67 (kip-ft) | = | 127.99 |
| | | | Mcx (kip-ft) | = | 773.35 |
| KL/Rx | = | 53.38 | KL/Ry | = | 93.05 |
| Cbx | = | 1.02 | | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.006

Eq H1-2: 0.013 + 0.972 = 0.985

Eq H1-1b Per H1.3: 0.003 + 0.986 + 0.000 = 0.989

# Member Code Check



**BEAM INFORMATION:**

| | | | | | |
|---|---|---|---|---|---|
| Story Level | = Roof | Frame Number | = 1 | Beam Number | = 226 |
| Fy (ksi) | = 50.00 | | | | |
| Beam Size | = W33X118 | | | | |

**INPUT DESIGN PARAMETERS:**

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 58.00 | 18.00 |
| Lu for Bending (ft) | 58.00 | 18.00 |
| K | 1.00 | 1.00 |
| Top Flange Continuously Braced | No | |
| Bottom Flange Continuously Braced | No | |

**CONTROLLING BEAM SEGMENT FORCES - SHEAR**

**Load Combination: 1.000 D + 0.750 Lp + 0.750 Sp**

| | |
|---|---|
| Segment distance (ft) i - end | 0.00 |
| j - end | 58.00 |

**SHEAR CHECK:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Vax (kip) | = | -48.42 | Vnx/1.67 (kip) | = 325.06 | Vax/(Vnx/1.67) | = | 0.149 |
| Vay (kip) | = | 0.00 | Vny/1.67 (kip) | = 305.75 | Vay/(Vny/1.67) | = | 0.000 |

**CONTROLLING BEAM SEGMENT FORCES - AXIAL**

**Load Combination: 0.460 D + 0.700 E3**

| | |
|---|---|
| Segment distance (ft) i - end | 0.00 |
| j - end | 5.80 |

**AXIAL CHECK:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pa (kip) | = | 74.96 | Pnx/1.67 (kip) | = 818.95 | Pa/(Pnx/1.67) | = | 0.092 |
| | | | Pny/1.67 (kip) | = 543.94 | Pa/(Pny/1.67) | = | 0.138 |
| | | | Pn/1.67 (kip) | = 543.94 | Pa/(Pn/1.67) | = | 0.138 |

**CONTROLLING BEAM SEGMENT FORCES - FLEXURE**

**Load Combination: 1.000 D + 0.750 Lp + 0.750 Sp + 0.450 W2**

| | |
|---|---|
| Segment distance (ft) i - end | 23.20 |
| j - end | 29.00 |

**CALCULATED PARAMETERS:**

| | | | | | |
|---|---|---|---|---|---|
| Pa ( kip) | = | 4.55 | Pnx/1.67 ( kip) | = | 818.95 |
| | | | Pny/1.67 ( kip) | = | 543.94 |
| Max (kip-ft) | = | 774.55 | Mnx/1.67 (kip-ft) | = | 785.57 |
| May (kip-ft) | = | 0.00 | Mny/1.67 (kip-ft) | = | 127.99 |
| | | | Mcx (kip-ft) | = | 773.35 |
| KL/Rx | = | 53.38 | KL/Ry | = | 93.05 |
| Cbx | = | 1.02 | | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.006

Eq H1-2: 0.013 + 0.972 = 0.985

Eq H1-1b Per H1.3: 0.003 + 0.986 + 0.000 = 0.989

# Member Code Check



**BRACE INFORMATION:**

Story Level = Roof  Frame Number = 1  Brace Number = 1
Fy (ksi) = 46.00
Brace Size = HSS6X6X3/8

**INPUT DESIGN PARAMETERS:**

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 65.76 | 65.76 |
| Lu for Bending (ft) | 65.76 | 65.76 |
| K | 1.00 | 1.00 |

**CONTROLLING BRACE FORCES - SHEAR**

**Load Combination: 1.000 D**

| | | | |
|---|---|---|---|
| Shear | Top | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |
| Shear | Bot. | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |

**SHEAR CHECK:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Vax (kip) | = 0.00 | Vnx/1.67 (kip) | = | 57.14 | Vax/(Vnx/1.67) | = | 0.000 |
| Vay (kip) | = 0.00 | Vny/1.67 (kip) | = | 57.14 | Vay/(Vny/1.67) | = | 0.000 |

**CONTROLLING BRACE FORCES - AXIAL**

**Load Combination: 1.140 D + 0.700 E3**

**AXIAL CHECK:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pa (kip) | = 144.50 | Pnx/1.67 (kip) | = | 208.79 | Pa/(Pnx/1.67) | = | 0.692 |
| | | Pny/1.67 (kip) | = | 208.79 | Pa/(Pny/1.67) | = | 0.692 |
| | | Pn/1.67 (kip) | = | 208.79 | Pa/(Pn/1.67) | = | 0.692 |

**CONTROLLING BRACE FORCES - FLEXURE**

**Load Combination: 1.140 D + 0.700 E3**

| | | | |
|---|---|---|---|
| Axial | | Load (kip) | -144.50 |
| Moment | Top | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |
| Moment | Bot. | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |

**CALCULATED PARAMETERS:**

| | | | | | |
|---|---|---|---|---|---|
| Pa (kip) | = | -144.50 | Pn/1.67 (kip) | = | 208.79 |
| Max (kip-ft) | = | 0.00 | Mnx/1.67 (kip-ft) | = | 36.27 |
| May (kip-ft) | = | 0.00 | Mny/1.67 (kip-ft) | = | 36.27 |
| Cbx | = | 1.00 | | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.692
Eq H1-1a: 0.692 + 8/9(0.000 + 0.000) = 0.692

# Member Code Check



**BRACE INFORMATION:**

| | | | | |
|---|---|---|---|---|
| Story Level | = Roof | Frame Number = 1 | | Brace Number = 2 |
| Fy (ksi) | = 46.00 | | | |
| Brace Size | = HSS6X6X3/8 | | | |

**INPUT DESIGN PARAMETERS:**

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 65.76 | 65.76 |
| Lu for Bending (ft) | 65.76 | 65.76 |
| K | 1.00 | 1.00 |

**CONTROLLING BRACE FORCES - SHEAR**

**Load Combination: 1.000 D**

| | | | |
|---|---|---|---|
| Shear | Top | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |
| Shear | Bot. | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |

**SHEAR CHECK:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Vax (kip) | = | 0.00 | Vnx/1.67 (kip) | = 57.14 | Vax/(Vnx/1.67) | = | 0.000 |
| Vay (kip) | = | 0.00 | Vny/1.67 (kip) | = 57.14 | Vay/(Vny/1.67) | = | 0.000 |

**CONTROLLING BRACE FORCES - AXIAL**

**Load Combination: 1.140 D + 0.700 E1**

**AXIAL CHECK:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pa (kip) | = | 152.99 | Pnx/1.67 (kip) | = 208.79 | Pa/(Pnx/1.67) | = | 0.733 |
| | | | Pny/1.67 (kip) | = 208.79 | Pa/(Pny/1.67) | = | 0.733 |
| | | | Pn/1.67 (kip) | = 208.79 | Pa/(Pn/1.67) | = | 0.733 |

**CONTROLLING BRACE FORCES - FLEXURE**

**Load Combination: 1.140 D + 0.700 E1**

| | | | |
|---|---|---|---|
| Axial | | Load (kip) | -152.99 |
| Moment | Top | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |
| Moment | Bot. | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |

**CALCULATED PARAMETERS:**

| | | | | | |
|---|---|---|---|---|---|
| Pa (kip) | = | -152.99 | Pn/1.67 (kip) | = | 208.79 |
| Max (kip-ft) | = | 0.00 | Mnx/1.67 (kip-ft) | = | 36.27 |
| May (kip-ft) | = | 0.00 | Mny/1.67 (kip-ft) | = | 36.27 |
| Cbx | = | 1.00 | | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.733

Eq H1-1a: 0.733 + 8/9(0.000 + 0.000) = 0.733

# Member Code Check



**BRACE INFORMATION:**

| | | | | |
|---|---|---|---|---|
| Story Level | = Roof | Frame Number = 1 | | Brace Number = 3 |
| Fy (ksi) | = 46.00 | | | |
| Brace Size | = HSS6X6X3/8 | | | |

**INPUT DESIGN PARAMETERS:**

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 65.76 | 65.76 |
| Lu for Bending (ft) | 65.76 | 65.76 |
| K | 1.00 | 1.00 |

**CONTROLLING BRACE FORCES - SHEAR**

**Load Combination: 1.000 D**

| | | | |
|---|---|---|---|
| Shear | Top | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |
| Shear | Bot. | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |

**SHEAR CHECK:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Vax (kip) | = 0.00 | Vnx/1.67 (kip) | = | 57.14 | Vax/(Vnx/1.67) | = | 0.000 |
| Vay (kip) | = 0.00 | Vny/1.67 (kip) | = | 57.14 | Vay/(Vny/1.67) | = | 0.000 |

**CONTROLLING BRACE FORCES - AXIAL**

**Load Combination: 1.140 D + 0.700 E3**

**AXIAL CHECK:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pa (kip) | = 152.99 | Pnx/1.67 (kip) | = | 208.79 | Pa/(Pnx/1.67) | = | 0.733 |
| | | Pny/1.67 (kip) | = | 208.79 | Pa/(Pny/1.67) | = | 0.733 |
| | | Pn/1.67 (kip) | = | 208.79 | Pa/(Pn/1.67) | = | 0.733 |

**CONTROLLING BRACE FORCES - FLEXURE**

**Load Combination: 1.140 D + 0.700 E3**

| | | | |
|---|---|---|---|
| Axial | | Load (kip) | -152.99 |
| Moment | Top | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |
| Moment | Bot. | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |

**CALCULATED PARAMETERS:**

| | | | | |
|---|---|---|---|---|
| Pa (kip) | = -152.99 | Pn/1.67 (kip) | = | 208.79 |
| Max (kip-ft) | = 0.00 | Mnx/1.67 (kip-ft) | = | 36.27 |
| May (kip-ft) | = 0.00 | Mny/1.67 (kip-ft) | = | 36.27 |
| Cbx | = 1.00 | | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.733

Eq H1-1a: 0.733 + 8/9(0.000 + 0.000) = 0.733

# Member Code Check

RAM Structural System
Bentley

| | |
|---|---|
| RAM Frame 15.08.00.37 | Page 9/18 |
| DataBase: 18054_Kimberly Clark Addition_20180416 | 05/07/18 14:31:49 |
| Building Code: IBC | Steel Code: AISC360-10 ASD |

**BRACE INFORMATION:**

Story Level = Roof     Frame Number = 1     Brace Number = 4
Fy (ksi) = 46.00
Brace Size = HSS6X6X3/8

**INPUT DESIGN PARAMETERS:**

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 65.76 | 65.76 |
| Lu for Bending (ft) | 65.76 | 65.76 |
| K | 1.00 | 1.00 |

**CONTROLLING BRACE FORCES - SHEAR**

**Load Combination: 1.000 D**

| | | | |
|---|---|---|---|
| Shear | Top | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |
| Shear | Bot. | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |

**SHEAR CHECK:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Vax (kip) = | 0.00 | Vnx/1.67 (kip) | = | 57.14 | Vax/(Vnx/1.67) | = | 0.000 |
| Vay (kip) = | 0.00 | Vny/1.67 (kip) | = | 57.14 | Vay/(Vny/1.67) | = | 0.000 |

**CONTROLLING BRACE FORCES - AXIAL**

**Load Combination: 1.140 D + 0.700 E1**

**AXIAL CHECK:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pa (kip) = | 144.50 | Pnx/1.67 (kip) | = | 208.79 | Pa/(Pnx/1.67) | = | 0.692 |
| | | Pny/1.67 (kip) | = | 208.79 | Pa/(Pny/1.67) | = | 0.692 |
| | | Pn/1.67 (kip) | = | 208.79 | Pa/(Pn/1.67) | = | 0.692 |

**CONTROLLING BRACE FORCES - FLEXURE**

**Load Combination: 1.140 D + 0.700 E1**

| | | | |
|---|---|---|---|
| Axial | | Load (kip) | -144.50 |
| Moment | Top | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |
| Moment | Bot. | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |

**CALCULATED PARAMETERS:**

| | | | | | |
|---|---|---|---|---|---|
| Pa (kip) | = | -144.50 | Pn/1.67 (kip) | = | 208.79 |
| Max (kip-ft) | = | 0.00 | Mnx/1.67 (kip-ft) | = | 36.27 |
| May (kip-ft) | = | 0.00 | Mny/1.67 (kip-ft) | = | 36.27 |
| Cbx | = | 1.00 | | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.692
Eq H1-1a: 0.692 + 8/9(0.000 + 0.000) = 0.692

# Member Code Check



## COLUMN INFORMATION:

| | | | | | |
|---|---|---|---|---|---|
| Story Level = | Roof | Frame Number = | 2 | Column Number = | 35 |
| Fy (ksi) = | 46.00 | | | | |
| Column Size = | HSS12X12X3/8 | | | | |

## INPUT DESIGN PARAMETERS:

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 31.00 | 31.00 |
| Lu for Bending (ft) | 31.00 | 31.00 |
| K | 1.00 | 1.00 |

## CONTROLLING COLUMN FORCES - SHEAR

**Load Combination: 1.000 D**

| | | | |
|---|---|---|---|
| Shear | Top | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |
| Shear | Bot. | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |

**SHEAR CHECK:**

| | | | | | |
|---|---|---|---|---|---|
| Vax (kip) = | 0.00 | Vnx/1.67 (kip) = | 126.35 | Vax/(Vnx/1.67) = | 0.000 |
| Vay (kip) = | 0.00 | Vny/1.67 (kip) = | 126.35 | Vay/(Vny/1.67) = | 0.000 |

## CONTROLLING COLUMN FORCES - AXIAL

**Load Combination: 1.140 D + 0.700 E3**

**AXIAL CHECK:**

| | | | | | |
|---|---|---|---|---|---|
| Pa (kip) = | 129.98 | Pnx/1.67 (kip) = | 290.38 | Pa/(Pnx/1.67) = | 0.448 |
| | | Pny/1.67 (kip) = | 290.38 | Pa/(Pny/1.67) = | 0.448 |
| | | Pn/1.67 (kip) = | 290.38 | Pa/(Pn/1.67) = | 0.448 |

## CONTROLLING COLUMN FORCES - FLEXURE

**Load Combination: 1.140 D + 0.700 E3**

| | | | |
|---|---|---|---|
| Axial | | Load (kip) | 129.98 |
| Moment | Top | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |
| Moment | Bot. | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |

**CALCULATED PARAMETERS:**

| | | | |
|---|---|---|---|
| Pa (kip) = | 129.98 | Pn/1.67 (kip) = | 290.38 |
| Max (kip-ft) = | 0.00 | Mnx/1.67 (kip-ft) = | 148.55 |
| May (kip-ft) = | 0.00 | Mny/1.67 (kip-ft) = | 148.55 |
| KL/Rx = | 78.75 | KL/Ry = | 78.75 |
| Cbx = | 1.00 | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.448

Eq H1-1a: 0.448 + 8/9(0.000 + 0.000) = 0.448

# Member Code Check



**COLUMN INFORMATION:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Story Level | = | Roof | Frame Number | = 2 | Column Number | = | 40 |
| Fy (ksi) | = | 46.00 | | | | | |
| Column Size | = | HSS12X12X3/8 | | | | | |

**INPUT DESIGN PARAMETERS:**

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 31.00 | 31.00 |
| Lu for Bending (ft) | 31.00 | 31.00 |
| K | 1.00 | 1.00 |

**CONTROLLING COLUMN FORCES - SHEAR**

**Load Combination: 1.000 D**

| | | | |
|---|---|---|---|
| Shear | Top | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |
| Shear | Bot. | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |

**SHEAR CHECK:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Vax (kip) | = | 0.00 | Vnx/1.67 (kip) | = | 126.35 | Vax/(Vnx/1.67) | = | 0.000 |
| Vay (kip) | = | 0.00 | Vny/1.67 (kip) | = | 126.35 | Vay/(Vny/1.67) | = | 0.000 |

**CONTROLLING COLUMN FORCES - AXIAL**

**Load Combination: 1.140 D + 0.700 E1**

**AXIAL CHECK:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Pa (kip) | = | 120.46 | Pnx/1.67 (kip) | = | 290.38 | Pa/(Pnx/1.67) | = | 0.415 |
| | | | Pny/1.67 (kip) | = | 290.38 | Pa/(Pny/1.67) | = | 0.415 |
| | | | Pn/1.67 (kip) | = | 290.38 | Pa/(Pn/1.67) | = | 0.415 |

**CONTROLLING COLUMN FORCES - FLEXURE**

**Load Combination: 1.140 D + 0.700 E1**

| | | | |
|---|---|---|---|
| Axial | | Load (kip) | 120.46 |
| Moment | Top | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |
| Moment | Bot. | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |

**CALCULATED PARAMETERS:**

| | | | | | |
|---|---|---|---|---|---|
| Pa (kip) | = | 120.46 | Pn/1.67 (kip) | = | 290.38 |
| Max (kip-ft) | = | 0.00 | Mnx/1.67 (kip-ft) | = | 148.55 |
| May (kip-ft) | = | 0.00 | Mny/1.67 (kip-ft) | = | 148.55 |
| KL/Rx | = | 78.75 | KL/Ry | = | 78.75 |
| Cbx | = | 1.00 | | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.415

Eq H1-1a: 0.415 + 8/9(0.000 + 0.000) = 0.415

# Member Code Check



**COLUMN INFORMATION:**

| | | | | |
|---|---|---|---|---|
| Story Level | = Roof | Frame Number = 2 | Column Number = 45 |
| Fy (ksi) | = 46.00 | | |
| Column Size | = HSS12X12X3/8 | | |

**INPUT DESIGN PARAMETERS:**

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 31.00 | 31.00 |
| Lu for Bending (ft) | 31.00 | 31.00 |
| K | 1.00 | 1.00 |

**CONTROLLING COLUMN FORCES - SHEAR**

**Load Combination: 1.000 D**

| | | | |
|---|---|---|---|
| Shear | Top | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |
| Shear | Bot. | Vmajor (kip) | 0.00 |
| | | Vminor (kip) | 0.00 |

**SHEAR CHECK:**

| | | | |
|---|---|---|---|
| Vax (kip) = 0.00 | Vnx/1.67 (kip) = 126.35 | Vax/(Vnx/1.67) = 0.000 |
| Vay (kip) = 0.00 | Vny/1.67 (kip) = 126.35 | Vay/(Vny/1.67) = 0.000 |

**CONTROLLING COLUMN FORCES - AXIAL**

**Load Combination: 1.140 D + 0.700 E1**

**AXIAL CHECK:**

| | | |
|---|---|---|
| Pa (kip) = 102.94 | Pnx/1.67 (kip) = 290.38 | Pa/(Pnx/1.67) = 0.355 |
| | Pny/1.67 (kip) = 290.38 | Pa/(Pny/1.67) = 0.355 |
| | Pn/1.67 (kip) = 290.38 | Pa/(Pn/1.67) = 0.355 |

**CONTROLLING COLUMN FORCES - FLEXURE**

**Load Combination: 1.140 D + 0.700 E1**

| | | | |
|---|---|---|---|
| Axial | | Load (kip) | 102.94 |
| Moment | Top | Mmajor (kip-ft) | -0.00 |
| | | Mminor (kip-ft) | 0.00 |
| Moment | Bot. | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |

**CALCULATED PARAMETERS:**

| | | | |
|---|---|---|---|
| Pa (kip) | = 102.94 | Pn/1.67 (kip) | = 290.38 |
| Max (kip-ft) | = -0.00 | Mnx/1.67 (kip-ft) | = 148.55 |
| May (kip-ft) | = 0.00 | Mny/1.67 (kip-ft) | = 148.55 |
| KL/Rx | = 78.75 | KL/Ry | = 78.75 |
| Cbx | = 1.00 | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.355

Eq H1-1a: 0.355 + 8/9(0.000 + 0.000) = 0.355

# Member Code Check

| | |
|---|---|
| RAM Frame 15.08.00.37 | Page 13/18 |
| DataBase: 18054_Kimberly Clark Addition_20180416 | 05/07/18 14:31:49 |
| Building Code: IBC | Steel Code: AISC360-10 ASD |

**BEAM INFORMATION:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Story Level | = | Roof | Frame Number | = | 2 | Beam Number = | 336 |
| Fy (ksi) | = | 50.00 | | | | | |
| Beam Size | = | W33X118 | | | | | |

**INPUT DESIGN PARAMETERS:**

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 58.00 | 18.00 |
| Lu for Bending (ft) | 58.00 | 18.00 |
| K | 1.00 | 1.00 |
| Top Flange Continuously Braced | No | |
| Bottom Flange Continuously Braced | No | |

**CONTROLLING BEAM SEGMENT FORCES - SHEAR**

**Load Combination: 1.000 D + 0.750 Lp + 0.750 Sp**

| | |
|---|---|
| Segment distance (ft) i - end | 0.00 |
| j - end | 58.00 |

**SHEAR CHECK:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Vax (kip) | = | -48.42 | Vnx/1.67 (kip) | = | 325.06 | Vax/(Vnx/1.67) = | 0.149 |
| Vay (kip) | = | 0.00 | Vny/1.67 (kip) | = | 305.75 | Vay/(Vny/1.67) = | 0.000 |

**CONTROLLING BEAM SEGMENT FORCES - AXIAL**

**Load Combination: 0.460 D + 0.700 E1**

| | |
|---|---|
| Segment distance (ft) i - end | 0.00 |
| j - end | 5.80 |

**AXIAL CHECK:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pa (kip) | = | 74.96 | Pnx/1.67 (kip) | = | 818.95 | Pa/(Pnx/1.67) = | 0.092 |
| | | | Pny/1.67 (kip) | = | 543.94 | Pa/(Pny/1.67) = | 0.138 |
| | | | Pn/1.67 (kip) | = | 543.94 | Pa/(Pn/1.67) = | 0.138 |

**CONTROLLING BEAM SEGMENT FORCES - FLEXURE**

**Load Combination: 1.000 D + 0.750 Lp + 0.750 Sp + 0.450 W1**

| | |
|---|---|
| Segment distance (ft) i - end | 23.20 |
| j - end | 29.00 |

**CALCULATED PARAMETERS:**

| | | | | | |
|---|---|---|---|---|---|
| Pa ( kip) | = | 4.55 | Pnx/1.67 ( kip) | = | 818.95 |
| | | | Pny/1.67 ( kip) | = | 543.94 |
| Max (kip-ft) | = | 774.55 | Mnx/1.67 (kip-ft) | = | 785.57 |
| May (kip-ft) | = | 0.00 | Mny/1.67 (kip-ft) | = | 127.99 |
| | | | Mcx (kip-ft) | = | 773.35 |
| KL/Rx | = | 53.38 | KL/Ry | = | 93.05 |
| Cbx | = | 1.02 | | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.006

Eq H1-2: 0.013 + 0.972 = 0.985

Eq H1-1b Per H1.3: 0.003 + 0.986 + 0.000 = 0.989

# Member Code Check



**BEAM INFORMATION:**

| | | | | | |
|---|---|---|---|---|---|
| Story Level | = Roof | Frame Number | = 2 | Beam Number | = 391 |
| Fy (ksi) | = 50.00 | | | | |
| Beam Size | = W33X118 | | | | |

**INPUT DESIGN PARAMETERS:**

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 58.00 | 18.00 |
| Lu for Bending (ft) | 58.00 | 18.00 |
| K | 1.00 | 1.00 |
| Top Flange Continuously Braced | No | |
| Bottom Flange Continuously Braced | No | |

**CONTROLLING BEAM SEGMENT FORCES - SHEAR**

**Load Combination: 1.000 D + 1.000 Sp**

| | |
|---|---|
| Segment distance (ft) i - end | 52.20 |
| j - end | 58.00 |

**SHEAR CHECK:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Vax (kip) | = | -36.04 | Vnx/1.67 (kip) | = 325.06 | Vax/(Vnx/1.67) | = | 0.111 |
| Vay (kip) | = | 0.00 | Vny/1.67 (kip) | = 305.75 | Vay/(Vny/1.67) | = | 0.000 |

**CONTROLLING BEAM SEGMENT FORCES - AXIAL**

**Load Combination: 0.460 D + 0.700 E3**

| | |
|---|---|
| Segment distance (ft) i - end | 0.00 |
| j - end | 5.80 |

**AXIAL CHECK:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pa (kip) | = | 74.96 | Pnx/1.67 (kip) | = 818.95 | Pa/(Pnx/1.67) | = | 0.092 |
| | | | Pny/1.67 (kip) | = 543.94 | Pa/(Pny/1.67) | = | 0.138 |
| | | | Pn/1.67 (kip) | = 543.94 | Pa/(Pn/1.67) | = | 0.138 |

**CONTROLLING BEAM SEGMENT FORCES - FLEXURE**

**Load Combination: 1.000 D + 1.000 Sp**

| | |
|---|---|
| Segment distance (ft) i - end | 23.20 |
| j - end | 29.00 |

**CALCULATED PARAMETERS:**

| | | | | | |
|---|---|---|---|---|---|
| Pa (kip) | = | -0.00 | Pn/1.67 (kip) | = | 1038.92 |
| Max (kip-ft) | = | 575.16 | Mnx/1.67 (kip-ft) | = | 785.45 |
| May (kip-ft) | = | 0.00 | Mny/1.67 (kip-ft) | = | 127.99 |
| Cbx | = | 1.02 | | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.000

Eq H1-1b: 0.000 + 0.732 + 0.000 = 0.732

# Member Code Check

RAM Frame 15.08.00.37 | Page 15/18
DataBase: 18054_Kimberly Clark Addition_20180416 | 05/07/18 14:31:49
Building Code: IBC | Steel Code: AISC360-10 ASD

**BRACE INFORMATION:**

Story Level = Roof    Frame Number = 2    Brace Number = 5
Fy (ksi) = 46.00
Brace Size = HSS6X6X3/8

**INPUT DESIGN PARAMETERS:**

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 65.76 | 65.76 |
| Lu for Bending (ft) | 65.76 | 65.76 |
| K | 1.00 | 1.00 |

**CONTROLLING BRACE FORCES - SHEAR**

**Load Combination: 1.000 D**

| | | | |
|---|---|---|---|
| Shear | Top | Vmajor (kip) | -0.00 |
| | | Vminor (kip) | 0.00 |
| Shear | Bot. | Vmajor (kip) | -0.00 |
| | | Vminor (kip) | 0.00 |

**SHEAR CHECK:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Vax (kip) | = | -0.00 | Vnx/1.67 (kip) | = | 57.14 | Vax/(Vnx/1.67) | = | 0.000 |
| Vay (kip) | = | 0.00 | Vny/1.67 (kip) | = | 57.14 | Vay/(Vny/1.67) | = | 0.000 |

**CONTROLLING BRACE FORCES - AXIAL**

**Load Combination: 1.140 D + 0.700 E3**

**AXIAL CHECK:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Pa (kip) | = | 144.50 | Pnx/1.67 (kip) | = | 208.79 | Pa/(Pnx/1.67) | = | 0.692 |
| | | | Pny/1.67 (kip) | = | 208.79 | Pa/(Pny/1.67) | = | 0.692 |
| | | | Pn/1.67 (kip) | = | 208.79 | Pa/(Pn/1.67) | = | 0.692 |

**CONTROLLING BRACE FORCES - FLEXURE**

**Load Combination: 1.140 D + 0.700 E3**

| | | | |
|---|---|---|---|
| Axial | | Load (kip) | -144.50 |
| Moment | Top | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |
| Moment | Bot. | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |

**CALCULATED PARAMETERS:**

| | | | | | |
|---|---|---|---|---|---|
| Pa (kip) | = | -144.50 | Pn/1.67 (kip) | = | 208.79 |
| Max (kip-ft) | = | 0.00 | Mnx/1.67 (kip-ft) | = | 36.27 |
| May (kip-ft) | = | 0.00 | Mny/1.67 (kip-ft) | = | 36.27 |
| Cbx | = | 1.00 | | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.692
Eq H1-1a: 0.692 + 8/9(0.000 + 0.000) = 0.692

# Member Code Check



**BRACE INFORMATION:**

| | | | | |
|---|---|---|---|---|
| Story Level = Roof | | Frame Number = 2 | | Brace Number = 6 |
| Fy (ksi) = 46.00 | | | | |
| Brace Size = HSS6X6X3/8 | | | | |

**INPUT DESIGN PARAMETERS:**

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 65.76 | 65.76 |
| Lu for Bending (ft) | 65.76 | 65.76 |
| K | 1.00 | 1.00 |

**CONTROLLING BRACE FORCES - SHEAR**

**Load Combination: 1.000 D**

| | | | |
|---|---|---|---|
| Shear | Top | Vmajor (kip) | -0.00 |
| | | Vminor (kip) | 0.00 |
| Shear | Bot. | Vmajor (kip) | -0.00 |
| | | Vminor (kip) | 0.00 |

**SHEAR CHECK:**

| | | | | | |
|---|---|---|---|---|---|
| Vax (kip) = | -0.00 | Vnx/1.67 (kip) = | 57.14 | Vax/(Vnx/1.67) = | 0.000 |
| Vay (kip) = | 0.00 | Vny/1.67 (kip) = | 57.14 | Vay/(Vny/1.67) = | 0.000 |

**CONTROLLING BRACE FORCES - AXIAL**

**Load Combination: 1.140 D + 0.700 E1**

**AXIAL CHECK:**

| | | | | | |
|---|---|---|---|---|---|
| Pa (kip) = | 152.99 | Pnx/1.67 (kip) = | 208.79 | Pa/(Pnx/1.67) = | 0.733 |
| | | Pny/1.67 (kip) = | 208.79 | Pa/(Pny/1.67) = | 0.733 |
| | | Pn/1.67 (kip) = | 208.79 | Pa/(Pn/1.67) = | 0.733 |

**CONTROLLING BRACE FORCES - FLEXURE**

**Load Combination: 1.140 D + 0.700 E1**

| | | | |
|---|---|---|---|
| Axial | | Load (kip) | -152.99 |
| Moment | Top | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |
| Moment | Bot. | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |

**CALCULATED PARAMETERS:**

| | | | |
|---|---|---|---|
| Pa (kip) = | -152.99 | Pn/1.67 (kip) = | 208.79 |
| Max (kip-ft) = | 0.00 | Mnx/1.67 (kip-ft) = | 36.27 |
| May (kip-ft) = | 0.00 | Mny/1.67 (kip-ft) = | 36.27 |
| Cbx = | 1.00 | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.733

Eq H1-1a: 0.733 + 8/9(0.000 + 0.000) = 0.733

# Member Code Check

RAM Frame 15.08.00.37 | Page 17/18
DataBase: 18054_Kimberly Clark Addition_20180416 | 05/07/18 14:31:49
Building Code: IBC | Steel Code: AISC360-10 ASD

RAM Structural System
Bentley

**BRACE INFORMATION:**

Story Level = Roof    Frame Number = 2    Brace Number = 7
Fy (ksi) = 46.00
Brace Size = HSS6X6X3/8

**INPUT DESIGN PARAMETERS:**

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 65.76 | 65.76 |
| Lu for Bending (ft) | 65.76 | 65.76 |
| K | 1.00 | 1.00 |

**CONTROLLING BRACE FORCES - SHEAR**

**Load Combination: 1.000 D**

| | | | |
|---|---|---|---|
| Shear | Top | Vmajor (kip) | -0.00 |
| | | Vminor (kip) | 0.00 |
| Shear | Bot. | Vmajor (kip) | -0.00 |
| | | Vminor (kip) | 0.00 |

**SHEAR CHECK:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Vax (kip) | = | -0.00 | Vnx/1.67 (kip) | = | 57.14 | Vax/(Vnx/1.67) | = | 0.000 |
| Vay (kip) | = | 0.00 | Vny/1.67 (kip) | = | 57.14 | Vay/(Vny/1.67) | = | 0.000 |

**CONTROLLING BRACE FORCES - AXIAL**

**Load Combination: 1.140 D + 0.700 E3**

**AXIAL CHECK:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Pa (kip) | = | 152.99 | Pnx/1.67 (kip) | = | 208.79 | Pa/(Pnx/1.67) | = | 0.733 |
| | | | Pny/1.67 (kip) | = | 208.79 | Pa/(Pny/1.67) | = | 0.733 |
| | | | Pn/1.67 (kip) | = | 208.79 | Pa/(Pn/1.67) | = | 0.733 |

**CONTROLLING BRACE FORCES - FLEXURE**

**Load Combination: 1.140 D + 0.700 E3**

| | | | |
|---|---|---|---|
| Axial | | Load (kip) | -152.99 |
| Moment | Top | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |
| Moment | Bot. | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |

**CALCULATED PARAMETERS:**

| | | | | | |
|---|---|---|---|---|---|
| Pa (kip) | = | -152.99 | Pn/1.67 (kip) | = | 208.79 |
| Max (kip-ft) | = | 0.00 | Mnx/1.67 (kip-ft) | = | 36.27 |
| May (kip-ft) | = | 0.00 | Mny/1.67 (kip-ft) | = | 36.27 |
| Cbx | = | 1.00 | | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.733
Eq H1-1a: 0.733 + 8/9(0.000 + 0.000) = 0.733

# Member Code Check

RAM Structural System
Bentley

| | |
|---|---|
| RAM Frame 15.08.00.37 | Page 18/18 |
| DataBase: 18054_Kimberly Clark Addition_20180416 | 05/07/18 14:31:49 |
| Building Code: IBC | Steel Code: AISC360-10 ASD |

**BRACE INFORMATION:**

| | | | | |
|---|---|---|---|---|
| Story Level | = Roof | Frame Number = 2 | Brace Number = 8 |
| Fy (ksi) | = 46.00 | | |
| Brace Size | = HSS6X6X3/8 | | |

**INPUT DESIGN PARAMETERS:**

| | X-Axis | Y-Axis |
|---|---|---|
| Lu for Axial (ft) | 65.76 | 65.76 |
| Lu for Bending (ft) | 65.76 | 65.76 |
| K | 1.00 | 1.00 |

**CONTROLLING BRACE FORCES - SHEAR**

**Load Combination: 1.000 D**

| | | | |
|---|---|---|---|
| Shear | Top | Vmajor (kip) | -0.00 |
| | | Vminor (kip) | 0.00 |
| Shear | Bot. | Vmajor (kip) | -0.00 |
| | | Vminor (kip) | 0.00 |

**SHEAR CHECK:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Vax (kip) | = | -0.00 | Vnx/1.67 (kip) | = | 57.14 | Vax/(Vnx/1.67) | = | 0.000 |
| Vay (kip) | = | 0.00 | Vny/1.67 (kip) | = | 57.14 | Vay/(Vny/1.67) | = | 0.000 |

**CONTROLLING BRACE FORCES - AXIAL**

**Load Combination: 1.140 D + 0.700 E1**

**AXIAL CHECK:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Pa (kip) | = | 144.50 | Pnx/1.67 (kip) | = | 208.79 | Pa/(Pnx/1.67) | = | 0.692 |
| | | | Pny/1.67 (kip) | = | 208.79 | Pa/(Pny/1.67) | = | 0.692 |
| | | | Pn/1.67 (kip) | = | 208.79 | Pa/(Pn/1.67) | = | 0.692 |

**CONTROLLING BRACE FORCES - FLEXURE**

**Load Combination: 1.140 D + 0.700 E1**

| | | | |
|---|---|---|---|
| Axial | | Load (kip) | -144.50 |
| Moment | Top | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |
| Moment | Bot. | Mmajor (kip-ft) | 0.00 |
| | | Mminor (kip-ft) | 0.00 |

**CALCULATED PARAMETERS:**

| | | | | | |
|---|---|---|---|---|---|
| Pa (kip) | = | -144.50 | Pn/1.67 (kip) | = | 208.79 |
| Max (kip-ft) | = | 0.00 | Mnx/1.67 (kip-ft) | = | 36.27 |
| May (kip-ft) | = | 0.00 | Mny/1.67 (kip-ft) | = | 36.27 |
| Cbx | = | 1.00 | | | |

**INTERACTION EQUATION:**

Pa/(Pn/1.67)),=,0.692

Eq H1-1a: 0.692 + 8/9(0.000 + 0.000) = 0.692

# Frame Reaction Envelope

RAM Structural System
Bentley

RAM Frame 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416 05/07/18 14:32:47
Building Code: IBC

**CRITERIA:**

| | | | |
|---|---|---|---|
| Rigid End Zones: | | Ignore Effects | |
| Member Force Output: | | At Face of Joint | |
| P-Delta: | Yes | Scale Factor: | 1.00 |
| Ground Level: | Base | | |

Mesh Criteria :

Max. Distance Between Nodes on Mesh Line (ft) : 4.00
Merge Node Tolerance (in) : 0.0100
Geometry Tolerance (in) : 0.0050

Walls Out-of-plane Stiffness Included in Analysis.

Rotational Fixities Released at Wall Foundation Nodes.

Sign considered for Dynamic Load Case Results.

Rigid Links Included at Fixed Beam-to-Wall Locations

Eigenvalue Analysis : Eigen Vectors (Subspace Iteration)

**LOAD COMBINATION CRITERIA:**

| | |
|---|---|
| Roof Live Load: | Snow |
| Snow Factor | Do Not Include Snow in Combinations with Seismic |
| Sds (for Ev) | 0.998 |
| Omega_o | 2.000 |

**LOAD CASE DEFINITIONS:**

| | | |
|---|---|---|
| D | DeadLoad | RAMUSER |
| Lp | PosLiveLoad | RAMUSER |
| E1 | EQX | EQ_ASCE710_X_+E_F |
| E2 | EQX | EQ_ASCE710_X_-E_F |
| E3 | EQX | EQ_ASCE710_-X_+E_F |
| E4 | EQX | EQ_ASCE710_-X_-E_F |
| E5 | EQY | EQ_ASCE710_Y_+E_F |
| E6 | EQY | EQ_ASCE710_Y_-E_F |
| E7 | EQY | EQ_ASCE710_-Y_+E_F |
| E8 | EQY | EQ_ASCE710_-Y_-E_F |

**LOAD COMBINATIONS: IBC 2015 / ASCE 7-10 ASD**

| | | |
|---|---|---|
| 1 | * | 1.140 D + 1.400 E1 |
| 2 | * | 1.140 D + 1.400 E2 |
| 3 | * | 1.140 D + 1.400 E3 |
| 4 | * | 1.140 D + 1.400 E4 |
| 5 | * | 1.140 D + 1.400 E5 |
| 6 | * | 1.140 D + 1.400 E6 |
| 7 | * | 1.140 D + 1.400 E7 |
| 8 | * | 1.140 D + 1.400 E8 |
| 9 | * | 1.105 D + 0.750 Lp + 1.050 E1 |
| 10 | * | 1.105 D + 0.750 Lp + 1.050 E2 |
| 11 | * | 1.105 D + 0.750 Lp + 1.050 E3 |
| 12 | * | 1.105 D + 0.750 Lp + 1.050 E4 |
| 13 | * | 1.105 D + 0.750 Lp + 1.050 E5 |

| | | |
|---|---|---|
| 14 | * | 1.105 D + 0.750 Lp + 1.050 E6 |
| 15 | * | 1.105 D + 0.750 Lp + 1.050 E7 |
| 16 | * | 1.105 D + 0.750 Lp + 1.050 E8 |
| 17 | * | 0.460 D + 1.400 E1 |
| 18 | * | 0.460 D + 1.400 E2 |
| 19 | * | 0.460 D + 1.400 E3 |
| 20 | * | 0.460 D + 1.400 E4 |
| 21 | * | 0.460 D + 1.400 E5 |
| 22 | * | 0.460 D + 1.400 E6 |
| 23 | * | 0.460 D + 1.400 E7 |
| 24 | * | 0.460 D + 1.400 E8 |

* = Load combination currently selected to use
*Code checks requiring Emh use (+ 1.000 Emh) for LRFD and (+ 0.700 Emh) for ASD in a set of generated load combinations independent of the combinations shown above.*

**REACTION MAXIMA AND MINIMA:**

**Frame #1:**

| **Node** | | **Rx kips** | **Ry kips** | **Rz kips** | **Mxx kip-ft** | **Myy kip-ft** | **Tzz kip-ft** |
|---|---|---|---|---|---|---|---|
| 37 | Max: | 0.00 | 0.00 | 198.09 | 0.00 | 0.00 | 0.00 |
| | LC: | 3 | 1 | 3 | 1 | 1 | 1 |
| | Min: | -269.86 | 0.00 | -119.25 | 0.00 | 0.00 | 0.00 |
| | LC: | 1 | 1 | 17 | 1 | 1 | 1 |
| 38 | Max: | 254.87 | 0.00 | 82.37 | 0.00 | 0.00 | 0.00 |
| | LC: | 3 | 1 | 9 | 1 | 1 | 1 |
| | Min: | -254.87 | 0.00 | 24.98 | 0.00 | 0.00 | 0.00 |
| | LC: | 1 | 1 | 21 | 1 | 1 | 1 |
| 39 | Max: | 269.86 | 0.00 | 198.09 | 0.00 | 0.00 | 0.00 |
| | LC: | 3 | 1 | 1 | 1 | 1 | 1 |
| | Min: | -0.00 | 0.00 | -119.25 | 0.00 | 0.00 | 0.00 |
| | LC: | 1 | 1 | 19 | 1 | 1 | 1 |

**Frame #2:**

| **Node** | | **Rx kips** | **Ry kips** | **Rz kips** | **Mxx kip-ft** | **Myy kip-ft** | **Tzz kip-ft** |
|---|---|---|---|---|---|---|---|
| 40 | Max: | 0.00 | 0.00 | 198.09 | 0.00 | 0.00 | 0.00 |
| | LC: | 19 | 1 | 3 | 1 | 1 | 1 |
| | Min: | -269.86 | 0.00 | -119.25 | 0.00 | 0.00 | 0.00 |
| | LC: | 1 | 1 | 17 | 1 | 1 | 1 |
| 41 | Max: | 254.87 | 0.00 | 61.07 | 0.00 | 0.00 | 0.00 |
| | LC: | 3 | 1 | 9 | 1 | 1 | 1 |
| | Min: | -254.87 | 0.00 | 19.52 | 0.00 | 0.00 | 0.00 |

# Frame Reaction Envelope



| Node | | Rx | Ry | Rz | Mxx | Myy | Tzz |
|---|---|---|---|---|---|---|---|
| | LC: | 1 | 1 | 21 | 1 | 1 | 1 |
| 42 | Max: | 269.86 | 0.00 | 171.06 | 0.00 | 0.00 | 0.00 |
| | LC: | 3 | 1 | 1 | 1 | 1 | 1 |
| | Min: | -0.00 | 0.00 | -130.17 | 0.00 | 0.00 | 0.00 |
| | LC: | 1 | 1 | 19 | 1 | 1 | 1 |

Main Diaphragm Design

Weight total = 5240k

Weight N-S = (5240k) − 116psf(21ft × 252ft × 2) = 4013 k

Weight E-W = 5240k − 116 psf(21ft × 640ft) = 3681 k

$f_{PS\,min}$ = 0.2(0.998) W = 800 k N-S (ult)

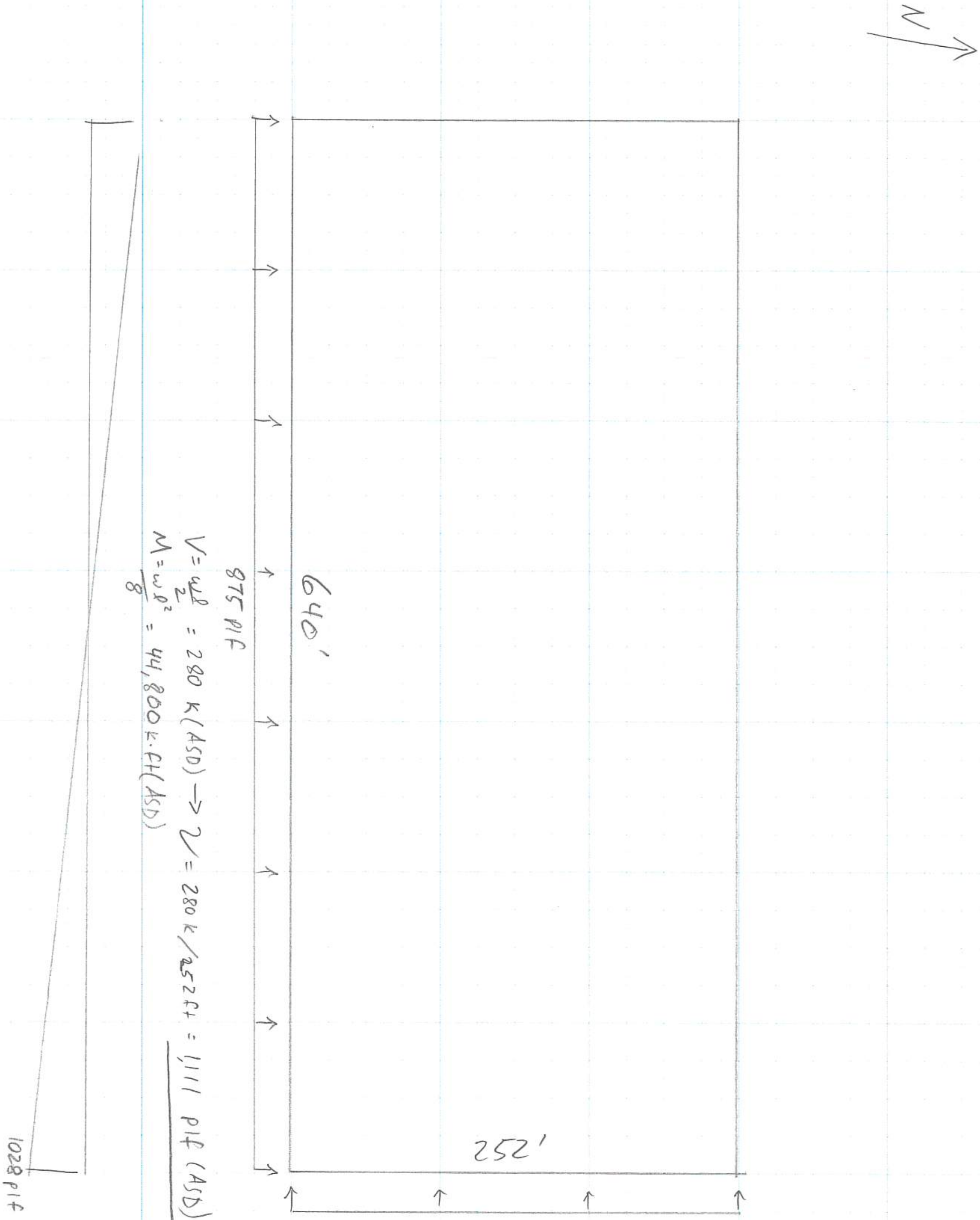
735 k E-W (ult)

$F_{NS}$ => $C_s$ = 0.166 V = 666 k

$F_{EW}$ => $C_s$ = 0.307 V = 1130 k

$f_{PS\,NS}$ = 800k (ult) = 560k (ASD)

$f_{PS\,EW}$ = 1130 k (ult) = 791k (ASD)




875 plf

$V = \frac{wl}{2} = 280\text{ k (ASD)} \rightarrow v = 280\text{ k}/252\text{ ft} = 1111\text{ plf (ASD)}$

$M = \frac{wl^2}{8} = 44{,}800\text{ k·ft (ASD)}$

3.2 k/ft

$V = w l/2 \quad 396\text{ kips} \rightarrow v = 396\text{k}/640' = 619\text{ plf (ASD)}$

$M = wl^2/8 = 25{,}402\text{k·ft (ASD)}$

Grid N OOP Anchorage

Wall weight = 150pcf(0.77ft) = 116 psf (ult)

$F_p$ = 0.8 (0.998)(116 psf) = 93 psf (ult)

trib width = 38/2 + 2 = 21 ft

$F_p$ line load = 1.95 klf (ult)

trib length = 5.8 ft/2 = 2.9 ft

OOP load on Ea Embed = 5.7 k (ult)

OOP load to design Angle = 11.31 k (ult)

Use L5x5x 7/16 Angle - See Enercalc
(2) HSA's ok (3/4" w/ 5" Embed) See Profis

ARW ENGINEERS structural consultants

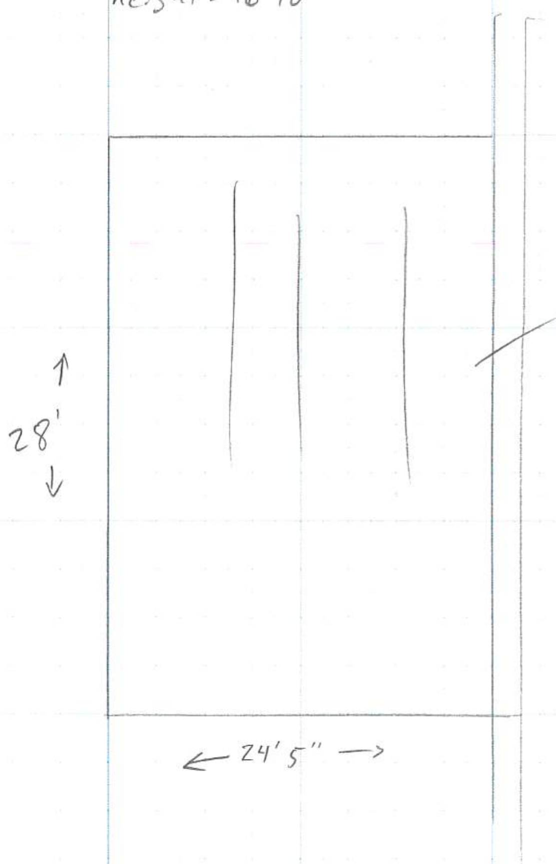
Project No. 18054 Sheet No. 

Project Kimberly Clark Addition

Prepared By SJV Date 4/13/18

## Electrical Room

height = 16'10"




(4) Spaces @ 6.1'

$\boxed{W12x19}$ – See Enercalc

Weight = 20psf (24.5x28) + 48psf (8.4x77) = $\underline{44.8k}$

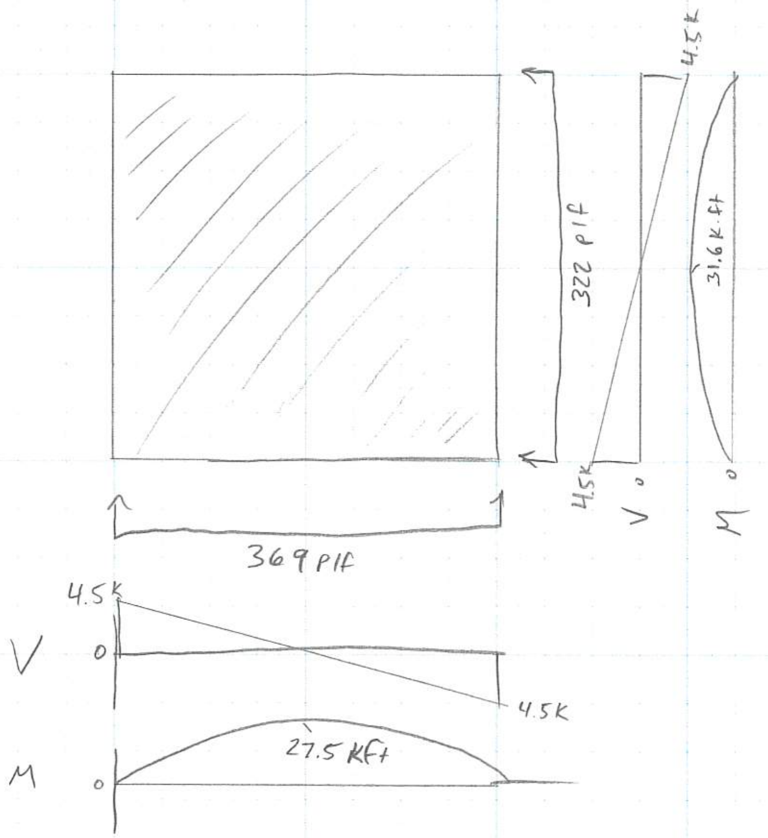
$\underline{\text{Use 45k}}$

$S_{DS} = 0.998$   $R = 5$   $I_e = 1.0$

$$C_s = \frac{0.998}{\frac{5}{1.0}} = 0.2 \qquad V = C_s W = 9k$$

$9k/2 = 4.5k/\text{wall}$

Electrical Room Diaph.




Diaph req'd capacity

N-S → 4.5k / 28 ft = 161 plf (ult)
E-W → 4.5k / 24'5" = 184 plf (ult)

Electrical Room

Roof framing - W Beams 28' Span; 6.1' trib width

Assumed dead load = 20 psf
Snow load = 30 psf

Use W12x19 - See Enercalc

Seismic

roof, walls

Weight - 20psf(28' x 24.5') + 48psf($\frac{16'10''}{2}$ x Length)

W = 44.8K -> Use 45K

$S_{DS}$ = 0.998 R = 5 (Special Masonry wall)

$C_s = \frac{0.998}{\left(\frac{5}{1.0}\right)} = 0.2$

V = $C_s$W = 9 K -> 4.5 K/wall

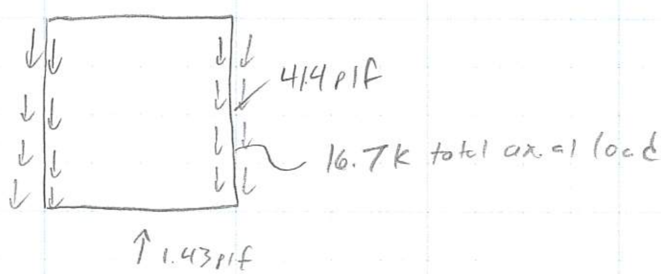
Conc. Wall OOP Subdiaph. Check

OOP Force = 22ft(9.25")(150pcf)(0.8)(0.998) = 2.04 k/lf (ult)
= 1.43 k/lf (ASD)

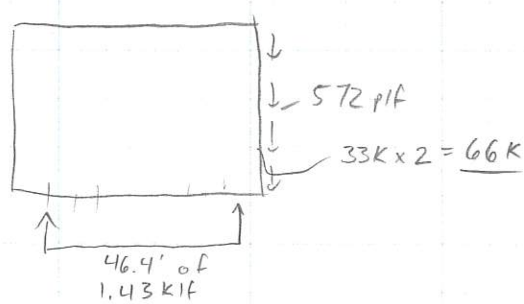
$B_{eq}$ = 58' x 20' = 2.9:1 NG for Subdiaph.

Use 11.3' x 20' = 0.57:1 ok

Diaph. Capacity = 966 plf




58x58 ft Diaph.



ARW ENGINEERS structural consultants

**MSJC 2013 ASD Reinforced Masonry Shear Piers**

Version Date: August 25, 2017 Author: DLP Reviewed By: TMD

09-Jul-13
10:21 AM

JOB TITLE: Kimberly Clark Addition
WALL LOCATION: Electrical Room West Wall
JOB #: 17022
DESIGNED BY: TMD

| | | | | | |
|---|---|---|---|---|---|
| Total Lateral Force **ASD** = | 5 kips | $f'_m$ = | 2000 psi | Running Bond = | Yes |
| $F_y$ = | 60000 psi | $F_s$ (For Horiz. Steel) = | 25600 psi | | |
| Special Reinforced Wall = | Yes | $F_s$ (For Vert. Steel) = | 25600 psi | | |
| | | $E_m$ = | 1800000 psi | | |
| | | $E_v$ = | 720000 psi | | |

| PIER I.D. | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| Pier Height, H (ft) = | 16.8 ft | | | | | | | |
| Pier Length, L (ft) = | 28.0 ft | | | | | | | |
| **Nominal Wall Thickness (in) =** | **8 in** | | | | | | | |
| Shear Equivalent Solid Thickness (in) = | 3.8 in | | | | | | | |
| Bending Equivalent Solid Thickness (in) = | 7.6 in | | | | | | | |
| Total Vertical Load, P **ASD** (kips) = | 1.0 kip | | | | | | | |
| Fixity = | F-P | | | | | | | |
| Wall Weight (psf) = | 48.0 psf | | | | | | | |
| **d** to Tension $A_s$ (ft) = | 25.2 ft | | | | | | | |
| Parially Grouted = | Yes | | | | | | | |
| **RIGIDITY DATA** | | | | | | | | |
| Relative Deflection = | 0.04 | | | | | | | |
| Rigidity = | 28.53 | | | | | | | |
| Σ of Rigidity = | | | | 28.53 | | | | |
| % of Force to Pier = | 100% | | | | | | | |
| V (kips) = | 5 kips | | | | | | | |
| M/V*d = | 0.67 | | | | | | | |
| **SHEAR REINFORCEMENT** | | | | | | | | |
| $f_v$ (psi) = | 5.9 psi | | | | | | | |
| $A_n$ ($in^2$) = | 1276.8 | | | | | | | |
| $F_{vm}$ (psi) = | 31.8 psi | | | | | | | |
| $A_{v\ req'd}$ ($in^2$/ft) = | 0.00 | | | | | | | |
| **# of Horizontal Bars =** | **2** | | | | | | | |
| **Bar size =** | **#4 bars** | | | | | | | |
| $A_v$ ($in^2$) = | 0.4 | | | | | | | |
| Max Horizontal Reinforcing Spacing, s (in) = | 48 in | | | | | | | |
| Required Horizontal Spacing, $s_{eq'd}$ (in) = | 48 in | | | | | | | |
| **s (in) =** | **48 in** | | | | | | | |
| Min $A_v$ check = | **OK** | | | | | | | |
| Min Horizontal Reinforcing Spacing Check = | **OK** | | | | | | | |
| $F_{vs}$ (psi) = | 25.3 psi | | | | | | | |
| $F_v$ (psi) = | 57.1 psi OK | | | | | | | |
| **BENDING REINFORCEMENT** | | | | | | | | |
| Resisting Moment (k-ft) = | 285.06 | | | | | | | |
| Overturning Moment (k-ft) = | 75.75 | | | | | | | |
| Moment at End (k-ft) = | 0.00 | | | | | | | |
| $F_b$ (psi) = | 900 | | | | | | | |
| $f_a$ (psi) at Base of Wall = | 9.22 | | | | | | | |
| Allowable $f_b$ (psi) = | 890.78 | | | | | | | |
| n = | 16.11 | | | | | | | |
| 2/kj = | 0.00 | | | | | | | |
| k = | 0.00 | | | | | | | |
| np (per 2/kj) = | 0.0000 | | | | | | | |
| npj = | 0.0000 | | | | | | | |
| np (per npj) = | 0.0000 | | | | | | | |
| Max np = | 0.0000 | | | | | | | |
| $\rho_{p\ req'd}$ = | 0.0000 | | | | | | | |
| Bending $A_s$ Required ($in^2$) = | 0.00 | | | | | | | |
| **# of Bending Bars =** | **1** | | | | | | | |
| **Bar size =** | **#5 bars** | | | | | | | |
| Bending $A_s$ Provided ($in^2$) = | 0.31 | | | | | | | |
| Reinforcing Check = | **OK** | | | | | | | |
| $\rho_{provided}$ = | 0.0001 | | | | | | | |
| $\rho_{max}$ = | 0.0058 | | | | | | | |
| Maximum Reinforcement Ratio = | **OK** | | | | | | | |
| **VERTICAL REINFORCEMENT** | | | | | | | | |
| Min Area of Vertical Reinforcement, ($in^2$/ft) = | **0.08** | | | | | | | |
| **Bars Each Face? =** | No | | | | | | | |
| **Bar size =** | **#5 bars** | | | | | | | |
| $A_{vert}$ ($in^2$/ft) = | 0.12 | | | | | | | |
| Max Vertical Reinforcement Spacing, s (in) = | 48 in | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **s (in) =** | **32 in** | | | | | | | |
| Min Vertical Reinforcement Check, ($in^2$/ft) = | **OK** | | | | | | | |
| Min Vertical Reinforcement Spacing Check = | **OK** | | | | | | | |

ENGINEERS
structural consultants

**MSJC 2013 ASD Reinforced Masonry Shear Piers**
Version Date: August 25, 2017 Author: DLP Reviewed By: TMD
09-Jul-13
10:21 AM

JOB TITLE: Kimberly Clark Addition
WALL LOCATION: Electrical Room N&S Walls
JOB #: 17022
DESIGNED BY: TMD

| | | | | | |
|---|---|---|---|---|---|
| Total Lateral Force **ASD** = | 5 kips | $f'_m$ = | 2000 psi | Running Bond = | Yes |
| $F_y$ = | 60000 psi | $F_s$ (For Horiz. Steel) = | 25600 psi | | |
| Special Reinforced Wall = | Yes | $F_s$ (For Vert. Steel) = | 25600 psi | | |
| | | $E_m$ = | 1800000 psi | | |
| | | $E_v$ = | 720000 psi | | |

| **PIER I.D.** | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| Pier Height, H (ft) = | 16.8 ft | | | | | | | |
| Pier Length, L (ft) = | 24.4 ft | | | | | | | |
| **Nominal Wall Thickness (in) =** | **8 in** | | | | | | | |
| Shear Equivalent Solid Thickness (in) = | 3.8 in | | | | | | | |
| Bending Equivalent Solid Thickness (in) = | 7.6 in | | | | | | | |
| Total Vertical Load, P **ASD** (kips) = | 1.0 kip | | | | | | | |
| Fixity = | F-P | | | | | | | |
| Wall Weight (psf) = | 48.0 psf | | | | | | | |
| **d** to Tension $A_s$ (ft) = | 22.0 ft | | | | | | | |
| Parially Grouted = | Yes | | | | | | | |
| **RIGIDITY DATA** | | | | | | | | |
| Relative Deflection = | 0.04 | | | | | | | |
| Rigidity = | 22.57 | | | | | | | |
| Σ of Rigidity = | | | | 22.57 | | | | |
| % of Force to Pier = | 100% | | | | | | | |
| V (kips) = | 5 kips | | | | | | | |
| M/V*d = | 0.77 | | | | | | | |
| **SHEAR REINFORCEMENT** | | | | | | | | |
| $f_v$ (psi) = | 6.7 psi | | | | | | | |
| $A_n$ ($in^2$) = | 1113.4 | | | | | | | |
| $F_{vm}$ (psi) = | 30.0 psi | | | | | | | |
| $A_{v\ req'd}$ ($in^2$/ft) = | 0.00 | | | | | | | |
| **# of Horizontal Bars =** | **2** | | | | | | | |
| **Bar size =** | **#4 bars** | | | | | | | |
| $A_v$ ($in^2$) = | 0.4 | | | | | | | |
| Max Horizontal Reinforcing Spacing, s (in) = | 48 in | | | | | | | |
| Required Horizontal Spacing, $s_{eq'd}$ (in) = | 48 in | | | | | | | |
| **s (in) =** | **48 in** | | | | | | | |
| Min $A_v$ check = | **OK** | | | | | | | |
| Min Horizontal Reinforcing Spacing Check = | **OK** | | | | | | | |
| $F_{vs}$ (psi) = | 25.3 psi | | | | | | | |
| $F_v$ (psi) = | 55.2 psi OK | | | | | | | |
| **BENDING REINFORCEMENT** | | | | | | | | |
| Resisting Moment (k-ft) = | 216.76 | | | | | | | |
| Overturning Moment (k-ft) = | 75.75 | | | | | | | |
| Moment at End (k-ft) = | 0.00 | | | | | | | |
| $F_b$ (psi) = | 900 | | | | | | | |
| $f_a$ (psi) at Base of Wall = | 9.28 | | | | | | | |
| Allowable $f_b$ (psi) = | 890.72 | | | | | | | |
| n = | 16.11 | | | | | | | |
| 2/kj = | 0.00 | | | | | | | |
| k = | 0.00 | | | | | | | |
| np (per 2/kj) = | 0.0000 | | | | | | | |
| npj = | 0.0000 | | | | | | | |
| np (per npj) = | 0.0000 | | | | | | | |
| Max np = | 0.0000 | | | | | | | |
| $\rho_{p\ req'd}$ = | 0.0000 | | | | | | | |
| Bending $A_s$ Required ($in^2$) = | 0.00 | | | | | | | |
| **# of Bending Bars =** | **1** | | | | | | | |
| **Bar size =** | **#5 bars** | | | | | | | |
| Bending $A_s$ Provided ($in^2$) = | 0.31 | | | | | | | |
| Reinforcing Check = | **OK** | | | | | | | |
| $\rho_{provided}$ = | 0.0002 | | | | | | | |
| $\rho_{max}$ = | 0.0058 | | | | | | | |
| Maximum Reinforcement Ratio = | **OK** | | | | | | | |
| **VERTICAL REINFORCEMENT** | | | | | | | | |
| Min Area of Vertical Reinforcement, ($in^2$/ft) = | **0.08** | | | | | | | |
| **Bars Each Face? =** | No | | | | | | | |
| **Bar size =** | **#5 bars** | | | | | | | |
| $A_{vert}$ ($in^2$/ft) = | 0.12 | | | | | | | |
| Max Vertical Reinforcement Spacing, s (in) = | 48 in | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **s (in) =** | **32 in** | | | | | | | |
| Min Vertical Reinforcement Check, ($in^2/ft$) = | **OK** | | | | | | | |
| Min Vertical Reinforcement Spacing Check = | **OK** | | | | | | | |

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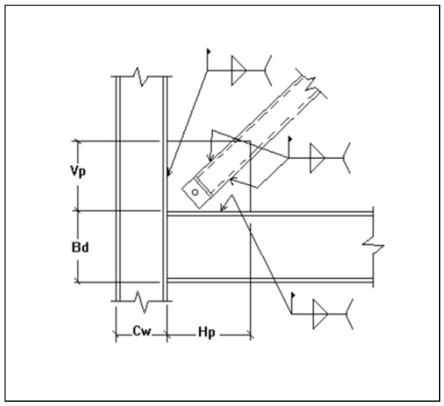
**Ordinary Concentric Braced Frame Gusset Plate Design (LRFD Forces)**
Version Date: June 7, 2016 Code: 14th Edition
JOB TITLE: Kimberly Clark Addition
DESCRIPTION: Grid H.1 Top of Brace
JOB #: 18054.00

## Column Width <> 0, Beam Depth <> 0

| Brace Connection Configuration | | | | | |
|---|---|---|---|---|---|
| Column Designation | | HSS12X12X3/8 | | | |
| Column Depth | Dc = | 12.00 inches | ec = | 6.00 inches | |
| Beam Designation | | W33X118 | | | |
| Beam Depth | Db = | 32.90 inches | eb = | 16.45 inches | |
| Brace Designation | | HSS6X6X3/8 | | | |
| Brace Depth | Dbrace = | 6.00 inches | ew = | 3.00 inches | |
| Brace Thickness | Tbrace = | 0.35 inches | | | |
| Angle of Brace to Vertical | Θ = | 63.00 degrees | 1.10 radians | | |
| | | | | | |
| Max. Dist. from Brace to Beam | d1 = | 1.00 inch | | | |
| Max. Dist from Brace to Column | d2 = | 1.00 inch | | | |
| Erection Bracket (angle) Leg Size | A = | 0.00 inches | | | |
| Erection Bolt Size | | 0.00 inches | | | |
| | | | | | |
| Gusset Plate Thickness | Gt = | 1 1/4 inches | | | |
| Gusset Plate Yield Strength | Fy = | 50.00 ksi | | | |

| Brace Forces | | |
|---|---|---|
| Factored Axial Force in Brace (incl | $P_u$ = | 472.00 kips |
| Horizontal Component of P | H = | 420.56 kips |
| Vertical Component of P | V = | 214.28 kips |




| Brace to Gusset Connection | | |
|---|---|---|
| Effective Weld Size | | 5/16 inches |
| Use Weld Size | | 5/16 inches |
| Total Weld Required | | 67.73 inches |
| Minimum Weld Length (Calculated) | | 16.93 inches |
| Minimum Weld Length Required (Actual) | | 17.00 inches |
| Minimum Weld Length Requested | | 10.00 inches |
| Weld Length (used) | l = | 17.00 inches |
| Safety Factor | | 1.00 OK |

| Check Block Tear-out of Gusset Plate | | |
|---|---|---|
| Design Gusset PL Shear Strength | $\phi V_n$= | 1275.00 kips |
| Design Gusset PL Tensile Strength | $\phi T_n$= | 330.47 kips |
| Maximum Load | $P_{u\_max}$= | 1605.47 kips |
| Safety Factor | | 3.40 OK |
| **Check Block Tear-out of Brace Wall** | | |
| Design Shear Strength | $\phi V_n$= | 655.00 kips OK |
| Safety Factor | | 1.39 OK |

| Check Tensile Rupture in the Net Section (Shear Lag) | | |
|---|---|---|
| Net Area | $A_n$= | 6.71 $in^2$ |
| Shear Lag Factor | U= | 0.87 |
| Effective Net Area | $A_e$= | 5.82 $in^2$ |
| Design Tensile Rupture Strength | $\phi F_u A_e$= | 253.16 kips |
| Overstrength Factor | $\Omega_o$= | 2.00 |
| Safety Factor | | 1.07 OK |

| Brace Tensile Yielding Capacity | | |
|---|---|---|
| Ratio $F_{ye}/F_y$ | $R_y$= | 1.30 $in^2$ |
| Specified Yield Stress | $F_y$= | 46.00 ksi |
| Gross Area of Brace | $A_g$= | 7.58 $in^2$ |
| Expected Strength | $R_yF_yA_g$= | 453.28 kips |
| Minimum $P_u/\Omega_o$ or $R_yF_yA_g$ | | 236.00 kips |

| User Requested Gusset Plate Size: | | | Calculated Gusset Plate Size: | | | Use Gusset Plate Size: | | |
|---|---|---|---|---|---|---|---|---|
| Length | Hp = | 0.00 inches | Length | Hp = | 51.00 inches | Use Length | Hp = | 51.00 inches |
| Height | Vp = | 0.00 inches | Height | Vp = | 15.00 inches | Use Height | Vp = | 15.00 inches |

| Gusset Plate Column Analogy | | | | | |
|---|---|---|---|---|---|
| Modified Whitmore Section Width | | MWS = | 16.94 inches | | |
| Factored stress $f_u$ = | 22.29 ksi | $\phi F_{cr}$ = | 44.59 ksi | | |
| Safety Factor = | 2.00 | fu<phiFcr - OK | | Stiffener Plate Req'd | NO |

| Gusset Weld Plate Weld Design | | | | |
|---|---|---|---|---|
| **Weld to Column** | | | **Weld to Beam** | |
| Requested Weld Size | 5/16 inch | | Requested Weld Size | 5/16 inch |
| Shear Stress (fv) | 2.24 kips/inch | | Shear Stress (fv) | 3.60 kips/inch |
| Tension Stress (ft) | 1.79 kips/inch | | Tension Stress (ft) | 1.44 kips/inch |
| Combined Stress (f) | 2.86 kips/inch | | Combined Stress (f) | 3.88 kips/inch |
| Min. Effect Weld Size (D) for Vp | 2.06 /16 inch | | Min Effect Weld Size (D) for Hp | 2.78 /16 inch |
| Use Minumum Weld Size (for Vp) | 0.19 inch | | Use Minumum Weld Size (for Hp) | 0.19 inch |
| Min. Weld Lth for Req. Weld Size | 6.17 inches | | Min. Weld Lth for Req. Weld Size | 28.36 inches |
| Vertical to Horizontal Weld Ratio | 0.22 (for every | | 0.22 inches of vert. weld provide 1 inch of horiz.) | |
| For Vertical 15.00 Weld Length (Vp), Use | 69.00 | | inches of Horizontal Weld | |

| Gusset Pl Reactions | |
|---|---|
| Column Vert. | 67.10 |
| Column Horiz. | 53.68 |
| Beam Vert. | 147.18 |
| Beam Horiz. | 366.87 |

**SUMMARY**

| | |
|---|---|
| Gusset Plate Size | USE 1.25" x 51" x 15" Plate |
| Brace to Gusset Plate Weld | USE 17" of 0.3125" weld each side of brace |
| Gusset Plate to Column Weld Size | USE 6.2" of 0.3125" weld each side of plate |
| Gusset Plate to Base PL Weld Size | USE 28.4" of 0.3125" weld each side of plate |
| Stiffener Plate Size | No Stiffener Plate is Required |

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structural consultants

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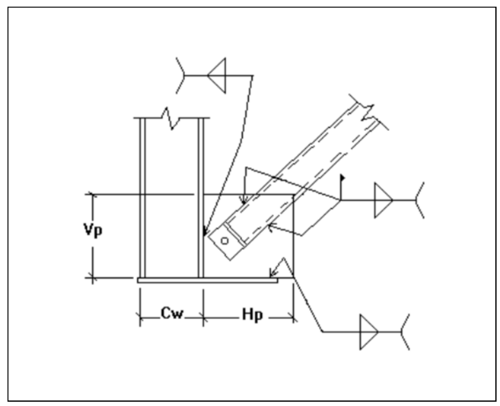
**Ordinary Concentric Braced Frame Gusset Plate Design (LRFD Forces)**
Version Date: June 7, 2016 Code: 14th Edition
JOB TITLE: Kimberly Clark Addition
DESCRIPTION: Grid H.1 Baseplate
JOB #: 18054.00

## Column Width <> 0, Beam Depth = 0

| Brace Connection Configuration | | | | | |
|---|---|---|---|---|---|
| Column Designation | | HSS12X12X3/8 | | | |
| Column Depth | Dc = | 12.00 inches | ec = | 6.00 inches | |
| Beam Depth | Db = | 0.00 inches | eb = | 0.00 inches | |
| Brace Designation | | HSS6X6X3/8 | | | |
| Brace Depth | Dbrace = | 6.00 inches | ew = | 3.00 inches | |
| Brace Thickness | Tbrace = | 0.35 inches | | | |
| Angle of Brace to Vertical | Θ = | 63.00 degrees | 1.10 radians | | |
| Max. Dist. from Brace to Beam | d1 = | 1.00 inch | | | |
| Max. Dist from Brace to Column | d2 = | 1.00 inch | | | |
| Erection Bracket (angle) Leg Size | A = | 0.00 inches | | | |
| Erection Bolt Size | | 0.00 inches | | | |
| Gusset Plate Thickness | Gt = | 1 1/4 inches | | | |
| Gusset Plate Yield Strength | Fy = | 50.00 ksi | | | |

| Brace Forces | | |
|---|---|---|
| Factored Axial Force in Brace (incl ! | $P_u$ = | 472.00 kips |
| Horizontal Component of P | H = | 420.56 kips |
| Vertical Component of P | V = | 214.28 kips |




| Brace to Gusset Connection | | |
|---|---|---|
| Effective Weld Size | | 5/16 inches |
| Use Weld Size | | 5/16 inches |
| Total Weld Required | | 67.73 inches |
| Minimum Weld Length (Calculated) | | 16.93 inches |
| Minimum Weld Length Required (Actual) | | 17.00 inches |
| Minimum Weld Length Requested | | 9.00 inches |
| Weld Length (used) | l = | 17.00 inches |
| Safety Factor | | 1.00 OK |

| Check Block Tear-out of Gusset Plate | | |
|---|---|---|
| Design Gusset PL Shear Strength | $\phi V_n$= | 1275.00 kips |
| Design Gusset PL Tensile Strength | $\phi T_n$= | 330.47 kips |
| Maximum Load | $P_{u\_max}$= | 1605.47 kips |
| Safety Factor | | 3.40 OK |
| **Check Block Tear-out of Brace Wall** | | |
| Design Shear Strength | $\phi V_n$= | 655.00 kips OK |
| Safety Factor | | 1.39 OK |

| Check Tensile Rupture in the Net Section (Shear Lag) | | |
|---|---|---|
| Net Area | $A_n$= | 6.71 $in^2$ |
| Shear Lag Factor | U= | 0.87 |
| Effective Net Area | $A_e$= | 5.82 $in^2$ |
| Design Tensile Rupture Strength | $\phi F_u A_e$= | 253.16 kips |
| Overstrength Factor | $\Omega_o$= | 2.00 |
| Safety Factor | | 1.07 OK |

| Brace Tensile Yielding Capacity | | |
|---|---|---|
| Ratio $F_{ye}/F_y$ | $R_y$= | 1.30 $in^2$ |
| Specified Yield Stress | $F_y$= | 46.00 ksi |
| Gross Area of Brace | $A_g$= | 7.58 $in^2$ |
| Expected Strength | $R_y F_y A_g$= | 453.28 kips |
| Minimum $P_u/\Omega_o$ or $R_y F_y A_g$ | | 236.00 kips |

| User Requested Gusset Plate Size: | | | Calculated Gusset Plate Size: | | | Use Gusset Plate Size: | | |
|---|---|---|---|---|---|---|---|---|
| Length | Hp = | 24.00 inches | Length | Hp = | 19.00 inches | Use Length | Hp = | 24.00 inches |
| Height | Vp = | 24.00 inches | Height | Vp = | 15.00 inches | Use Height | Vp = | 24.00 inches |

### Gusset Plate Column Analogy

| | | | |
|---|---|---|---|
| Modified Whitmore Section Width | | MWS = | 9.98 inches |
| fa = | 37.82 ksi | Fa = | 44.97 ksi |
| Safety Factor = | 1.19 | fu<phiFcr - OK | Stiffener Plate Req'd NO |

### Gusset Weld Plate Weld Design

| Weld to Column | | Weld to Base Plate | |
|---|---|---|---|
| Requested Weld Size | 5/16 inch | Requested Weld Size | 5/16 inch |
| Shear Stress (fv) | 4.46 kips/inch | Shear Stress (fv) | 6.53 kips/inch |
| Tension Stress (ft) | 2.23 kips/inch | Tension Stress (ft) | 0.00 kips/inch |
| Combined Stress (f) | 4.99 kips/inch | Combined Stress (f) | 6.53 kips/inch |
| Min. Effect Weld Size (D) for Vp | 3.58 /16 inch | Min Effect Weld Size (D) for Hp | 4.68 /16 inch |
| Use Minumum Weld Size (for Vp) | 0.25 inch | Use Minumum Weld Size (for Hp) | 0.31 inch |
| Min. Weld Lth for Req. Weld Size | 17.19 inches | Min. Weld Lth for Req. Weld Size | 22.49 inches |
| Vertical to Horizontal Weld Ratio | 0.76 (for every | 0.76 inches of vert. weld provide 1 inch of horiz.) | |
| For Vertical 24.00 Weld Length (Vp), Use | 31.40 | inches of Horizontal Weld | |

| Gusset Pl Reactions | |
|---|---|
| Column Vert. | 214.28 |
| Column Horiz. | 107.14 |
| Beam Vert. | 0.00 |
| Beam Horiz. | 313.41 |

**SUMMARY**

| | |
|---|---|
| Gusset Plate Size | USE 1.25" x 19" x 15" Plate |
| Brace to Gusset Plate Weld | USE 17" of 0.3125" weld each side of brace |
| Gusset Plate to Column Weld Size | USE 17.2" of 0.3125" weld each side of plate |
| Gusset Plate to Base PL Weld Size | USE 22.5" of 0.3125" weld each side of plate |
| Stiffener Plate Size | No Stiffener Plate is Required |

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# IBC 2015 Cast-in-place Anchor Bolt Design referencing ACI 318-14 Chapter 17

Version Date: December 5, 2017 | Author: Troy M. Dye | Reviewed By: Scott Porter

JOB TITLE: Kimberly Clark Addition | JOB #: 18054
DESCRIPTION: embed | DESIGNER: SJV

## Pier and Anchor Bolt Geometry

| | | Min Edge or Spacing | Bolt Quantities |
|---|---|---|---|
| Top Pier Edge | 12 | OK | |
| AB-f5 | 0 | | |
| AB-f4 | 0 | | |
| AB-f3 | 0 | | |
| AB-f2 | 0 | | |
| AB-f1 | 7 | OK | 3 |
| Column centerline | 0 | << | 0 |
| AB-b1 | 7 | OK | 3 |
| AB-b2 | 0 | | |
| AB-b3 | 0 | | |
| AB-b4 | 0 | | |
| AB-b5 | 0 | | |
| Bottom Pier Edge | 12 | OK | 6 # Bolts in Group |

| | | | Pier Dimensions |
|---|---|---|---|
| Left Pier Edge | 11 | OK | 36.0 " wide |
| AB-l1 | 7 | OK | 38.0 " long |
| Column centerline | 0 | << | Bolt Group Dimensions |
| AB-r1 | 7 | OK | 14.0 " wide |
| Right Pier Edge | 11 | OK | 14.0 " long |

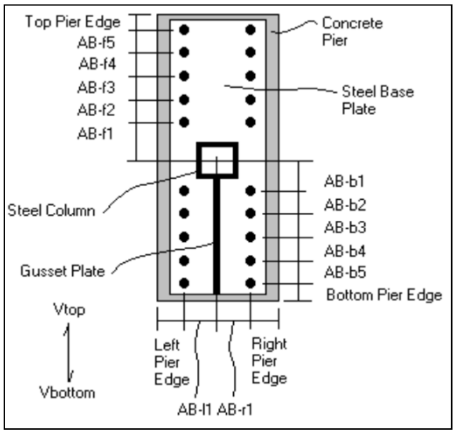


*Figure 1. Generic Anchor Bolt Locations*

## Design Loads

**Shear $V_u$ :** 17.2 kips — *Use ACI 318 Section 5.3 load combinations*

**Tension $P_u$:** 0 kips

| | |
|---|---|
| Is the seismic tension component more than 20% of the total factored tension force? | NO |
| Pier confined for tension force? | NO |
| Pier confined for shear force? | NO |

| | | | | | |
|---|---|---|---|---|---|
| Anchors Torqued: | NO | | | | |
| Bolt Grade: | A36 | | Ductile Anchor | | 17.2.3.4.3a |
| Bolt Diameter: | 0.75 | inches | | | |
| Embedment Length: | 5 | inches | Bearing Area: | 8.56 | $in^2$ |
| Concrete $f'_c$: | 4500 | psi | Steel $\phi_t$: | 0.75 | *Section 17.3.3* |
| | | | Steel $\phi_s$: | 0.65 | *Section 17.3.3* |
| Rebar $f_y$: | 60000 | psi | Concrete $\phi$: | 0.7 | *Section 17.3.3* |
| Anchor $F_u$ : | 58 | ksi | $\lambda$ : | 1 | *Section 19.2.4* |
| Bolt Area $A_{bolt}$ : | 0.33 | $in^2$ | $\lambda_a$ : | 1 | *Section 17.2.6* |
| Seismic Design Category Factor: | 1 | *Section 17.2.3.4.4* | | | |
| | | | Eccentricity for Tension | 0 | in |
| Pier Ht / Ftg Thick: | 9.25 | inches **OK** | Eccentricity for Shear | 0 | |
| Bolt type: | H | | | | |

| *Bolt Diameter ($in^2$)* | *Threads per (inch)* | *Tensile Stress Area ($in^2$)* |
|---|---|---|
| 0.5 | 13 | 0.14 |
| 0.625 | 11 | 0.23 |
| 0.75 | 10 | 0.33 |
| 0.875 | 9 | 0.46 |
| 1 | 8 | 0.61 |
| 1.125 | 7 | 0.76 |
| 1.25 | 7 | 0.97 |
| 1.375 | 6 | 1.15 |
| 1.5 | 6 | 1.41 |
| 1.75 | 5 | 1.90 |
| 2 | 4.5 | 2.50 |
| 2.25 | 4.5 | 3.25 |
| 2.5 | 4 | 4.00 |
| 2.75 | 4 | 4.93 |
| 3 | 4 | 5.97 |

## Tension Calculations

| | | | | $c_{a2}$ | | | $c_{a1}$ | |
|---|---|---|---|---|---|---|---|---|
| $A_N$ : | 841 | $in^2$ | Left Edge Dist. : | 7.5 | inches | Top Edge Dist. : | 7.5 | inches |
| $A_{NO}$ : | 225 | $in^2$ | Right Edge Dist. : | 7.5 | inches | Bottom Edge Dist. : | 7.5 | inches |

**Concrete Tension Capacity (Section 17.4.2) - Breakout Strength**

$\psi_{ec,N}$: 1.00 $\psi_{ed,N}$: 1.00 $\psi_{c,N}$: 1

$N_b$ = 18.0 kips $N_{cb}$ = 67.3 kips

**Concrete Tension Capacity (Section 17.4.3) - Pullout Strength**

$\psi_{c,P}$: 1 $N_{pn}$ = 308.1 kips

$N_p$ = 308.1 kips Capacity of Group: 1848.6 kips

**Concrete Tension Capacity (Section 17.4.4) - Side-Face Blowout Strength**

Use $A_N$ : 841 $in^2$

$N_{sb}$ = N/A kips $N_{sbg}$ = N/A kips

**$\phi P_c$ :** 47.1 kips **$P_c$ :** 67.3 kips — Ultimate Concrete Strength

**Steel Tension Capacity (Section 17.4.1)**

**$P_{ss}'$ :** 19.4 kips / AB **$P_{ss}$ :** 139.7 kips — Ultimate Steel Tension Capacity

07-May-18
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ARW ENGINEERS structural consultants

**IBC 2015 Cast-in-place Anchor Bolt Design referencing ACI 318-14 Chapter 17**

Version Date: December 5, 2017

JOB TITLE: Kimberly Clark Addition — JOB #: 18054
DESCRIPTION: embed — DESIGNER: SJV

## Shear Calculations

B — Specify which system resists shear

**Bolts Resisting Shear** — Bolts resist tension and shear

**Steel Shear Capacity (Section 17.5.1)**

$V_{sa}$ : 9.31 kips / AB — $\mathbf{V_{sa}}$ : $\boxed{27.9}$ kips — Ultimate Steel Shear Capacity based on Assumed Breakout Surface

n : 3 Number of anchors resisting shear based on assumed concrete breakout surface

Grout height below base plate, $h_2$ : 1.5 inches

**Concrete Shear Breakout Capacity (Section 17.5.2)**

$\psi_{ec,V}$: 1.00 $\psi_{ed,V}$: 0.88 $\psi_{c,V}$: 1.2 $\psi_{h,V}$: 1.10

| **Top Edge Bolts** | | | **Bottom Edge Bolts** | | |
|---|---|---|---|---|---|
| Edge Distance: | 12.0 | inches | Edge Distance : | 12.0 | inches |
| $A_{Vc}$ = | 333.0 | in$^2$ | $A_{Vc}$ = | 333.0 | in$^2$ |
| $A_{Vco}$ = | 648.0 | in$^2$ | $A_{Vco}$ = | 648.0 | in$^2$ |
| $V_b$ = | 24.7 | kips | $V_b$ = | 24.7 | kips |
| $V_{cb}$ = | 14.8 | kips | $V_{cb}$ = | 14.8 | kips |
| **Concrete Shear Pryout Capacity (Section 17.5.3)** | | | | | |
| $V_{cp}$ = | 134.6 | kips | $N_b$ = | 18.0 | kips |
| Group Capacity $\mathbf{V_n}$: | $\boxed{89.0}$ | kips | Group Capacity $\mathbf{V_n}$: | $\boxed{89.0}$ | kips |

Ultimate Concrete Strength

## Combined Tension and Shear

**Shear Force Acting Towards Top Pier Edge, $V_{top}$**

| | | |
|---|---|---|
| 0.276 | < 1 - OK | Concrete Shear ($V_u/\phi V_n$) |
| 0.947 | < 1 - OK | Steel Shear ($V_u/\phi V_{ss}$) |

**Anchor Bolts O.K.**
**Concrete O.K.**
Checks Shear Only

**Shear Force Acting Towards Bottom Pier Edge, $V_{bottom}$**

| | | |
|---|---|---|
| 0.000 | < 1 - OK | Concrete Tension ($P_u/\phi P_n$) |
| 0.276 | < 1 - OK | Concrete Shear ($V_u/\phi V_n$) |
| 0.276 | < 1 - OK | Concrete Combined (Section D.7) |
| 0.000 | < 1 - OK | Steel Tension ($P_u/\phi P_{ss}$) |
| 0.947 | < 1 - OK | Steel Shear ($V_u/\phi V_{ss}$) |
| 0.947 | < 1 - OK | Steel Combined (Section D.7) |

**Anchor Bolts O.K.**
**Concrete O.K.**
Checks Shear and Tension

**ACI 318 SECTION 17.2.3.4.3 DOES NOT APPLY**

## DESIGN SUMMARY

**Anchor Bolts** — **(6) 0.75" diameter headed anchor bolts w/ 5"minimum embedment**
*Designed for combined tension and shear* — *See D3.3.4.3 a items 3 through 6 for ductile anchor requirements*

**Tension Confined Pier** — **N/A**
*Designed to transfer anchor bolt tension into reinforcement*

**Shear Confined Pier** — **N/A**
*Designed to transfer anchor bolt shear into reinforcement*

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**IBC 2015 Cast-in-place Anchor Bolt Design referencing ACI 318-14 Chapter 17**
Version Date: December 5, 2017

| | | | |
|---|---|---|---|
| JOB TITLE: | Kimberly Clark Addition | JOB #: | 18054 |
| DESCRIPTION: | embed | DESIGNER: | SJV |

## Anchor Reinforcing

***Reinforcing Data***

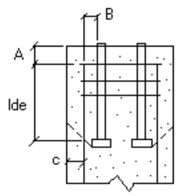
| | |
|---|---|
| $\Psi$t : | 1 |
| $\Psi$e : | 1 |
| $\Psi$s : | 1 |
| $\gamma$ : | 0.8 |

Assumes that vertical reinforcement layout is symmetrical around anchor bolt pattern

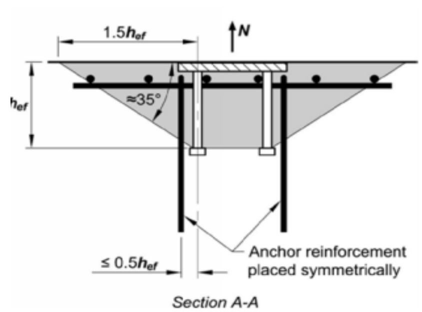
NOTE: The calculation for the concrete anchor capacities are based on 1) Tension pullout, 2) Shear pryout. The breakout strength in tension and shear and side face blowout are omitted because the vertical reinforcement is used to confine this failure cone.

***Pier Reinforcement to Resist Tension Breakout (17.4.2.9)***

| | | | |
|---|---|---|---|
| Vert. Pier Reinforcing Size : | 5 | bar | |
| Distance from A.B. to Rebar (B) : | 4 | in | |
| Cover above vert. reinf (A) : | 2 | in | |
| c : | 3 | in | |
| Rebar Area : | 0.31 | $in^2$ | |
| Rebar Diameter : | 0.625 | in | |
| $l_{db}$ : | 17.44 | in | |
| $l_{de}$ : | -1.00 | in | |
| 0.75*$F_y$ of Rebar @ $l_{de}$ - $f_s$ : | -2.58 | ksi | |
| $A_{st}$ : | 0.00 | $in^2$ | |
| Total # of vertical bars required : | 1 | | Quantity of reinforcement placed symmetrically around anchor bolts |
| Embedment of standard hook : | 6.00 | in | |




**bolts**




***Pier Reinforcement to Resist Shear Breakout (17.5.2.9)***

| | | | |
|---|---|---|---|
| Hairpin/stirrup reinforcing size : | 4 | bar | |
| Rebar area : | 0.4 | $in^2$ | |
| $A_{st}$ : | 0.38 | $in^2$ | |
| Total # of hairpins/stirrups required : | 1 | | Quantity of hairpins or stirrups wrappe around anchor bolts |

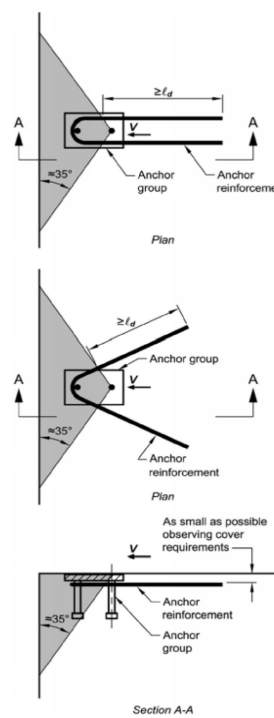



*Fig. RD.6.2.9(a)—Hairpin anchor reinforcement for shear.*

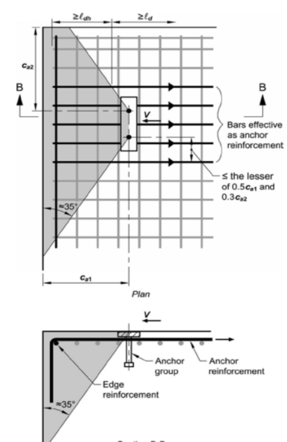



*Fig. RD.6.2.9(b)—Edge reinforcement and anchor reinforcement for shear.*

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## IBC 2015 Cast-in-place Anchor Bolt Design referencing ACI 318-14 Chapter 17

Version Date: December 5, 2017 | Author: Troy M. Dye | Reviewed By: Scott Porter

| | | | |
|---|---|---|---|
| JOB TITLE: | Kimberly Clark Addition | JOB #: | 18054 |
| DESCRIPTION: | Center Columns | DESIGNER: | SJV |

### Pier and Anchor Bolt Geometry

| | Min Edge or Spacing | | Bolt Quantities |
|---|---|---|---|
| Top Pier Edge | 12 | | |
| AB-f5 | 0 | | |
| AB-f4 | 0 | | |
| AB-f3 | 0 | | |
| AB-f2 | 8 | | 2 |
| AB-f1 | 10 | | 2 |
| Column centerline | 0 | << | |
| AB-b1 | 10 | | 2 |
| AB-b2 | 8 | | 2 |
| AB-b3 | | | |
| AB-b4 | 0 | | |
| AB-b5 | 0 | | |
| Bottom Pier Edge | 12 | | 8 # Bolts in Group |

| | | | |
|---|---|---|---|
| | | | Pier Dimensions |
| Left Pier Edge | 12 | | 32.0 " wide |
| AB-l1 | 4 | | 60.0 " long |
| Column centerline | 0 | << | Bolt Group Dimensions |
| AB-r1 | 4 | | 8.0 " wide |
| Right Pier Edge | 12 | | 36.0 " long |

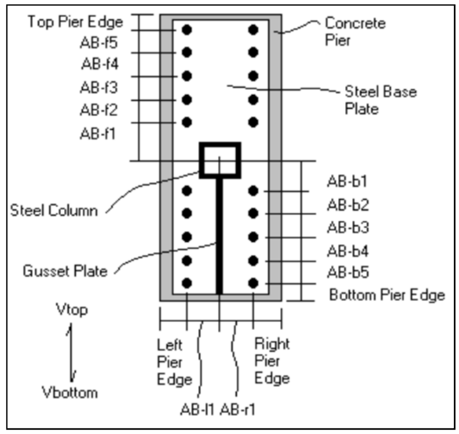


*Figure 1. Generic Anchor Bolt Locations*

### Design Loads

**Shear $V_u$ :** **420** kips — *Use ACI 318 Section 5.3 load combinations*

**Tension $P_u$:** **0** kips

**Increase Shear Vu and Tension Pu above by Omega**

| | |
|---|---|
| Is the seismic tension component more than 20% of the total factored tension force? | YES |
| Pier confined for tension force? | YES |
| Pier confined for shear force? | YES |

| | | | | | |
|---|---|---|---|---|---|
| Anchors Torqued: | NO | | | | |
| Bolt Grade: | F1554 Gr. 105 | | Omega Level Force | 17.2.3.4.3d & 17.2.3.5.3c | |
| Bolt Diameter: | 2 | inches | | | |
| Embedment Length: | 24 | inches | Bearing Area: | 5.86 | $in^2$ |
| Concrete $f'_c$: | 4500 | psi | Steel $\phi_t$: | 0.75 | *Section 17.3.3* |
| | | | Steel $\phi_s$: | 0.65 | *Section 17.3.3* |
| Rebar $f_y$: | 60000 | psi | Concrete $\phi$: | 0.75 | *Section 17.3.3* |
| Anchor $F_u$ : | 125 | ksi | $\lambda$ : | 1 | *Section 19.2.4* |
| Bolt Area $A_{bolt}$ : | 2.50 | $in^2$ | $\lambda_a$ : | 1 | *Section 17.2.6* |
| Seismic Design Category Factor: | 0.75 | *Section 17.2.3.4.4* | | | |
| | | | Eccentricity for Tension | 0 | in |
| Pier Ht / Ftg Thick: | 32 | inches OK | Eccentricity for Shear | 0 | |
| Bolt type: | H | | | | |

| *Bolt Diameter ($in^2$)* | *Threads per (inch)* | *Tensile Stress Area ($in^2$)* |
|---|---|---|
| 0.5 | 13 | 0.14 |
| 0.625 | 11 | 0.23 |
| 0.75 | 10 | 0.33 |
| 0.875 | 9 | 0.46 |
| 1 | 8 | 0.61 |
| 1.125 | 7 | 0.76 |
| 1.25 | 7 | 0.97 |
| 1.375 | 6 | 1.15 |
| 1.5 | 6 | 1.41 |
| 1.75 | 5 | 1.90 |
| 2 | 4.5 | 2.50 |
| 2.25 | 4.5 | 3.25 |
| 2.5 | 4 | 4.00 |
| 2.75 | 4 | 4.93 |
| 3 | 4 | 5.97 |

### Tension Calculations

| | | | | $c_{a2}$ | | | $c_{a1}$ | |
|---|---|---|---|---|---|---|---|---|
| $A_N$ : | 1920 | $in^2$ | Left Edge Dist. : | 12 | inches | Top Edge Dist. : | 12 | inches |
| $A_{NO}$ : | 576 | $in^2$ | Right Edge Dist. : | 12 | inches | Bottom Edge Dist. : | 12 | inches |

**Concrete Tension Capacity (Section 17.4.2) - Breakout Strength**

$\psi_{ec,N}$: 1.00 $\psi_{ed,N}$: 0.80 $\psi_{c,N}$: 1

$N_b$ = 34.3 kips $N_{cb}$ = 91.6 kips

**Concrete Tension Capacity (Section 17.4.3) - Pullout Strength**

$\psi_{c,P}$: 1 $N_{pn}$ = 210.9 kips

$N_p$ = 210.9 kips Capacity of Group: 1687.2 kips

**Concrete Tension Capacity (Section 17.4.4) - Side-Face Blowout Strength**

Use $A_N$ : 1920 $in^2$

$N_{sb}$ = N/A kips $N_{sbg}$ = N/A kips

**$\phi P_c$ :** 949.1 kips **$P_c$ :** **1687.2** kips — Ultimate Concrete Strength Based on Pullout Only

**Steel Tension Capacity (Section 17.4.1)**

**$P_{ss}'$ :** 312.3 kips / AB **$P_{ss}$ :** **2498.2** kips — Ultimate Steel Tension Capacity

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## IBC 2015 Cast-in-place Anchor Bolt Design referencing ACI 318-14 Chapter 17

Version Date: December 5, 2017

JOB TITLE: Kimberly Clark Addition    JOB #: 18054
DESCRIPTION: Center Columns    DESIGNER: SJV

### Shear Calculations

B — Specify which system resists shear

**Bolts Resisting Shear** — Bolts resist tension and shear

**Steel Shear Capacity (Section 17.5.1)**

$V_{sa}$ : 149.89 kips / AB    **$V_{sa}$ :** **1199.1** kips — Ultimate Steel Shear Capacity based on Assumed Breakout Surface

n : 8 Number of anchors resisting shear based on assumed concrete breakout surface

Grout height below base plate, $h_2$ : 1.5 inches

**Concrete Shear Breakout Capacity (Section 17.5.2)**

$\psi_{ec,V}$: 1.00    $\psi_{ed,V}$: 0.90    $\psi_{c,V}$: 1.2    $\psi_{h,V}$: 1.00

| Top Edge Bolts | | | Bottom Edge Bolts | | |
|---|---|---|---|---|---|
| Edge Distance: | 12.0 | inches | Edge Distance : | 12.0 | inches |
| $A_{Vc}$ = | 576.0 | $in^2$ | $A_{Vc}$ = | 576.0 | $in^2$ |
| $A_{Vco}$ = | 648.0 | $in^2$ | $A_{Vco}$ = | 648.0 | $in^2$ |
| $V_b$ = | 41.8 | kips | $V_b$ = | 41.8 | kips |
| $V_{cb}$ = | 40.2 | kips | $V_{cb}$ = | 40.2 | kips |

**Concrete Shear Pryout Capacity (Section 17.5.3)**

| | | | | | |
|---|---|---|---|---|---|
| $V_{cp}$ = | 1143.1 | kips | $N_b$ = | 214.3 | kips |
| Group Capacity **$V_n$**: | **1143.1** | kips | Group Capacity **$V_n$**: | **1143.1** | kips |

Ultimate Concrete Capacity Based on Pryout Strength Only

### Combined Tension and Shear

**Shear Force Acting Towards Top Pier Edge, $V_{top}$**

| | | |
|---|---|---|
| 0.653 | < 1 - OK | Concrete Shear ($V_u/\phi V_n$) |
| 0.539 | < 1 - OK | Steel Shear ($V_u/\phi V_{ss}$) |

**Anchor Bolts O.K.**
**Concrete O.K.**
Checks Shear Only

**Shear Force Acting Towards Bottom Pier Edge, $V_{bottom}$**

| | | |
|---|---|---|
| 0.000 | < 1 - OK | Concrete Tension ($P_u/\phi P_n$) |
| 0.653 | < 1 - OK | Concrete Shear ($V_u/\phi V_n$) |
| 0.653 | < 1 - OK | Concrete Combined (Section D.7) |
| 0.000 | < 1 - OK | Steel Tension ($P_u/\phi P_{ss}$) |
| 0.539 | < 1 - OK | Steel Shear ($V_u/\phi V_{ss}$) |
| 0.539 | < 1 - OK | Steel Combined (Section D.7) |

**Anchor Bolts O.K.**
**Concrete O.K.**
Checks Shear and Tension

**FORCES INCLUDE OMEGA PER 17.2.3.4.3d and 17.2.3.5.3c**

### DESIGN SUMMARY

**Anchor Bolts** — **(8) 2" diameter headed anchor bolts w/ 24"minimum embedment**
*Designed for combined tension and shear*

**Tension Confined Pier** — **32" wide x 60" long w/ min (1) #5 vertical bars**
*Designed to transfer anchor bolt tension into reinforcement*

**Shear Confined Pier** — **32" wide x 60" long w/ min (24) #4 hairpin**
*Designed to transfer anchor bolt shear into reinforcement*

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**IBC 2015 Cast-in-place Anchor Bolt Design referencing ACI 318-14 Chapter 17**
Version Date: December 5, 2017

| | | | |
|---|---|---|---|
| JOB TITLE: | Kimberly Clark Addition | JOB #: | 18054 |
| DESCRIPTION: | Center Columns | DESIGNER: | SJV |

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## Anchor Reinforcing

***Reinforcing Data***

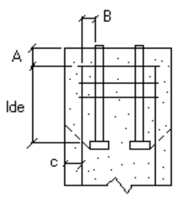
| | |
|---|---|
| $\Psi t$ : | 1 |
| $\Psi e$ : | 1 |
| $\Psi s$ : | 1 |
| $\gamma$ : | 0.8 |

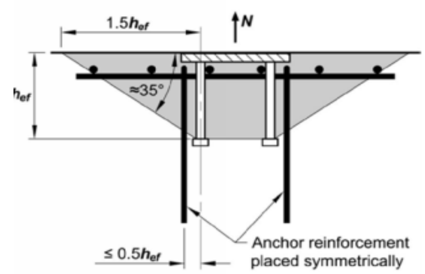
Assumes that vertical reinforcement layout is symmetrical around anchor bolt pattern

NOTE: The calculation for the concrete anchor capacities are based on 1) Tension pullout, 2) Shear pryout. The breakout strength in tension and shear and side face blowout are omitted because the vertical reinforcement is used to confine this failure cone.

***Pier Reinforcement to Resist Tension Breakout (17.4.2.9)***

| | | |
|---|---|---|
| Vert. Pier Reinforcing Size : | 5 | bar |
| Distance from A.B. to Rebar (B) : | 4 | in |
| Cover above vert. reinf (A) : | 2 | in |
| c : | 3 | in |
| Rebar Area : | 0.31 | $in^2$ |
| Rebar Diameter : | 0.625 | in |
| $l_{db}$ : | 17.44 | in |
| $l_{de}$ : | 18.00 | in |
| $0.75^*F_y$ of Rebar @ $l_{de}$ - $f_s$ : | 45.00 | ksi |
| $A_{st}$ : | 0.00 | $in^2$ |
| Total # of vertical bars required : | 1 | Quantity of reinforcement placed symmetrically around anchor bolts |
| Embedment of standard hook : | 6.71 | in |




Section A-A

***Pier Reinforcement to Resist Shear Breakout (17.5.2.9)***

| | | |
|---|---|---|
| Hairpin/stirrup reinforcing size : | 4 | bar |
| Rebar area : | 0.4 | $in^2$ |
| $A_{st}$ : | 9.33 | $in^2$ |
| Total # of hairpins/stirrups required : | 24 | Quantity of hairpins or stirrups wrappe around anchor bolts |

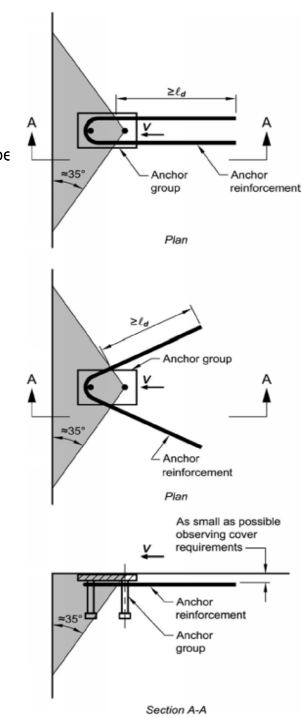



Fig. RD.6.2.9(a)—Hairpin anchor reinforcement for shear.

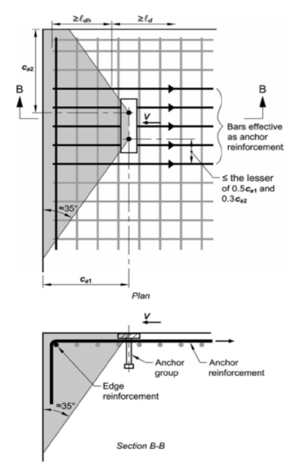



Fig. RD.6.2.9(b)—Edge reinforcement and anchor reinforcement for shear.

## Simply Supported Steel Diaphragm Design

Version Date: April 20, 2018 | Author: SJV | Reviewed By: | Date: 07-May-18

JOB TITLE: Kimberly Clark Warehouse Addition | JOB #: 18054

Diaphragm Location Main Diaphragm

$w_{ns}$ = 875 plf

$\ell_{ns}$ = 252 ft
d = 232 ft

$w_{ew}$ = 3200 plf

$\ell_{ns}$ = 640 ft
d = 634 ft

## Diaphragm Analysis

### North-South

$v_{max}$ = 1111 plf
shear slope = 3 plf/ft

| Zone | 1 | 2 | 3 | |
|---|---|---|---|---|
| Zone boundary | 100 ft | 100 ft | 120 ft | |
| Zone Shear | **1111 plf** | **764 plf** | **417 plf** | |
| Selected Deck | 18 Ga w/ VSC2 @ 12" | 18 Ga w/ VSC2 @ 18" | 18 Ga w/ VSC2 @ 24" | |
| Selected Deck q = | 1333 plf | 1121 plf | 966 plf | |
| F = | 6.7 | 7.6 | 8.0 | μ-in/lb |
| Strength Check: | **OK** | **OK** | **OK** | |

### East-West

$v_{max}$ = 630 plf
shear slope = 5 plf/ft

| Zone | 1 | 2 | 3 | |
|---|---|---|---|---|
| Zone boundary dist. | 126 | 0 | 0 | |
| Zone Shear | **630 plf** | **0 plf** | **0 plf** | |
| Selected Deck | 18 Ga w/ VSC2 @ 24" | | | |
| Selected Deck q = | 966 plf | 0 plf | 0 plf | |
| F = | 7.9 | 0.0 | 0.0 | μ-in/lb |
| Strength Check: | **OK** | | | |

## Chord Analysis

### North-South

$M_{max}$ = 44,800 k·ft
T = C = 193 kips

$F_y$ = 36 ksi
$A_{req}$ = **5.4 in²**

Section Type:
Section:
A = 34.7 in² **OK**
Diaph. I = 134,473,882 in⁴
E = 29,000 ksi

### East-West

$M_{max}$ = 25,402 k·ft
T = C = 40 kips

$F_y$ = 36 ksi
$A_{req}$ = **1.1 in²**

***Compression not checked in this program.***

Section Type:
Section:
A = 1.2 in² **OK**
Diaph. I = 34,728,998 in⁴
E = 29,000 ksi

## Diaphragm Deflection

### North-South

| Zone | 1 | 2 | 3 | sum |
|---|---|---|---|---|
| Shear deflection, $\Delta_w$: | 0.628 in | 0.449 in | 0.200 in | **1.277 in** |

Flexural deflection, $\Delta_f$: **0.847 in**

Total Diaph Deflection: **2.124 in**
(does not incorporate $C_d$)

### East-West

| Zone | 1 | 2 | 3 | sum |
|---|---|---|---|---|
| Shear deflection, $\Delta_w$: | 0.314 in | 0.000 in | 0.000 in | **0.314 in** |

Flexural deflection, $\Delta_f$: **0.288 in**

Total Diaph Deflection: **0.602 in**
(does not incorporate $C_d$)

$$\Delta_W = \frac{wL^2 F}{8b * 10^6} \qquad \Delta_f = \frac{5}{384}\frac{wL^4}{EI}$$

# Steel Column



Description : North W33x118 Chord w/ kickers @ 18' o.c.

## *Code References*

Calculations per AISC 360-10, IBC 2015, CBC 2016, ASCE 7-10
Load Combinations Used : IBC 2015

## General Information

| | | | |
|---|---|---|---|
| Steel Section Name : | W33x118 | Overall Column Height | 58.0 ft |
| Analysis Method : | Allowable Strength | Top & Bottom Fixity | Top & Bottom Pinned |
| Steel Stress Grade | A-992, High Strength, Low Alloy, Fy = | Brace condition for deflection (buckling) along columns : | |
| Fy : Steel Yield | 50.0 ksi | X-X (width) axis : Unbraced Length for X-X Axis buckling = 18 ft, K = 1.0 | |
| E : Elastic Bending Modulus | 29,000.0 ksi | Y-Y (depth) axis : Unbraced Length for Y-Y Axis buckling = 58.0 ft, K = 1.0 | |

## Applied Loads

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

Column self weight included : 6,844.0 lbs * Dead Load Factor
AXIAL LOADS . . .
Chord Force: Axial Load at 58.0 ft, E = 185.10 k
BENDING LOADS . . .
1: Lat. Point Load at 5.80 ft creating Mx-x, D = 4.574, S = 5.046 k
2: Lat. Point Load at 11.60 ft creating Mx-x, D = 4.574, S = 5.046 k
3: Lat. Point Load at 17.40 ft creating Mx-x, D = 4.574, S = 5.046 k
Lat. Point Load at 23.20 ft creating Mx-x, D = 4.574, S = 5.046 k
Lat. Point Load at 29.0 ft creating Mx-x, D = 4.574, S = 5.046 k
Lat. Point Load at 34.80 ft creating Mx-x, D = 4.574, S = 5.046 k
Lat. Point Load at 40.60 ft creating Mx-x, D = 4.574, S = 5.046 k
Lat. Point Load at 46.40 ft creating Mx-x, D = 4.574, S = 5.046 k
Lat. Point Load at 52.20 ft creating Mx-x, D = 4.574, S = 5.046 k
Lat. Uniform Load creating Mx-x, D = 0.1180 k/ft

## *DESIGN SUMMARY*

### Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio = **0.8803** : 1

| | | |
|---|---|---|
| Load Combination | +1.105D+0.750S+0.5250E | |
| Location of max.above base | 29.195 | ft |
| At maximum location values are . . . | | |
| Pa : Axial | 104.739 | k |
| Pn / Omega : Allowable | 551.22 | k |
| Ma-x : Applied | 694.70 | k-ft |
| Mn-x / Omega : Allowable | 884.65 | k-ft |
| Ma-y : Applied | 0.0 | k-ft |
| Mn-y / Omega : Allowable | 127.994 | k-ft |

PASS Maximum Shear Stress Ratio = **0.1437** : 1

| | | |
|---|---|---|
| Load Combination | +D+S | |
| Location of max.above base | 0.0 | ft |
| At maximum location values are . . . | | |
| Va : Applied | 46.712 | k |
| Vn / Omega : Allowable | 325.060 | k |

Maximum Load Reactions . .

| | |
|---|---|
| Top along X-X | 0.0 k |
| Bottom along X-X | 0.0 k |
| Top along Y-Y | 46.712 k |
| Bottom along Y-Y | 46.712 k |

Maximum Load Deflections . . .

Along Y-Y 2.652 in at 29.195 ft above base
for load combination : +D+S

Along X-X 0.0 in at 0.0 ft above base
for load combination :

## Load Combination Results

| Load Combination | Maximum Axial + Bending Stress Ratios: Stress Ratio | Status | Location | Maximum Shear Ratios: Stress Ratio | Status | Location |
|---|---|---|---|---|---|---|
| D Only | 0.437 | PASS | 29.19 ft | 0.074 | PASS | 0.00 ft |
| +D+S | 0.850 | PASS | 29.19 ft | 0.144 | PASS | 0.00 ft |
| +D+0.750S | 0.746 | PASS | 28.81 ft | 0.126 | PASS | 0.00 ft |
| +1.140D+0.70E | 0.685 | PASS | 29.19 ft | 0.084 | PASS | 0.00 ft |
| +1.140D-0.70E | 0.215 | PASS | 29.19 ft | 0.084 | PASS | 0.00 ft |
| +1.105D+0.750S+0.5250E | 0.880 | PASS | 29.19 ft | 0.134 | PASS | 58.00 ft |

# Steel Column



Description : North W33x118 Chrord w/ kickers @ 18' o.c.

## Load Combination Results

| Load Combination | Maximum Axial + Bending Stress Ratios: Stress Ratio | Status | Location | Maximum Shear Ratios: Stress Ratio | Status | Location |
|---|---|---|---|---|---|---|
| +1.105D+0.750S-0.5250E | 0.867 | PASS | 29.19 ft | 0.134 | PASS | 58.00 ft |
| +0.60D | 0.262 | PASS | 29.19 ft | 0.044 | PASS | 0.00 ft |
| +0.4603D+0.70E | 0.417 | PASS | 28.81 ft | 0.034 | PASS | 0.00 ft |
| +0.4603D-0.70E | 0.225 | PASS | 0.39 ft | 0.034 | PASS | 0.00 ft |

## Maximum Reactions

Note: Only non-zero reactions are listed.

| Load Combination | Axial Reaction @ Base | X-X Axis Reaction k @ Base | @ Top | Y-Y Axis Reaction @ Base | @ Top | Mx - End Moments k-ft @ Base | @ Top | My - End Moments @ Base | @ Top |
|---|---|---|---|---|---|---|---|---|---|
| D Only | 6.844 | | | 24.005 | 24.005 | | | | |
| +D+S | 6.844 | | | 46.712 | 46.712 | | | | |
| +D+0.750S | 6.844 | | | 41.035 | 41.035 | | | | |
| +D+0.70E | 136.414 | | | 24.005 | 24.005 | | | | |
| +D-0.70E | -122.726 | | | 24.005 | 24.005 | | | | |
| +D+0.750S+0.5250E | 104.022 | | | 41.035 | 41.035 | | | | |
| +D+0.750S-0.5250E | -90.334 | | | 41.035 | 41.035 | | | | |
| +0.60D | 4.106 | | | 14.403 | 14.403 | | | | |
| +0.60D+0.70E | 133.676 | | | 14.403 | 14.403 | | | | |
| +0.60D-0.70E | -125.464 | | | 14.403 | 14.403 | | | | |
| S Only | | | | 22.707 | 22.707 | | | | |
| E Only | 185.100 | | | | | | | | |
| E Only * -1.0 | -185.100 | | | | | | | | |

## Extreme Reactions

| Item | Extreme Value | Axial Reaction @ Base | X-X Axis Reaction k @ Base | @ Top | Y-Y Axis Reaction @ Base | @ Top | Mx - End Moments k-ft @ Base | @ Top | My - End Moments @ Base | @ Top |
|---|---|---|---|---|---|---|---|---|---|---|
| Axial @ Base | Maximum | 185.100 | | | | | | | | |
| " | Minimum | -185.100 | | | | | | | | |
| Reaction, X-X Axis Base | Maximum | 6.844 | | | 24.005 | 24.005 | | | | |
| " | Minimum | 6.844 | | | 24.005 | 24.005 | | | | |
| Reaction, Y-Y Axis Base | Maximum | 6.844 | | | 46.712 | 46.712 | | | | |
| " | Minimum | 185.100 | | | | | | | | |
| Reaction, X-X Axis Top | Maximum | 6.844 | | | 24.005 | 24.005 | | | | |
| " | Minimum | 6.844 | | | 24.005 | 24.005 | | | | |
| Reaction, Y-Y Axis Top | Maximum | 6.844 | | | 24.005 | 24.005 | | | | |
| " | Minimum | 185.100 | | | | | | | | |
| Moment, X-X Axis Base | Maximum | 6.844 | | | 24.005 | 24.005 | | | | |
| " | Minimum | 6.844 | | | 24.005 | 24.005 | | | | |
| Moment, Y-Y Axis Base | Maximum | 6.844 | | | 24.005 | 24.005 | | | | |
| " | Minimum | 6.844 | | | 24.005 | 24.005 | | | | |
| Moment, X-X Axis Top | Maximum | 6.844 | | | 24.005 | 24.005 | | | | |
| " | Minimum | 6.844 | | | 24.005 | 24.005 | | | | |
| Moment, Y-Y Axis Top | Maximum | 6.844 | | | 24.005 | 24.005 | | | | |
| " | Minimum | 6.844 | | | 24.005 | 24.005 | | | | |

## Maximum Deflections for Load Combinations

| Load Combination | Max. X-X Deflection | | Distance | | Max. Y-Y Deflection | | Distance | |
|---|---|---|---|---|---|---|---|---|
| D Only | 0.0000 | in | 0.000 | ft | 1.354 | in | 29.195 | ft |
| +D+S | 0.0000 | in | 0.000 | ft | 2.652 | in | 29.195 | ft |
| +D+0.750S | 0.0000 | in | 0.000 | ft | 2.328 | in | 29.195 | ft |
| +D+0.70E | 0.0000 | in | 0.000 | ft | 1.354 | in | 29.195 | ft |
| +D-0.70E | 0.0000 | in | 0.000 | ft | 1.354 | in | 29.195 | ft |
| +D+0.750S+0.5250E | 0.0000 | in | 0.000 | ft | 2.328 | in | 29.195 | ft |
| +D+0.750S-0.5250E | 0.0000 | in | 0.000 | ft | 2.328 | in | 29.195 | ft |
| +0.60D | 0.0000 | in | 0.000 | ft | 0.813 | in | 29.195 | ft |
| +0.60D+0.70E | 0.0000 | in | 0.000 | ft | 0.813 | in | 29.195 | ft |
| +0.60D-0.70E | 0.0000 | in | 0.000 | ft | 0.813 | in | 29.195 | ft |
| S Only | 0.0000 | in | 0.000 | ft | 1.298 | in | 29.195 | ft |
| E Only | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| E Only * -1.0 | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |

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# Steel Column

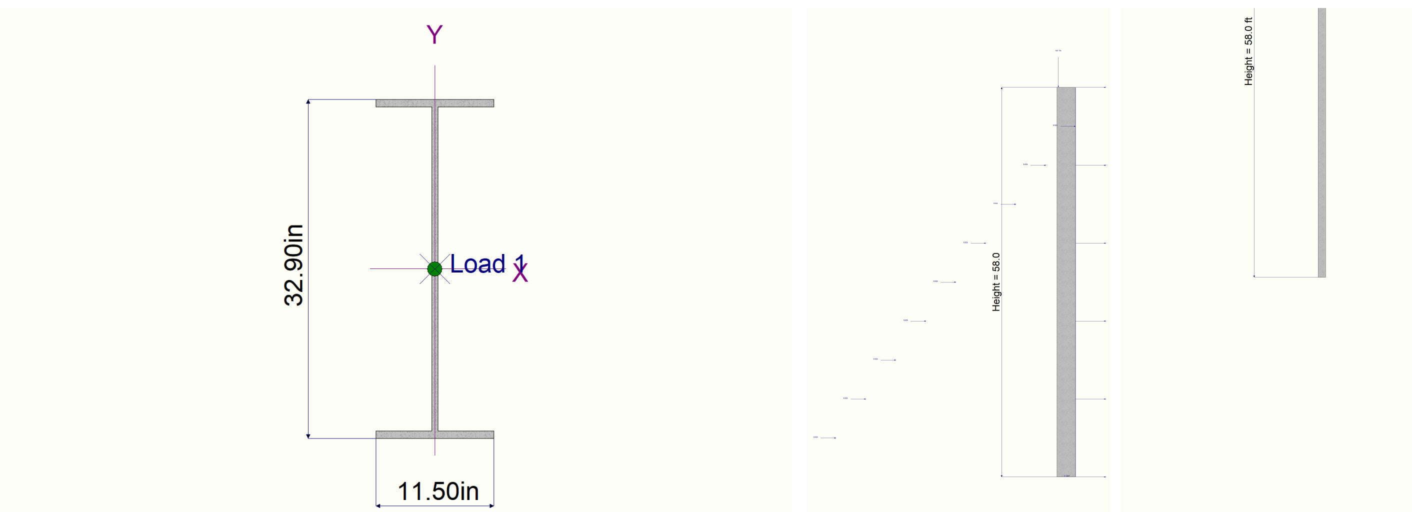


Description : North W33x118 Chrord w/ kickers @ 18' o.c.

## Steel Section Properties : W33x118

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth | = | 32.900 | in | I xx | = | 5,900.00 | in^4 | J | = | 5.300 | in^4 |
| Web Thick | = | 0.550 | in | S xx | = | 359.00 | in^3 | Cw | = | 48300.00 | in^6 |
| Flange Width | = | 11.500 | in | R xx | = | 13.000 | in | | | | |
| Flange Thick | = | 0.740 | in | Zx | = | 415.000 | in^3 | | | | |
| Area | = | 34.700 | in^2 | I yy | = | 187.000 | in^4 | | | | |
| Weight | = | 118.000 | plf | S yy | = | 32.600 | in^3 | Wno | = | 92.500 | in^2 |
| Kdesign | = | 1.440 | in | R yy | = | 2.320 | in | Sw | = | 197.000 | in^4 |
| K1 | = | 1.125 | in | Zy | = | 51.300 | in^3 | Qf | = | 65.100 | in^3 |
| rts | = | 2.890 | in | rT | = | 0.000 | in | Qw | = | 205.000 | in^3 |
| Ycg | = | 0.000 | in | | | | | | | | |

## Sketches



# Steel Beam





Description : Edge Angle OOP

## CODE REFERENCES

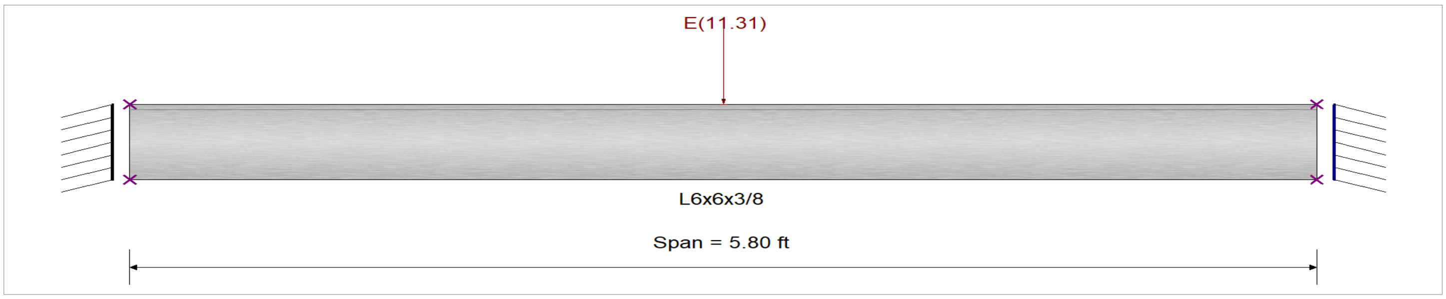
Calculations per AISC 360-10, IBC 2015, ASCE 7-10
Load Combination Set : IBC 2015

## Material Properties

| | | | |
|---|---|---|---|
| Analysis Method : | Allowable Strength Design | Fy : Steel Yield : | 36.0 ksi |
| Beam Bracing : | Beam bracing is defined as a set spacing over all spans | E: Modulus : | 29,000.0 ksi |
| Bending Axis : | Major Axis Bending | | |

## Unbraced Lengths

First Brace starts at  ft from Left-Most support
Regular spacing of lateral supports on length of beam = 2.90 ft




## Applied Loads

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

Beam self weight NOT internally calculated and added
Load(s) for Span Number 1
Point Load : E = 11.310 k @ 2.90 ft

## DESIGN SUMMARY

**Design OK**

| | | | |
|---|---|---|---|
| Maximum Bending Stress Ratio = | **0.796** : 1 | Maximum Shear Stress Ratio = | **0.136** : 1 |
| Section used for this span | **L6x6x3/8** | Section used for this span | **L6x6x3/8** |
| Ma : Applied | 5.740 k-ft | Va : Applied | 3.959 k |
| Mn / Omega : Allowable | 7.213 k-ft | Vn/Omega : Allowable | 29.102 k |
| Load Combination | E Only * 0.70 | Load Combination | E Only * 0.70 |
| Location of maximum on span | 2.900ft | Location of maximum on span | 2.900 ft |
| Span # where maximum occurs | Span # 1 | Span # where maximum occurs | Span # 1 |

### Maximum Deflection

| | | | |
|---|---|---|---|
| Max Downward Transient Deflection | 0.044 in | Ratio = | 1,565 >=360 |
| Max Upward Transient Deflection | 0.044 in | Ratio = | 1,565 >=360 |
| Max Downward Total Deflection | 0.031 in | Ratio = | 2236 >=180 |
| Max Upward Total Deflection | 0.000 in | Ratio = | 0 <180 |

## Maximum Forces & Stresses for Load Combinations

| Load Combination | | Max Stress Ratios | | Summary of Moment Values | | | | | | | Summary of Shear Values | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Segment Length | Span # | M | V | Mmax + | Mmax - | Ma Max | Mnx | Mnx/Omega | Cb | Rm | Va Max | Vnx | Vnx/Omega |
| Dsgn. L = 2.90 ft | 1 | | 0.000 | | | | 12.64 | 7.57 | 1.00 | 1.00 | -0.00 | 48.60 | 29.10 |
| Dsgn. L = 2.90 ft | 1 | | 0.000 | | | | 12.64 | 7.57 | 1.00 | 1.00 | -0.00 | 48.60 | 29.10 |
| E Only * 0.70 | | | | | | | | | | | | | |
| Dsgn. L = 2.90 ft | 1 | 0.796 | 0.136 | 5.74 | -5.74 | 5.74 | 12.05 | 7.21 | 2.26 | 1.00 | 3.96 | 48.60 | 29.10 |
| Dsgn. L = 2.90 ft | 1 | 0.796 | 0.136 | 5.74 | -5.74 | 5.74 | 12.05 | 7.21 | 2.26 | 1.00 | 3.96 | 48.60 | 29.10 |
| E Only * 0.5250 | | | | | | | | | | | | | |
| Dsgn. L = 2.90 ft | 1 | 0.597 | 0.102 | 4.30 | -4.30 | 4.30 | 12.05 | 7.21 | 2.26 | 1.00 | 2.97 | 48.60 | 29.10 |
| Dsgn. L = 2.90 ft | 1 | 0.597 | 0.102 | 4.30 | -4.30 | 4.30 | 12.05 | 7.21 | 2.26 | 1.00 | 2.97 | 48.60 | 29.10 |

## Vertical Reactions

Support notation : Far left is #1 Values in KIPS

| Load Combination | Support 1 | Support 2 |
|---|---|---|
| Overall MAXimum | 5.655 | 5.655 |
| Overall MINimum | 2.969 | 2.969 |
| E Only * 0.70 | 3.959 | 3.959 |
| E Only * 0.5250 | 2.969 | 2.969 |
| E Only | 5.655 | 5.655 |

# Steel Beam





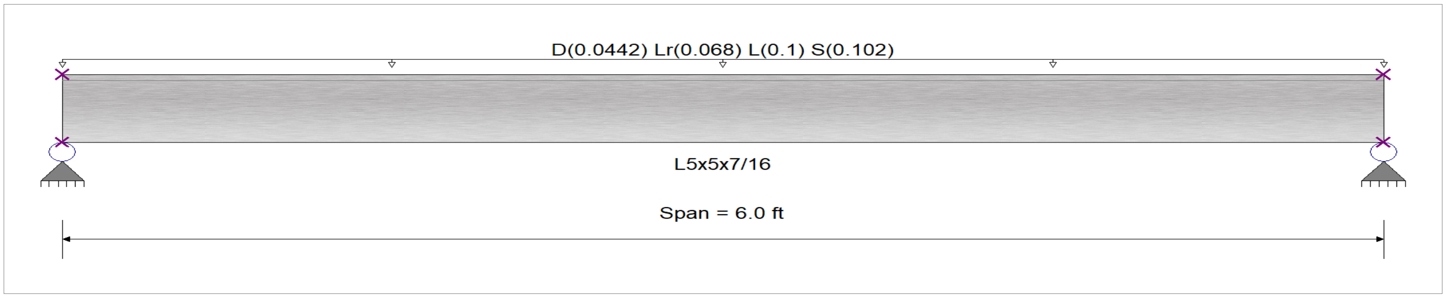
Description : Ledger Angle

## CODE REFERENCES

Calculations per AISC 360-10, IBC 2015, ASCE 7-10
Load Combination Set : IBC 2015

## Material Properties

| | | | |
|---|---|---|---|
| Analysis Method : | Allowable Strength Design | Fy : Steel Yield : | 36.0 ksi |
| Beam Bracing : | Completely Unbraced | E: Modulus : | 29,000.0 ksi |
| Bending Axis : | Major Axis Bending | | |




## Applied Loads

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

Beam self weight calculated and added to loading
Uniform Load : D = 0.04420, Lr = 0.0680, L = 0.10, S = 0.1020 k/ft, Tributary Width = 1.0 ft

## DESIGN SUMMARY

**Design OK**

| | | | |
|---|---|---|---|
| Maximum Bending Stress Ratio = | 0.162 : 1 | Maximum Shear Stress Ratio = | 0.023 : 1 |
| Section used for this span | L5x5x7/16 | Section used for this span | L5x5x7/16 |
| Ma : Applied | 0.973 k-ft | Va : Applied | 0.6484 k |
| Mn / Omega : Allowable | 5.993 k-ft | Vn/Omega : Allowable | 28.326 k |
| Load Combination | +1.105D+0.750L+0.750S | Load Combination | +1.105D+0.750L+0.750S |
| Location of maximum on span | 3.000 ft | Location of maximum on span | 0.000 ft |
| Span # where maximum occurs | Span # 1 | Span # where maximum occurs | Span # 1 |

**Maximum Deflection**

| | | | |
|---|---|---|---|
| Max Downward Transient Deflection | 0.010 in | Ratio = | 6,988 >=360 |
| Max Upward Transient Deflection | 0.010 in | Ratio = | 6,988 >=360 |
| Max Downward Total Deflection | 0.021 in | Ratio = | 3394 >=180 |
| Max Upward Total Deflection | 0.000 in | Ratio = | 0 <180 |

## Maximum Forces & Stresses for Load Combinations

| Load Combination / Segment Length | Span # | Max Stress Ratios M | Max Stress Ratios V | Mmax + | Mmax - | Ma Max | Mnx | Mnx/Omega | Cb | Rm | Va Max | Vnx | Vnx/Omega |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D Only | | | | | | | | | | | | | |
| Dsgn. L = 6.00 ft | 1 | 0.044 | 0.006 | 0.26 | | 0.26 | 10.01 | 5.99 | 1.14 | 1.00 | 0.18 | 47.30 | 28.33 |
| +D+L | | | | | | | | | | | | | |
| Dsgn. L = 6.00 ft | 1 | 0.119 | 0.017 | 0.71 | | 0.71 | 10.01 | 5.99 | 1.14 | 1.00 | 0.48 | 47.30 | 28.33 |
| +D+Lr | | | | | | | | | | | | | |
| Dsgn. L = 6.00 ft | 1 | 0.095 | 0.013 | 0.57 | | 0.57 | 10.01 | 5.99 | 1.14 | 1.00 | 0.38 | 47.30 | 28.33 |
| +D+S | | | | | | | | | | | | | |
| Dsgn. L = 6.00 ft | 1 | 0.121 | 0.017 | 0.72 | | 0.72 | 10.01 | 5.99 | 1.14 | 1.00 | 0.48 | 47.30 | 28.33 |
| +D+0.750Lr+0.750L | | | | | | | | | | | | | |
| Dsgn. L = 6.00 ft | 1 | 0.139 | 0.020 | 0.83 | | 0.83 | 10.01 | 5.99 | 1.14 | 1.00 | 0.55 | 47.30 | 28.33 |
| +D+0.750L+0.750S | | | | | | | | | | | | | |
| Dsgn. L = 6.00 ft | 1 | 0.158 | 0.022 | 0.95 | | 0.95 | 10.01 | 5.99 | 1.14 | 1.00 | 0.63 | 47.30 | 28.33 |
| +1.140D | | | | | | | | | | | | | |
| Dsgn. L = 6.00 ft | 1 | 0.050 | 0.007 | 0.30 | | 0.30 | 10.01 | 5.99 | 1.14 | 1.00 | 0.20 | 47.30 | 28.33 |
| +1.105D+0.750L+0.750S | | | | | | | | | | | | | |
| Dsgn. L = 6.00 ft | 1 | 0.162 | 0.023 | 0.97 | | 0.97 | 10.01 | 5.99 | 1.14 | 1.00 | 0.65 | 47.30 | 28.33 |
| +0.60D | | | | | | | | | | | | | |
| Dsgn. L = 6.00 ft | 1 | 0.026 | 0.004 | 0.16 | | 0.16 | 10.01 | 5.99 | 1.14 | 1.00 | 0.11 | 47.30 | 28.33 |
| +0.4603D | | | | | | | | | | | | | |
| Dsgn. L = 6.00 ft | 1 | 0.020 | 0.003 | 0.12 | | 0.12 | 10.01 | 5.99 | 1.14 | 1.00 | 0.08 | 47.30 | 28.33 |

## Vertical Reactions

Support notation : Far left is #1 Values in KIPS

| Load Combination | Support 1 | Support 2 |
|---|---|---|
| Overall MAXimum | 0.630 | 0.630 |

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# Steel Beam



Description : Ledger Angle

## Vertical Reactions

Support notation : Far left is #1 Values in KIPS

| Load Combination | Support 1 | Support 2 |
|---|---|---|
| Overall MINimum | 0.105 | 0.105 |
| D Only | 0.176 | 0.176 |
| +D+L | 0.476 | 0.476 |
| +D+Lr | 0.380 | 0.380 |
| +D+S | 0.482 | 0.482 |
| +D+0.750Lr+0.750L | 0.554 | 0.554 |
| +D+0.750L+0.750S | 0.630 | 0.630 |
| +0.60D | 0.105 | 0.105 |
| Lr Only | 0.204 | 0.204 |
| L Only | 0.300 | 0.300 |
| S Only | 0.306 | 0.306 |

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## ACI 318-14 CONCRETE SHEAR PIERS STRENGTH DESIGN

07-May-18

Version Date: December 21, 2017 | Author: Arek Higgs | Reviewed By: Josh Blazzard

| | | | |
|---|---|---|---|
| JOB TITLE: | Kimberly Clark Addition | JOB #: | 18054 |
| WALL LOCATION: | Grid 2 | DESIGNED BY: | SJV |

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTAL LAT. FORCE (ULTIMATE)= | 436 | kips | $S_{ds}$= | 0.938 | $F_y$: | 60000 psi |
| SEISMIC DESIGN CATEGORY. (A-F) : | D | 1700 | R= | 6.0 | f'c: | 4000 psi |
| φ FOR SHEAR: (ACI 21.2.1, Table 21.2.1 (b)) | 0.75 | | Ie= | 1.00 | Wall Density δ (pcf): | 150 |
| φ FOR BENDING: (ACI 21.2.1, Table 21.2.1 (h)) | 0.9 | | | | λ: | 1.0 |
| OVERALL WALL LENGTH (ft): | 256.52 | | | | HEIGHT/LENGTH OF OVERALL WALL: | 0.17932 |
| OVERALL WALL HEIGHT (ft): | 46 | | | | ac: (FOR OVERALL WALL): | 3.00 |
| φ*$V_n$ MAX (kips) FOR COMBINED PIERS: (ACI 18.10.4.4) | 2837 | OK | | | | |

| peir typr | CC | BB | | D | | E | | D | |
|---|---|---|---|---|---|---|---|---|---|
| **pier plf** | 345 | 1831 | | 1904 | | 2113 | | 2003 | |
| **Peir length** | 22.27 | 19.27 | | 20.27 | | 18.27 | | 19.27 | |
| **PIER I.D. #** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| PIER HEIGHT (ft): | 46.00 | 14.00 | 7.20 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| PIER LENGTH (ft): | 22.27 | 9.44 | 3.17 | 4.64 | 4.64 | 4.64 | 4.64 | 4.64 | 4.64 |
| NOMINAL PIER THICKNESS (in): | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 |
| TOTAL VERTICAL LOAD- P (ASD) (k): | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wall Self Weight (psf) | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 |
| Additional Weight on Wall (psf) | | | | | | | | | |
| Total Wall Weight (psf) | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 |
| FIXITY TYPE (F-F = 2, F-P = 1 ): | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| EFFECTIVE LENGTH FACTOR: (ACI 11.5.4.2) | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 |
| EFFECTIVE LENGTH "d" (ft): | 17.81667 | 7.55 | 2.533333 | 3.712 | 3.712 | 3.712 | 3.712 | 3.712 | 3.712 |
| $\beta_1$= | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| UNIFORM DEAD LOAD ON PIER (k/ft): | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **RIGIDITY DATA** | | | | | | | | | |
| HEIGHT/LENGTH: | 2.07 | 1.48 | 2.27 | 2.16 | 2.16 | 2.16 | 2.16 | 2.16 | 2.16 |
| $(H/L)^3$ : | 8.81 | 3.26 | 11.75 | 10.01 | 10.01 | 10.01 | 10.01 | 10.01 | 10.01 |
| RELATIVE DEFLECTION: | 0.448 | 0.189 | 0.201 | 0.178 | 0.178 | 0.178 | 0.178 | 0.178 | 0.178 |
| RIGIDTY = 1/DEFL. : | 2.232 | 5.283 | 4.980 | 5.614 | 5.614 | 5.614 | 5.614 | 5.614 | 5.614 |
| SUM. RIGIDITIES: | | | | | | | | | |
| % OF FORCE TO PIER: | 2% | 4% | 4% | 4% | 4% | 4% | 4% | 4% | 4% |
| $V_u$ = SHEAR/PIER (kips): | 7.67 | 18.16 | 17.12 | 19.30 | 19.30 | 19.30 | 19.30 | 19.30 | 19.30 |
| M / (V * DEPTH): | 2.58 | 1.85 | 1.42 | 1.35 | 1.35 | 1.35 | 1.35 | 1.35 | 1.35 |
| **SUMMARY** | | | | | | | | | |
| **REINFORCING** | | | | | | | | | |
| φ FOR SHEAR: (ACI 21.2.1, Table 21.2.1 (b)) | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| VERTICAL PLAN GROSS AREA OF CONCRETE, $A_{cv}$ ($in^2$): | 2472 | 1048 | 352 | 515 | 515 | 515 | 515 | 515 | 515 |
| HORIZONTAL PLAN GROSS AREA OF CONCRETE ($in^2$): | 5106 | 1554 | 799 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 |
| MIN. HORIZ. REINF. RATIO: (ACI 18.10.2.1, 11.6.1 and 11.6.2) (ρ) | 0.0020 | 0.0020 | 0.0025 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 |
| MIN. VERT. REINF. RATIO: (ACI 18.10.2.1, 11.6.1 and 11.6.2) (ρ) | 0.0015 | 0.0015 | 0.0025 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0015 |
| φ*$V_n$ MAX (kips): (ACI 11.5.4.3 and 18.10.4.4) | 750 | 318 | 107 | 156 | 156 | 156 | 156 | 156 | 156 |
| φ*$V_c$ MAX (kips): (ACI 11.5.4.5) | 188 | 80 | 27 | 39 | 39 | 39 | 39 | 39 | 39 |
| NEEDED HORIZ. REINF. ($in^2$/ft): (ACI 11.5.4.8 and 22.5.10.1) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HORIZONTAL BAR SIZE: | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** |
| VERTICAL BAR SIZE: | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** |
| **REINFORCING SPACING** | | | | | | | | | |
| $l_w$/3 (in): | 89 | 38 | 13 | 19 | 19 | 19 | 19 | 19 | 19 |
| $l_w$/5 (in): | 53 | 23 | 8 | 11 | 11 | 11 | 11 | 11 | 11 |
| 3h (in): | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 |
| MAX. SPACING OF HORIZ. REINF. (in): (ACI 11.9.9.3) | **18** | **18** | **8** | **11** | **11** | **11** | **11** | **11** | **11** |
| MAX. SPACING OF VERT. REINF. (in): (ACI 11.9.9.5) | **18** | **18** | **13** | **18** | **18** | **18** | **18** | **18** | **18** |
| Actual Spacing of Horiz. Reinf. (in) | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** |
| Actual Spacing of Vert. Reinf. (in) | **6** | **6** | **6** | **6** | **6** | **6** | **6** | **6** | **6** |
| Actual Horizontal Area of Steel Provided ($in^2$/ft): | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 |
| Actual Vertical Area of Steel Provided ($in^2$/ft): | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 |
| Horizontal Steel Required ($in^2$/ft): | 0.22 | 0.22 | 0.28 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 |
| Vertical Steel Required ($in^2$/ft): | 0.17 | 0.22 | 0.28 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 |
| Horiz. Steel Acceptance Check: | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| Vert. Steel Acceptance Check: | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| **SHEAR CAPACITY** | | | | | | | | | |
| 2*$A_{cv}$*SQRT(f'c) (kips): | 313 | 133 | 44 | 65 | 65 | 65 | 65 | 65 | 65 |
| 2 LAYERS OF REINF. REQ'D?: (ACI 11.7.2.3 and 18.10.2.2) | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** |
| 2 LAYERS OF REINF. USED? | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** |
| $\alpha_c$: (ACI 18.10.4.1) | 2.0 | 3.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| φ*$V_n$ MAX (kips): (ACI EQ. 18.10.4.1) | 457 | 243 | 73 | 95 | 95 | 95 | 95 | 95 | 95 |
| MAXIMUM SHEAR CHECK: | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| Nominal Shear Strength Vn (kips): | **818** | **347** | **116** | **170** | **170** | **170** | **170** | **170** | **170** |
| **FLEXURAL REINFORCING** | | | | | | | | | |
| Resisting Moment From Wall Self Wt. = (0.9-0.2Sds)(MrSW); (k-ft) | 940 | 51 | 3 | 9 | 9 | 9 | 9 | 9 | 9 |
| MAXIMUM MOMENT, $M_u$=Vh-(0.9-0.2$S_{ds}$)($M_{rDL}$ + $M_{rSW}$); (k-ft): | -161 | 220 | 59 | 90 | 90 | 90 | 90 | 90 | 90 |
| $A_{s,req}$ ($in^2$): | 0.00 | 0.55 | 0.44 | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| REQUIRED FLEXURAL STEEL, $A_s$ ($in^2$): | **0.00** | **0.55** | **0.44** | **0.46** | **0.46** | **0.46** | **0.46** | **0.46** | **0.46** |

## FLEXURAL REINFORCEMENT USED

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Flexural Bar Used | **#10 Bar** | **#10 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** |
| Diameter of Bar: | 1.27 | 1.27 | 0.625 | 0.625 | 0.625 | 0.625 | 0.625 | 0.625 | 0.625 |
| $A_s$/Bar ($in^2$): | 1.27 | 1.27 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 |
| # of Rows of Bars in Boundary: | 4 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Center-to-CetnerSpacing of Bars in Boundary (in): | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Clear Spacing Check: | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| TOTAL # OF BARS Required: | **0** | **4** | **2** | **2** | **2** | **2** | **2** | **2** | **2** |
| Min User Specified # of Bars: | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** |
| LENGTH OF BOUNDARY (in): | **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** |
| Boundary Length Check: | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| AREA OF STEEL PROVIDED ($in^2$): | 5.08 | 5.08 | 1.24 | 1.24 | 1.24 | 1.24 | 1.24 | 1.24 | 1.24 |
| FLEXURAL STEEL PROVIDED CHECK | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| Nominal Flexural Capacity Mn (k-ft): | **5307** | **2178** | **181** | **269** | **269** | **269** | **269** | **269** | **269** |
| Factored Flexural Capcity ΦMn (k-ft): | **4777** | **1960** | **163** | **242** | **242** | **242** | **242** | **242** | **242** |
| Cracking Moment Mcr (k-ft): | **4352** | **782** | **88** | **189** | **189** | **189** | **189** | **189** | **189** |
| Factored Flexural Capcity ΦMn>Mcr | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |

## SPECIAL BOUNDARY ELEMENTS (ACI 18.10.6)

(ACI 18.10.6.2 is not considered in this analysis)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **(ACI 18.10.6.3)** | | | | | | | | | |
| GROSS MOMENT OF INERTIA OF PIER Ig ($in^4$): | ######## | 1119632 | 42297 | 133063 | 133063 | 133063 | 133063 | 133063 | 133063 |
| SECTION MODULUS OF PIER ($in^3$): | 110,110 | 19773 | 2226 | 4780 | 4780 | 4780 | 4780 | 4780 | 4780 |
| BENDING STRESS, $f_b$ (psi): | -18 | 133 | 320 | 225 | 225 | 225 | 225 | 225 | 225 |
| AXIAL STRESS, $f_a$ (psi): | 48 | 15 | 8 | 10 | 10 | 10 | 10 | 10 | 10 |
| EXTREME FIBER COMP. STRESS (psi): | 30 | 148 | 328 | 236 | 236 | 236 | 236 | 236 | 236 |
| $0.2f'_c$ | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 |
| SPECIAL BOUNDARY ELEMENTS REQ'D?: | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** |
| **(ACI 18.10.6.4)** | | | | | | | | | |
| a (in): | 9.69 | 9.69 | 2.37 | 2.37 | 2.37 | 2.37 | 2.37 | 2.37 | 2.37 |
| c (in): | 11.40 | 11.40 | 2.78 | 2.78 | 2.78 | 2.78 | 2.78 | 2.78 | 2.78 |
| (a) Min Length of Boundary Element (in.): | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| (b) Min wdith of compression zone (in.): | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| (c) Width of Compression Zone (in,): | 12 | NA | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Min Compression Zone Check: | **NG** | **OK** | **NG** | **NG** | **NG** | **NG** | **NG** | **NG** | **NG** |
| ( e) Transverse Reinforcement per 18.7.5.2(a)-( e) & 18.7.5.3 Req'd: | NA | YES | NA | NA | NA | NA | NA | NA | NA |
| (f) Required Amount of Transverse Reinforcement $A_{sh1}$: | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| (f) Required Amount of Transverse Reinforcement $A_{sh2}$: | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Tie Bar Size: | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar |
| $A_{sh1}$ Provided ($in^2$): | 0.11 | 0.11 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 |
| $A_{sh1}$ Sufficient: | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| $A_{sh2}$ Provided ($in^2$): | 0.44 | 0.44 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 |
| $A_{sh2}$ Sufficient: | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| (g) Required Footing Thickenss: | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| (h) Development of Horizontal Wall Reinf. Req'd @ Boundary: | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Horizontal Wall Reinf. Ends into Boundary: | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked |
| Min Length of Boundary Element for Development: | NA | NA | NA | NA | NA | NA | NA | NA | NA |

## WHEN S.B. ELEMENTS ARE NOT REQ'D

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **(ACI 18.10.6.5)** | | | | | | | | | |
| $400/F_y$: (ACI 18.10.6.5(a)) | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 |
| ρ BOUNDARY ELEMENT: | 0.0000 | 0.0458 | 0.0056 | 0.0056 | 0.0056 | 0.0056 | 0.0056 | 0.0056 | 0.0056 |
| Provisions of 18.7.5.2(a)-(e ) Required? | NO | YES | NO | NO | NO | NO | NO | NO | NO |
| TRANSVERSE TIES NEEDED? | NO | YES | NO | NO | NO | NO | NO | NO | NO |
| TRANSVERSE TIES SPACING (ACI 18.10.6.5(a)) | 6.00 | 6.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| TRANS. BARS REQUIRED TO HAVE HOOKS? (ACI 18.10.6.5(b)) | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| D | | B | | Z | | D | | E | | AA | | Z | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1904 | | 1657 | | 1175 | | 2003 | | 2003 | | 1493 | | 1239 | |
| 20.27 | | 18.27 | | 19.27 | | 19.27 | | 19.27 | | 20.27 | | 18.27 | |
| **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** |
| 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| 4.64 | 4.64 | 4.64 | 3.64 | 2.30 | 4.64 | 4.64 | 4.64 | 4.64 | 4.64 | 4.64 | 3.64 | 2.30 | 4.64 |
| 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 |
| 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 |
| 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 |
| 3.712 | 3.712 | 3.712 | 2.912 | 1.84 | 3.712 | 3.712 | 3.712 | 3.712 | 3.712 | 3.712 | 2.912 | 1.84 | 3.712 |
| 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2.16 | 2.16 | 2.16 | 2.75 | 4.35 | 2.16 | 2.16 | 2.16 | 2.16 | 2.16 | 2.16 | 2.75 | 4.35 | 2.16 |
| 10.01 | 10.01 | 10.01 | 20.73 | 82.19 | 10.01 | 10.01 | 10.01 | 10.01 | 10.01 | 10.01 | 20.73 | 82.19 | 10.01 |
| 0.178 | 0.178 | 0.178 | 0.313 | 1.030 | 0.178 | 0.178 | 0.178 | 0.178 | 0.178 | 0.178 | 0.313 | 1.030 | 0.178 |
| 5.614 | 5.614 | 5.614 | 3.192 | 0.971 | 5.614 | 5.614 | 5.614 | 5.614 | 5.614 | 5.614 | 3.192 | 0.971 | 5.614 |
| | | | **126.830** | | | | | | | | | | |
| 4% | 4% | 4% | 3% | 1% | 4% | 4% | 4% | 4% | 4% | 4% | 3% | 1% | 4% |
| 19.30 | 19.30 | 19.30 | 10.97 | 3.34 | 19.30 | 19.30 | 19.30 | 19.30 | 19.30 | 19.30 | 10.97 | 3.34 | 19.30 |
| 1.35 | 1.35 | 1.35 | 1.72 | 2.72 | 1.35 | 1.35 | 1.35 | 1.35 | 1.35 | 1.35 | 1.72 | 2.72 | 1.35 |
| 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| 515 | 515 | 515 | 404 | 255 | 515 | 515 | 515 | 515 | 515 | 515 | 404 | 255 | 515 |
| 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 |
| 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 |
| 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0015 |
| 156 | 156 | 156 | 123 | 78 | 156 | 156 | 156 | 156 | 156 | 156 | 123 | 78 | 156 |
| 39 | 39 | 39 | 31 | 19 | 39 | 39 | 39 | 39 | 39 | 39 | 31 | 19 | 39 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** |
| **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** |
| 19 | 19 | 19 | 15 | 9 | 19 | 19 | 19 | 19 | 19 | 19 | 15 | 9 | 19 |
| 11 | 11 | 11 | 9 | 6 | 11 | 11 | 11 | 11 | 11 | 11 | 9 | 6 | 11 |
| 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 |
| **11** | **11** | **11** | **9** | **6** | **11** | **11** | **11** | **11** | **11** | **11** | **9** | **6** | **11** |
| **18** | **18** | **18** | **15** | **9** | **18** | **18** | **18** | **18** | **18** | **18** | **15** | **9** | **18** |
| **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** |
| **6** | **6** | **6** | **6** | **6** | **6** | **6** | **6** | **6** | **6** | **6** | **6** | **6** | **6** |
| 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 |
| 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 |
| 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 |
| 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 |
| **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| 65 | 65 | 65 | 51 | 32 | 65 | 65 | 65 | 65 | 65 | 65 | 51 | 32 | 65 |
| **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** |
| **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** |
| 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| 95 | 95 | 95 | 75 | 47 | 95 | 95 | 95 | 95 | 95 | 95 | 75 | 47 | 95 |
| **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| **170** | **170** | **170** | **134** | **85** | **170** | **170** | **170** | **170** | **170** | **170** | **134** | **85** | **170** |
| 9 | 9 | 9 | 5 | 2 | 9 | 9 | 9 | 9 | 9 | 9 | 5 | 2 | 9 |
| 90 | 90 | 90 | 51 | 16 | 90 | 90 | 90 | 90 | 90 | 90 | 51 | 16 | 90 |
| 0.46 | 0.46 | 0.46 | 0.33 | 0.16 | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 | 0.33 | 0.16 | 0.46 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.46 | 0.46 | 0.46 | 0.33 | 0.16 | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 | 0.33 | 0.16 | 0.46 |

| #5 Bar | #6 Bar | #5 Bar | #6 Bar | #5 Bar | #6 Bar | #6 Bar | #6 Bar | #6 Bar | #6 Bar | #6 Bar | #6 Bar | #6 Bar | #6 Bar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.625 | 0.75 | 0.625 | 0.75 | 0.625 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| 0.31 | 0.44 | 0.31 | 0.44 | 0.31 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 |
| 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** |
| **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** |
| **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** |
| OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| 1.24 | 1.76 | 1.24 | 1.76 | 1.24 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 |
| **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| **269** | **377** | **269** | **293** | **130** | **377** | **377** | **377** | **377** | **377** | **377** | **293** | **180** | **377** |
| **242** | **339** | **242** | **263** | **117** | **339** | **339** | **339** | **339** | **339** | **339** | **263** | **162** | **339** |
| **189** | **189** | **189** | **116** | **46** | **189** | **189** | **189** | **189** | **189** | **189** | **116** | **46** | **189** |
| OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 133063 | 133063 | 133063 | 64240 | 16206 | 133063 | 133063 | 133063 | 133063 | 133063 | 133063 | 64240 | 16206 | 133063 |
| 4780 | 4780 | 4780 | 2941 | 1174 | 4780 | 4780 | 4780 | 4780 | 4780 | 4780 | 2941 | 1174 | 4780 |
| 225 | 225 | 225 | 208 | 159 | 225 | 225 | 225 | 225 | 225 | 225 | 208 | 159 | 225 |
| 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 236 | 236 | 236 | 219 | 169 | 236 | 236 | 236 | 236 | 236 | 236 | 219 | 169 | 236 |
| 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 |
| NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| | | | | | | | | | | | | | |
| 2.37 | 3.36 | 2.37 | 3.36 | 2.37 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 |
| 2.78 | 3.95 | 2.78 | 3.95 | 2.78 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 |
| NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| NG | NG | NG | NG | NG | NG | NG | NG | NG | NG | NG | NG | NG | NG |
| NA | YES | NA | YES | NA | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar |
| 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 |
| OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 |
| OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked |
| NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 |
| 0.0056 | 0.0079 | 0.0056 | 0.0079 | 0.0056 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 |
| NO | YES | NO | YES | NO | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| NO | YES | NO | YES | NO | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| 4.00 | 5.00 | 4.00 | 5.00 | 4.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |
| NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| | | |
|---|---|---|
| Y | | |
| 2497 | | |
| 22.27 | | |
| **24** | **25** | **26** |
| 10.00 | 10.00 | |
| 4.64 | 6.30 | |
| 9.25 | 9.25 | |
| 0.00 | 0.00 | |
| 115.63 | 115.63 | 0.00 |
| | | |
| 115.63 | 115.63 | 0.00 |
| 2 | 2 | |
| 0.80 | 0.80 | |
| 3.712 | 5.041667 | 0 |
| 0.85 | 0.85 | 0.85 |
| 0.00 | 0.00 | 0.00 |
| | | |
| 2.16 | 1.59 | 0.00 |
| 10.01 | 4.00 | 0.00 |
| 0.178 | 0.095 | 0.000 |
| 5.614 | 10.565 | 0.000 |
| | | |
| 4% | 8% | 0% |
| 19.30 | 36.32 | 0.00 |
| 1.35 | 0.99 | 0.00 |
| | | |
| 0.75 | 0.75 | |
| 515 | 700 | 0 |
| 1110 | 1110 | 0 |
| 0.0020 | 0.0025 | 0.0000 |
| 0.0015 | 0.0025 | 0.0000 |
| 156 | 212 | 0 |
| 39 | 53 | 0 |
| 0.00 | 0.00 | 0.00 |
| **#5 Bar** | **#5 Bar** | **#5 Bar** |
| **#6 Bar** | **#6 Bar** | **#6 Bar** |
| | | |
| 19 | 25 | 0 |
| 11 | 15 | 0 |
| 28 | 28 | 0 |
| **11** | **15** | **0** |
| **18** | **18** | **0** |
| **14** | **14** | **14** |
| **6** | **6** | **6** |
| 0.53 | 0.53 | 0.00 |
| 1.76 | 1.76 | 0.00 |
| 0.22 | 0.28 | 0.00 |
| 0.17 | 0.28 | 0.00 |
| **OK** | **OK** | **0** |
| **OK** | **OK** | **0** |
| | | |
| 65 | 88 | 0 |
| **NO** | **NO** | **0** |
| **YES** | **YES** | **YES** |
| 2.0 | 2.8 | 0.0 |
| 95 | 172 | 0 |
| **OK** | **OK** | **0** |
| **170** | **232** | **0** |
| | | |
| 9 | 16 | 0 |
| 90 | 168 | 0 |
| 0.46 | 0.63 | 0.00 |

| | | |
|---|---|---|
| 0.46 | 0.63 | 0.00 |

| | | |
|---|---|---|
| **#6 Bar** | **#6 Bar** | **#6 Bar** |
| 0.75 | 0.75 | 0.75 |
| 0.44 | 0.44 | 0.44 |
| 2 | 2 | 2 |
| 4 | 4 | 4 |
| **OK** | **OK** | **OK** |
| **2** | **2** | **0** |
| **4** | **4** | **4** |
| **12** | **12** | **0** |
| **OK** | **OK** | **0** |
| 1.76 | 1.76 | 0.00 |
| **OK** | **OK** | **0** |
| **377** | **518** | **0** |
| **339** | **466** | **0** |
| **189** | **349** | **0** |
| **OK** | **OK** | **0** |

| | | |
|---|---|---|
| 133063 | 333393 | 0 |
| 4780 | 8817 | 0 |
| 225 | 229 | 0 |
| 10 | 10 | 0 |
| 236 | 239 | 0 |
| 800 | 800 | 0 |
| **NO** | **NO** | **0** |

| | | |
|---|---|---|
| 3.36 | 3.36 | 0.00 |
| 3.95 | 3.95 | 0.00 |
| NA | NA | 0.00 |
| NA | NA | 0.00 |
| 12 | NA | 0 |
| **NG** | **OK** | 0 |
| YES | YES | 0 |
| NA | NA | 0.00 |
| NA | NA | 0.00 |
| #3 Bar | #3 Bar | #3 Bar |
| 0.22 | 0.22 | 0 |
| **OK** | **OK** | 0 |
| 0.22 | 0.22 | 0 |
| **OK** | **OK** | 0 |
| NA | NA | 0.00 |
| NO | NO | 0 |
| Hooked | Hooked | Hooked |
| NA | NA | 0 |

| | | |
|---|---|---|
| 0.0067 | 0.0067 | 0.0000 |
| 0.0079 | 0.0079 | 0.0000 |
| YES | YES | 0.0000 |
| YES | YES | 0.0000 |
| 5.00 | 5.00 | 0.00 |
| NO | NO | 0 |

# ACI 318-14 CONCRETE SHEAR PIERS STRENGTH DESIGN

07-May-18

Version Date: December 21, 2017 Author: Arek Higgs Reviewed By: Josh Blazzard

| | | | |
|---|---|---|---|
| JOB TITLE: | Kimberly Clark Addition | JOB #: | 18054 |
| WALL LOCATION: | Grid 13 | DESIGNED BY: | SJV |

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTAL LAT. FORCE (ULTIMATE)= | 436 | kips | $S_{ds}$= | 0.938 | $F_y$: | 60000 psi |
| SEISMIC DESIGN CATEGORY. (A-F) : | D | 1708 | R= | 6.0 | f'$_c$: | 4000 psi |
| ϕ FOR SHEAR: (ACI 21.2.1, Table 21.2.1 (b)) | 0.75 | | Ie= | 1.00 | Wall Density δ (pcf): | 150 |
| ϕ FOR BENDING: (ACI 21.2.1, Table 21.2.1 (h)) | 0.9 | | | | λ: | 1.0 |
| OVERALL WALL LENGTH (ft): | 255.22 | | | | HEIGHT/LENGTH OF OVERALL WALL: | 0.18024 |
| OVERALL WALL HEIGHT (ft): | 46 | | | | ac: (FOR OVERALL WALL): | 3.00 |
| ϕ*$V_n$ MAX (kips) FOR COMBINED PIERS: (ACI 18.10.4.4) | 2333 | OK | | | | |

| peir typr | J | H | | C | | G | | D | |
|---|---|---|---|---|---|---|---|---|---|
| **pier plf** | 339 | 545 | | 1215 | | 1806 | | 2183 | |
| **Peir length** | 20.97 | 19.27 | | 20.27 | | 18.27 | | 19.27 | |
| **PIER I.D. #** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| PIER HEIGHT (ft): | 46.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| PIER LENGTH (ft): | 20.97 | 2.64 | 2.64 | 4.64 | 2.30 | 3.64 | 4.64 | 4.64 | 4.64 |
| NOMINAL PIER THICKNESS (in): | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 |
| TOTAL VERTICAL LOAD- P (ASD) (k): | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wall Self Weight (psf) | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 |
| Additional Weight on Wall (psf) | | | | | | | | | |
| Total Wall Weight (psf) | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 |
| FIXITY TYPE (F-F = 2, F-P = 1 ): | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| EFFECTIVE LENGTH FACTOR: (ACI 11.5.4.2) | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 |
| EFFECTIVE LENGTH "d" (ft): | 16.776 | 2.10832 | 2.10832 | 3.708 | 1.84 | 2.912 | 3.712 | 3.712 | 3.712 |
| $\beta_1$= | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| UNIFORM DEAD LOAD ON PIER (k/ft): | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **RIGIDITY DATA** | | | | | | | | | |
| HEIGHT/LENGTH: | 2.19 | 3.79 | 3.79 | 2.16 | 4.35 | 2.75 | 2.16 | 2.16 | 2.16 |
| $( H/L )^3$ : | 10.56 | 54.63 | 54.63 | 10.04 | 82.19 | 20.73 | 10.01 | 10.01 | 10.01 |
| RELATIVE DEFLECTION: | 0.528 | 0.714 | 0.714 | 0.179 | 1.030 | 0.313 | 0.178 | 0.178 | 0.178 |
| RIGIDTY = 1/DEFL. : | 1.895 | 1.401 | 1.401 | 5.601 | 0.971 | 3.192 | 5.614 | 5.614 | 5.614 |
| SUM. RIGIDITIES: | | | | | | | | | |
| % OF FORCE TO PIER: | 2% | 1% | 1% | 5% | 1% | 3% | 5% | 5% | 5% |
| $V_u$ = SHEAR/PIER (kips): | 7.10 | 5.25 | 5.25 | 20.98 | 3.64 | 11.96 | 21.03 | 21.03 | 21.03 |
| M / (V * DEPTH): | 2.74 | 2.37 | 2.37 | 1.35 | 2.72 | 1.72 | 1.35 | 1.35 | 1.35 |
| **SUMMARY** | | | | | | | | | |
| **REINFORCING** | | | | | | | | | |
| ϕ FOR SHEAR: (ACI 21.2.1, Table 21.2.1 (b)) | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| VERTICAL PLAN GROSS AREA OF CONCRETE, $A_{cv}$ (in$^2$): | 2328 | 293 | 293 | 514 | 255 | 404 | 515 | 515 | 515 |
| HORIZONTAL PLAN GROSS AREA OF CONCRETE (in$^2$): | 5106 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 |
| MIN. HORIZ. REINF. RATIO: (ACI 18.10.2.1, 11.6.1 and 11.6.2) (ρ) | 0.0020 | 0.0020 | 0.0020 | 0.0025 | 0.0020 | 0.0020 | 0.0025 | 0.0025 | 0.0025 |
| MIN. VERT. REINF. RATIO: (ACI 18.10.2.1, 11.6.1 and 11.6.2) (ρ) | 0.0015 | 0.0015 | 0.0015 | 0.0025 | 0.0015 | 0.0015 | 0.0025 | 0.0025 | 0.0025 |
| ϕ*$V_n$ MAX (kips): (ACI 11.5.4.3 and 18.10.4.4) | 707 | 89 | 89 | 156 | 78 | 123 | 156 | 156 | 156 |
| ϕ*$V_c$ MAX (kips): (ACI 11.5.4.5) | 177 | 22 | 22 | 39 | 19 | 31 | 39 | 39 | 39 |
| NEEDED HORIZ. REINF. (in$^2$/ft): (ACI 11.5.4.8 and 22.5.10.1) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HORIZONTAL BAR SIZE: | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** |
| VERTICAL BAR SIZE: | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** |
| **REINFORCING SPACING** | | | | | | | | | |
| $l_w$/3 (in): | 84 | 11 | 11 | 19 | 9 | 15 | 19 | 19 | 19 |
| $l_w$/5 (in): | 50 | 6 | 6 | 11 | 6 | 9 | 11 | 11 | 11 |
| 3h (in): | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 |
| MAX. SPACING OF HORIZ. REINF. (in): (ACI 11.9.9.3) | **18** | **6** | **6** | **11** | **6** | **9** | **11** | **11** | **11** |
| MAX. SPACING OF VERT. REINF. (in): (ACI 11.9.9.5) | **18** | **11** | **11** | **18** | **9** | **15** | **18** | **18** | **18** |
| Actual Spacing of Horiz. Reinf. (in) | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** |
| Actual Spacing of Vert. Reinf. (in) | **6** | **3** | **3** | **3** | **3** | **6** | **6** | **6** | **6** |
| Actual Horizontal Area of Steel Provided (in$^2$/ft): | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 |
| Actual Vertical Area of Steel Provided (in$^2$/ft): | 1.76 | 3.52 | 3.52 | 3.52 | 3.52 | 1.76 | 1.76 | 1.76 | 1.76 |
| Horizontal Steel Required (in$^2$/ft): | 0.22 | 0.22 | 0.22 | 0.28 | 0.22 | 0.22 | 0.28 | 0.28 | 0.28 |
| Vertical Steel Required (in$^2$/ft): | 0.17 | 0.17 | 0.17 | 0.28 | 0.17 | 0.17 | 0.28 | 0.28 | 0.28 |
| Horiz. Steel Acceptance Check: | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| Vert. Steel Acceptance Check: | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| **SHEAR CAPACITY** | | | | | | | | | |
| 2*$A_{cv}$*SQRT(f'$_c$) (kips): | 294 | 37 | 37 | 65 | 32 | 51 | 65 | 65 | 65 |
| 2 LAYERS OF REINF. REQ'D?: (ACI 11.7.2.3 and 18.10.2.2) | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** |
| 2 LAYERS OF REINF. USED? | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** |
| $\alpha_c$: (ACI 18.10.4.1) | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| ϕ*$V_n$ MAX (kips): (ACI EQ. 18.10.4.1) | 430 | 54 | 54 | 107 | 47 | 75 | 107 | 107 | 107 |
| MAXIMUM SHEAR CHECK: | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| Nominal Shear Strength Vn (kips): | **770** | **97** | **97** | **170** | **85** | **134** | **170** | **170** | **170** |
| **FLEXURAL REINFORCING** | | | | | | | | | |
| Resisting Moment From Wall Self Wt. = (0.9-0.2Sds)(MrSW); (k-ft) | 833 | 3 | 3 | 9 | 2 | 5 | 9 | 9 | 9 |
| MAXIMUM MOMENT, $M_u$ =Vh-(0.9-0.2$S_{ds}$)($M_{rDL}$ + $M_{rSW}$); (k-ft): | -105 | 25 | 25 | 98 | 17 | 56 | 98 | 98 | 98 |
| $A_{s,req}$ (in$^2$): | 0.00 | 0.22 | 0.22 | 0.50 | 0.18 | 0.36 | 0.50 | 0.50 | 0.50 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| REQUIRED FLEXURAL STEEL, $A_s$ ($in^2$): | **0.00** | **0.22** | **0.22** | **0.50** | **0.18** | **0.36** | **0.50** | **0.50** | **0.50** |

## FLEXURAL REINFORCEMENT USED

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Flexural Bar Used | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** |
| Diameter of Bar: | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| $A_s$/Bar ($in^2$): | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 |
| # of Rows of Bars in Boundary: | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Center-to-CetnerSpacing of Bars in Boundary (in): | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Clear Spacing Check: | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| TOTAL # OF BARS Required: | **0** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** |
| Min User Specified # of Bars: | **10** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** |
| LENGTH OF BOUNDARY (in): | **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** |
| Boundary Length Check: | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| AREA OF STEEL PROVIDED ($in^2$): | 4.40 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 |
| FLEXURAL STEEL PROVIDED CHECK | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| Nominal Flexural Capacity Mn (k-ft): | **4337** | **208** | **208** | **377** | **180** | **293** | **377** | **377** | **377** |
| Factored Flexural Capcity ΦMn (k-ft): | **3903** | **187** | **187** | **339** | **162** | **263** | **339** | **339** | **339** |
| Cracking Moment Mcr (k-ft): | **3859** | **61** | **61** | **189** | **46** | **116** | **189** | **189** | **189** |
| Factored Flexural Capcity ΦMn>Mcr | OK | OK | OK | OK | OK | OK | OK | OK | OK |

## SPECIAL BOUNDARY ELEMENTS (ACI 18.10.6)

(ACI 18.10.6.2 is not considered in this analysis)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **(ACI 18.10.6.3)** | | | | | | | | | |
| GROSS MOMENT OF INERTIA OF PIER Ig ($in^4$): | ######## | 24381 | 24381 | 132634 | 16206 | 64240 | 133063 | 133063 | 133063 |
| SECTION MODULUS OF PIER ($in^3$): | 97,622 | 1542 | 1542 | 4769 | 1174 | 2941 | 4780 | 4780 | 4780 |
| BENDING STRESS, $f_b$ (psi): | -13 | 191 | 191 | 247 | 174 | 228 | 247 | 247 | 247 |
| AXIAL STRESS, $f_a$ (psi): | 48 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| EXTREME FIBER COMP. STRESS (psi): | 35 | 202 | 202 | 257 | 185 | 239 | 257 | 257 | 257 |
| $0.2f'_c$ | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 |
| SPECIAL BOUNDARY ELEMENTS REQ'D?: | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **(ACI 18.10.6.4)** | | | | | | | | | |
| a (in): | 8.39 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 |
| c (in): | 9.88 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 |
| (a) Min Length of Boundary Element (in.): | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| (b) Min wdith of compression zone (in.): | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| (c) Width of Compression Zone (in,): | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Min Compression Zone Check: | NG | NG | NG | NG | NG | NG | NG | NG | NG |
| ( e) Transverse Reinforcement per 18.7.5.2(a)-( e) & 18.7.5.3 Req'd: | NA | YES | YES | YES | YES | YES | YES | YES | YES |
| (f) Required Amount of Transverse Reinforcement $A_{sh1}$: | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| (f) Required Amount of Transverse Reinforcement $A_{sh2}$: | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Tie Bar Size: | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar |
| $A_{sh1}$ Provided ($in^2$): | 0.55 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 |
| $A_{sh1}$ Sufficient: | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| $A_{sh2}$ Provided ($in^2$): | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 |
| $A_{sh2}$ Sufficient: | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| (g) Required Footing Thickenss: | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| (h) Development of Horizontal Wall Reinf. Req'd @ Boundary: | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Horizontal Wall Reinf. Ends into Boundary: | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked |
| Min Length of Boundary Element for Development: | NA | NA | NA | NA | NA | NA | NA | NA | NA |

## WHEN S.B. ELEMENTS ARE NOT REQ'D

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **(ACI 18.10.6.5)** | | | | | | | | | |
| $400/F_y$: (ACI 18.10.6.5(a)) | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 |
| ρ BOUNDARY ELEMENT: | 0.0000 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 |
| Provisions of 18.7.5.2(a)-(e ) Required? | NO | YES | YES | YES | YES | YES | YES | YES | YES |
| TRANSVERSE TIES NEEDED? | NO | YES | YES | YES | YES | YES | YES | YES | YES |
| TRANSVERSE TIES SPACING (ACI 18.10.6.5(a)) | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |
| TRANS. BARS REQUIRED TO HAVE HOOKS? (ACI 18.10.6.5(b)) | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| C | | F | | D | | E | | D | | C | | B | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1217 | | 1806 | | 2183 | | 2183 | | 2183 | | 1217 | | 1806 | |
| 20.27 | | 18.27 | | 19.27 | | 19.27 | | 19.27 | | 20.27 | | 18.27 | |
| **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** |
| 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| 4.64 | 2.30 | 3.64 | 4.64 | 4.64 | 4.64 | 4.64 | 4.64 | 4.64 | 4.64 | 4.64 | 2.30 | 3.64 | 4.64 |
| 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 |
| 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 | 115.63 |
| 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 |
| 3.712 | 1.84 | 2.912 | 3.712 | 3.712 | 3.712 | 3.712 | 3.712 | 3.712 | 3.712 | 3.712 | 1.84 | 2.912 | 3.712 |
| 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2.16 | 4.35 | 2.75 | 2.16 | 2.16 | 2.16 | 2.16 | 2.16 | 2.16 | 2.16 | 2.16 | 4.35 | 2.75 | 2.16 |
| 10.01 | 82.19 | 20.73 | 10.01 | 10.01 | 10.01 | 10.01 | 10.01 | 10.01 | 10.01 | 10.01 | 82.19 | 20.73 | 10.01 |
| 0.178 | 1.030 | 0.313 | 0.178 | 0.178 | 0.178 | 0.178 | 0.178 | 0.178 | 0.178 | 0.178 | 1.030 | 0.313 | 0.178 |
| 5.614 | 0.971 | 3.192 | 5.614 | 5.614 | 5.614 | 5.614 | 5.614 | 5.614 | 5.614 | 5.614 | 0.971 | 3.192 | 5.614 |
| | | | **116.383** | | | | | | | | | | |
| 5% | 1% | 3% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 1% | 3% | 5% |
| 21.03 | 3.64 | 11.96 | 21.03 | 21.03 | 21.03 | 21.03 | 21.03 | 21.03 | 21.03 | 21.03 | 3.64 | 11.96 | 21.03 |
| 1.35 | 2.72 | 1.72 | 1.35 | 1.35 | 1.35 | 1.35 | 1.35 | 1.35 | 1.35 | 1.35 | 2.72 | 1.72 | 1.35 |
| 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| 515 | 255 | 404 | 515 | 515 | 515 | 515 | 515 | 515 | 515 | 515 | 255 | 404 | 515 |
| 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 | 1110 |
| 0.0025 | 0.0020 | 0.0020 | 0.0025 | 0.0025 | 0.0025 | 0.0025 | 0.0025 | 0.0025 | 0.0025 | 0.0025 | 0.0020 | 0.0020 | 0.0025 |
| 0.0025 | 0.0015 | 0.0015 | 0.0025 | 0.0025 | 0.0025 | 0.0025 | 0.0025 | 0.0025 | 0.0025 | 0.0025 | 0.0015 | 0.0015 | 0.0025 |
| 156 | 78 | 123 | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 78 | 123 | 156 |
| 39 | 19 | 31 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 19 | 31 | 39 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** |
| **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** |
| 19 | 9 | 15 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 9 | 15 | 19 |
| 11 | 6 | 9 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 6 | 9 | 11 |
| 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 |
| **11** | **6** | **9** | **11** | **11** | **11** | **11** | **11** | **11** | **11** | **11** | **6** | **9** | **11** |
| **18** | **9** | **15** | **18** | **18** | **18** | **18** | **18** | **18** | **18** | **18** | **9** | **15** | **18** |
| **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** |
| **6** | **6** | **6** | **6** | **6** | **6** | **6** | **6** | **6** | **6** | **6** | **6** | **6** | **6** |
| 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 |
| 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 |
| 0.28 | 0.22 | 0.22 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.22 | 0.22 | 0.28 |
| 0.28 | 0.17 | 0.17 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.17 | 0.17 | 0.28 |
| **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| 65 | 32 | 51 | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 32 | 51 | 65 |
| **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** |
| **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** | **YES** |
| 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| 107 | 47 | 75 | 107 | 107 | 107 | 107 | 107 | 107 | 107 | 107 | 47 | 75 | 107 |
| **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| **170** | **85** | **134** | **170** | **170** | **170** | **170** | **170** | **170** | **170** | **170** | **85** | **134** | **170** |
| 9 | 2 | 5 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 2 | 5 | 9 |
| 98 | 17 | 56 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 17 | 56 | 98 |
| 0.50 | 0.18 | 0.36 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.18 | 0.36 | 0.50 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.50 | 0.18 | 0.36 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.18 | 0.36 | 0.50 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** |
| 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 |
| 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** |
| **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **4** |
| **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** | **12** |
| **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 | 1.76 |
| **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| **377** | **180** | **293** | **377** | **377** | **377** | **377** | **377** | **377** | **377** | **377** | **180** | **293** | **377** |
| **339** | **162** | **263** | **339** | **339** | **339** | **339** | **339** | **339** | **339** | **339** | **162** | **263** | **339** |
| **189** | **46** | **116** | **189** | **189** | **189** | **189** | **189** | **189** | **189** | **189** | **46** | **116** | **189** |
| **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 133063 | 16206 | 64240 | 133063 | 133063 | 133063 | 133063 | 133063 | 133063 | 133063 | 133063 | 16206 | 64240 | 133063 |
| 4780 | 1174 | 2941 | 4780 | 4780 | 4780 | 4780 | 4780 | 4780 | 4780 | 4780 | 1174 | 2941 | 4780 |
| 247 | 174 | 228 | 247 | 247 | 247 | 247 | 247 | 247 | 247 | 247 | 174 | 228 | 247 |
| 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 257 | 185 | 239 | 257 | 257 | 257 | 257 | 257 | 257 | 257 | 257 | 185 | 239 | 257 |
| 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 |
| **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** |
| 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 | 3.36 |
| 3.95 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 |
| NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| **NG** | **NG** | **NG** | **NG** | **NG** | **NG** | **NG** | **NG** | **NG** | **NG** | **NG** | **NG** | **NG** | **NG** |
| YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar |
| 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 |
| **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 |
| **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked |
| NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 | 0.0067 |
| 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 | 0.0079 |
| YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |
| NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| A | | |
|---|---|---|
| 3467 | | |
| 22.27 | | |
| **24** | **25** | **26** |
| 10.00 | 10.00 | |
| 4.64 | 7.64 | |
| 9.25 | 9.25 | |
| 0.00 | 0.00 | |
| 115.63 | 115.63 | 0.00 |
| | | |
| 115.63 | 115.63 | 0.00 |
| 2 | 2 | |
| 0.80 | 0.80 | |
| 3.712 | 6.112 | 0 |
| 0.85 | 0.85 | 0.85 |
| 0.00 | 0.00 | 0.00 |
| | | |
| 2.16 | 1.31 | 0.00 |
| 10.01 | 2.24 | 0.00 |
| 0.178 | 0.067 | 0.000 |
| 5.614 | 14.994 | 0.000 |
| | | |
| 5% | 13% | 0% |
| 21.03 | 56.17 | 0.00 |
| 1.35 | 0.82 | 0.00 |
| | | |
| | | |
| 0.75 | 0.75 | |
| 515 | 848 | 0 |
| 1110 | 1110 | 0 |
| 0.0025 | 0.0025 | 0.0000 |
| 0.0025 | 0.0025 | 0.0000 |
| 156 | 257 | 0 |
| 39 | 64 | 0 |
| 0.00 | 0.00 | 0.00 |
| **#5 Bar** | **#5 Bar** | **#5 Bar** |
| **#6 Bar** | **#6 Bar** | **#6 Bar** |
| | | |
| 19 | 31 | 0 |
| 11 | 18 | 0 |
| 28 | 28 | 0 |
| **11** | **18** | **0** |
| **18** | **18** | **0** |
| **14** | **14** | **14** |
| **6** | **6** | **6** |
| 0.53 | 0.53 | 0.00 |
| 1.76 | 1.76 | 0.00 |
| 0.28 | 0.28 | 0.00 |
| 0.28 | 0.28 | 0.00 |
| **OK** | **OK** | **0** |
| **OK** | **OK** | **0** |
| | | |
| 65 | 107 | 0 |
| **NO** | **NO** | **0** |
| **YES** | **YES** | **YES** |
| 2.0 | 3.0 | 0.0 |
| 107 | 216 | 0 |
| **OK** | **OK** | **0** |
| **170** | **281** | **0** |
| | | |
| 9 | 24 | 0 |
| 98 | 260 | 0 |
| 0.50 | 0.80 | 0.00 |

| | | |
|---|---|---|
| 0.50 | 0.80 | 0.00 |

| | | |
|---|---|---|
| **#6 Bar** | **#6 Bar** | **#6 Bar** |
| 0.75 | 0.75 | 0.75 |
| 0.44 | 0.44 | 0.44 |
| 2 | 2 | 2 |
| 4 | 4 | 4 |
| **OK** | **OK** | **OK** |
| **2** | **2** | **0** |
| **4** | **4** | **4** |
| **12** | **12** | **0** |
| **OK** | **OK** | **0** |
| 1.76 | 1.76 | 0.00 |
| **OK** | **OK** | **0** |
| **377** | **631** | **0** |
| **339** | **568** | **0** |
| **189** | **512** | **0** |
| **OK** | **OK** | **0** |

| | | |
|---|---|---|
| 133063 | 593997 | 0 |
| 4780 | 12958 | 0 |
| 247 | 241 | 0 |
| 10 | 10 | 0 |
| 257 | 251 | 0 |
| 800 | 800 | 0 |
| **NO** | **NO** | **0** |

| | | |
|---|---|---|
| 3.36 | 3.36 | 0.00 |
| 3.95 | 3.95 | 0.00 |
| NA | NA | 0.00 |
| NA | NA | 0.00 |
| 12 | NA | 0 |
| **NG** | **OK** | 0 |
| YES | YES | 0 |
| NA | NA | 0.00 |
| NA | NA | 0.00 |
| #3 Bar | #3 Bar | #3 Bar |
| 0.22 | 0.22 | 0 |
| **OK** | **OK** | 0 |
| 0.22 | 0.22 | 0 |
| **OK** | **OK** | 0 |
| NA | NA | 0.00 |
| NO | NO | 0 |
| Hooked | Hooked | Hooked |
| NA | NA | 0 |

| | | |
|---|---|---|
| 0.0067 | 0.0067 | 0.0000 |
| 0.0079 | 0.0079 | 0.0000 |
| YES | YES | 0.0000 |
| YES | YES | 0.0000 |
| 5.00 | 5.00 | 0.00 |
| NO | YES | 0 |

# ACI 318-14 CONCRETE SHEAR PIERS STRENGTH DESIGN

07-May-18

Version Date: December 21, 2017 | Author: Arek Higgs | Reviewed By: Josh Blazzard

| | | | |
|---|---|---|---|
| JOB TITLE: | Kimberly Clark Addition | JOB #: | 18054 |
| WALL LOCATION: | Grid 13 | DESIGNED BY: | SJV |

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTAL LAT. FORCE (ULTIMATE)= | 436 | kips | $S_{ds}$= | 0.938 | $F_y$: | 60000 psi |
| SEISMIC DESIGN CATEGORY. (A-F) : | D | 1708 | R= | 6.0 | $f'_c$: | 4000 psi |
| $\phi$ FOR SHEAR: (ACI 21.2.1, Table 21.2.1 (b)) | 0.75 | | Ie= | 1.00 | Wall Density δ (pcf): | 150 |
| $\phi$ FOR BENDING: (ACI 21.2.1, Table 21.2.1 (h)) | 0.9 | | | | λ: | 1.0 |
| OVERALL WALL LENGTH (ft): | 255.22 | | | | HEIGHT/LENGTH OF OVERALL WALL: | 0.18024 |
| OVERALL WALL HEIGHT (ft): | 46 | | | | ac: (FOR OVERALL WALL): | 3.00 |
| $\phi$*$V_n$ MAX (kips) FOR COMBINED PIERS: (ACI 18.10.4.4) | 4984 | OK | | | | |

| peir typr | J | H | | C | | G | | D | |
|---|---|---|---|---|---|---|---|---|---|
| **pier plf** | 1903 | 1641 | | 1794 | | 1493 | | 1641 | |
| **Peir length** | 20.97 | 19.27 | | 20.27 | | 18.27 | | 19.27 | |
| **PIER I.D. #** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| PIER HEIGHT (ft): | 46.00 | 46.00 | | 46.00 | | 46.00 | | 46.00 | |
| PIER LENGTH (ft): | 20.97 | 19.27 | | 20.27 | | 18.27 | | 19.27 | |
| NOMINAL PIER THICKNESS (in): | 9.25 | 9.25 | | 9.25 | | 9.25 | | 9.25 | |
| TOTAL VERTICAL LOAD- P (ASD) (k): | 0.00 | 0.00 | | 0.00 | | 0.00 | | 0.00 | |
| Wall Self Weight (psf) | 115.63 | 115.63 | 0.00 | 115.63 | 0.00 | 115.63 | 0.00 | 115.63 | 0.00 |
| Additional Weight on Wall (psf) | | | | | | | | | |
| Total Wall Weight (psf) | 115.63 | 115.63 | 0.00 | 115.63 | 0.00 | 115.63 | 0.00 | 115.63 | 0.00 |
| FIXITY TYPE (F-F = 2, F-P = 1 ): | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| EFFECTIVE LENGTH FACTOR: (ACI 11.5.4.2) | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 |
| EFFECTIVE LENGTH "d" (ft): | 16.776 | 15.416 | 0 | 16.216 | 0 | 14.616 | 0 | 15.416 | 0 |
| $\beta_1$= | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| UNIFORM DEAD LOAD ON PIER (k/ft): | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **RIGIDITY DATA** | | | | | | | | | |
| HEIGHT/LENGTH: | 2.19 | 2.39 | 0.00 | 2.27 | 0.00 | 2.52 | 0.00 | 2.39 | 0.00 |
| $(H/L)^3$ : | 10.56 | 13.60 | 0.00 | 11.69 | 0.00 | 15.96 | 0.00 | 13.60 | 0.00 |
| RELATIVE DEFLECTION: | 0.528 | 0.666 | 0.000 | 0.579 | 0.000 | 0.772 | 0.000 | 0.666 | 0.000 |
| RIGIDTY = 1/DEFL. : | 1.895 | 1.502 | 0.000 | 1.727 | 0.000 | 1.296 | 0.000 | 1.502 | 0.000 |
| SUM. RIGIDITIES: | | | | | | | | | |
| % OF FORCE TO PIER: | 9% | 7% | 0% | 8% | 0% | 6% | 0% | 7% | 0% |
| $V_u$ = SHEAR/PIER (kips): | 39.91 | 31.63 | 0.00 | 36.37 | 0.00 | 27.28 | 0.00 | 31.63 | 0.00 |
| M / (V * DEPTH): | 2.74 | 2.98 | 0.00 | 2.84 | 0.00 | 3.15 | 0.00 | 2.98 | 0.00 |
| **SUMMARY** | | | | | | | | | |
| **REINFORCING** | | | | | | | | | |
| $\phi$ FOR SHEAR: (ACI 21.2.1, Table 21.2.1 (b)) | 0.75 | 0.75 | | 0.75 | | 0.75 | | 0.75 | |
| VERTICAL PLAN GROSS AREA OF CONCRETE, $A_{cv}$ (in$^2$): | 2328 | 2139 | 0 | 2250 | 0 | 2028 | 0 | 2139 | 0 |
| HORIZONTAL PLAN GROSS AREA OF CONCRETE (in$^2$): | 5106 | 5106 | 0 | 5106 | 0 | 5106 | 0 | 5106 | 0 |
| MIN. HORIZ. REINF. RATIO: (ACI 18.10.2.1, 11.6.1 and 11.6.2) ($\rho$) | 0.0020 | 0.0020 | 0.0000 | 0.0020 | 0.0000 | 0.0020 | 0.0000 | 0.0020 | 0.0000 |
| MIN. VERT. REINF. RATIO: (ACI 18.10.2.1, 11.6.1 and 11.6.2) ($\rho$) | 0.0015 | 0.0015 | 0.0000 | 0.0015 | 0.0000 | 0.0015 | 0.0000 | 0.0015 | 0.0000 |
| $\phi$*$V_n$ MAX (kips): (ACI 11.5.4.3 and 18.10.4.4) | 707 | 649 | 0 | 683 | 0 | 616 | 0 | 649 | 0 |
| $\phi$*$V_c$ MAX (kips): (ACI 11.5.4.5) | 177 | 162 | 0 | 171 | 0 | 154 | 0 | 162 | 0 |
| NEEDED HORIZ. REINF. (in$^2$/ft): (ACI 11.5.4.8 and 22.5.10.1) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HORIZONTAL BAR SIZE: | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** |
| VERTICAL BAR SIZE: | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** |
| **REINFORCING SPACING** | | | | | | | | | |
| $l_w$/3 (in): | 84 | 77 | 0 | 81 | 0 | 73 | 0 | 77 | 0 |
| $l_w$/5 (in): | 50 | 46 | 0 | 49 | 0 | 44 | 0 | 46 | 0 |
| 3h (in): | 28 | 28 | 0 | 28 | 0 | 28 | 0 | 28 | 0 |
| MAX. SPACING OF HORIZ. REINF. (in): (ACI 11.9.9.3) | **18** | **18** | **0** | **18** | **0** | **18** | **0** | **18** | **0** |
| MAX. SPACING OF VERT. REINF. (in): (ACI 11.9.9.5) | **18** | **18** | **0** | **18** | **0** | **18** | **0** | **18** | **0** |
| Actual Spacing of Horiz. Reinf. (in) | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** |
| Actual Spacing of Vert. Reinf. (in) | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** |
| Actual Horizontal Area of Steel Provided (in$^2$/ft): | 0.27 | 0.27 | 0.00 | 0.27 | 0.00 | 0.27 | 0.00 | 0.27 | 0.00 |
| Actual Vertical Area of Steel Provided (in$^2$/ft): | 1.06 | 1.06 | 0.00 | 1.06 | 0.00 | 1.06 | 0.00 | 1.06 | 0.00 |
| Horizontal Steel Required (in$^2$/ft): | 0.22 | 0.22 | 0.00 | 0.22 | 0.00 | 0.22 | 0.00 | 0.22 | 0.00 |
| Vertical Steel Required (in$^2$/ft): | 0.17 | 0.17 | 0.00 | 0.17 | 0.00 | 0.17 | 0.00 | 0.17 | 0.00 |
| Horiz. Steel Acceptance Check: | **OK** | **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** |
| Vert. Steel Acceptance Check: | **OK** | **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** |
| **SHEAR CAPACITY** | | | | | | | | | |
| 2*$A_{cv}$*SQRT($f'_c$) (kips): | 294 | 271 | 0 | 285 | 0 | 257 | 0 | 271 | 0 |
| 2 LAYERS OF REINF. REQ'D?: (ACI 11.7.2.3 and 18.10.2.2) | **NO** | **NO** | **0** | **NO** | **0** | **NO** | **0** | **NO** | **0** |
| 2 LAYERS OF REINF. USED? | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** |
| $\alpha_c$: (ACI 18.10.4.1) | 2.0 | 2.0 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 |
| $\phi$*$V_n$ MAX (kips): (ACI EQ. 18.10.4.1) | 430 | 395 | 0 | 416 | 0 | 375 | 0 | 395 | 0 |
| MAXIMUM SHEAR CHECK: | **OK** | **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** |
| Nominal Shear Strength Vn (kips): | **503** | **462** | **0** | **486** | **0** | **438** | **0** | **462** | **0** |
| **FLEXURAL REINFORCING** | | | | | | | | | |
| Resisting Moment From Wall Self Wt. = (0.9-0.2Sds)(MrSW); (k-ft) | 833 | 704 | 0 | 778 | 0 | 632 | 0 | 704 | 0 |
| MAXIMUM MOMENT, $M_u$=Vh-(0.9-0.2$S_{ds}$)($M_{rDL}$ + $M_{rSW}$); (k-ft): | 1404 | 1120 | 0 | 1282 | 0 | 972 | 0 | 1120 | 0 |
| $A_{s,req}$ (in$^2$): | 1.56 | 1.36 | 0.00 | 1.48 | 0.00 | 1.24 | 0.00 | 1.36 | 0.00 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| REQUIRED FLEXURAL STEEL, $A_s$ ($in^2$): | **1.56** | **1.36** | **0.00** | **1.48** | **0.00** | **1.24** | **0.00** | **1.36** | **0.00** |

## FLEXURAL REINFORCEMENT USED

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Flexural Bar Used | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** |
| Diameter of Bar: | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| $A_s$/Bar ($in^2$): | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 |
| # of Rows of Bars in Boundary: | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Center-to-CetnerSpacing of Bars in Boundary (in): | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Clear Spacing Check: | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** | **OK** |
| TOTAL # OF BARS Required: | **4** | **4** | **0** | **4** | **0** | **4** | **0** | **4** | **0** |
| Min User Specified # of Bars: | **10** | **10** | **10** | **10** | **10** | **10** | **10** | **10** | **10** |
| LENGTH OF BOUNDARY (in): | **12** | **12** | **0** | **12** | **0** | **12** | **0** | **12** | **0** |
| Boundary Length Check: | **OK** | **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** |
| AREA OF STEEL PROVIDED ($in^2$): | 4.40 | 4.40 | 0.00 | 4.40 | 0.00 | 4.40 | 0.00 | 4.40 | 0.00 |
| FLEXURAL STEEL PROVIDED CHECK | **OK** | **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** |
| Nominal Flexural Capacity Mn (k-ft): | **4337** | **3977** | **0** | **4189** | **0** | **3766** | **0** | **3977** | **0** |
| Factored Flexural Capcity ΦMn (k-ft): | **3903** | **3580** | **0** | **3770** | **0** | **3390** | **0** | **3580** | **0** |
| Cracking Moment Mcr (k-ft): | **3859** | **3259** | **0** | **3606** | **0** | **2929** | **0** | **3259** | **0** |
| Factored Flexural Capcity ΦMn>Mcr | **OK** | **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** |

## SPECIAL BOUNDARY ELEMENTS (ACI 18.10.6)

(ACI 18.10.6.2 is not considered in this analysis)

**(ACI 18.10.6.3)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| GROSS MOMENT OF INERTIA OF PIER Ig ($in^4$): | ######## | 9531239 | 0 | 11093420 | 0 | 8123064 | 0 | 9531239 | 0 |
| SECTION MODULUS OF PIER ($in^3$): | 97,622 | 82436 | 0 | 91214 | 0 | 74102 | 0 | 82436 | 0 |
| BENDING STRESS, $f_b$ (psi): | 173 | 163 | 0 | 169 | 0 | 157 | 0 | 163 | 0 |
| AXIAL STRESS, $f_a$ (psi): | 48 | 48 | 0 | 48 | 0 | 48 | 0 | 48 | 0 |
| EXTREME FIBER COMP. STRESS (psi): | 220 | 211 | 0 | 217 | 0 | 205 | 0 | 211 | 0 |
| $0.2f'_c$ | 800 | 800 | 0 | 800 | 0 | 800 | 0 | 800 | 0 |
| SPECIAL BOUNDARY ELEMENTS REQ'D?: | **NO** | **NO** | **0** | **NO** | **0** | **NO** | **0** | **NO** | **0** |

**(ACI 18.10.6.4)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| a (in): | 8.39 | 8.39 | 0.00 | 8.39 | 0.00 | 8.39 | 0.00 | 8.39 | 0.00 |
| c (in): | 9.88 | 9.88 | 0.00 | 9.88 | 0.00 | 9.88 | 0.00 | 9.88 | 0.00 |
| (a) Min Length of Boundary Element (in.): | NA | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 |
| (b) Min wdith of compression zone (in.): | NA | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 |
| (c) Width of Compression Zone (in,): | 12 | 12 | 0 | 12 | 0 | 12 | 0 | 12 | 0 |
| Min Compression Zone Check: | **NG** | **NG** | 0 | **NG** | 0 | **NG** | 0 | **NG** | 0 |
| ( e) Transverse Reinforcement per 18.7.5.2(a)-( e) & 18.7.5.3 Req'd: | YES | YES | 0 | YES | 0 | YES | 0 | YES | 0 |
| (f) Required Amount of Transverse Reinforcement $A_{sh1}$: | NA | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 |
| (f) Required Amount of Transverse Reinforcement $A_{sh2}$: | NA | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 |
| Tie Bar Size: | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar |
| $A_{sh1}$ Provided ($in^2$): | 0.55 | 0.55 | 0 | 0.55 | 0 | 0.55 | 0 | 0.55 | 0 |
| $A_{sh1}$ Sufficient: | **OK** | **OK** | 0 | **OK** | 0 | **OK** | 0 | **OK** | 0 |
| $A_{sh2}$ Provided ($in^2$): | 0.22 | 0.22 | 0 | 0.22 | 0 | 0.22 | 0 | 0.22 | 0 |
| $A_{sh2}$ Sufficient: | **OK** | **OK** | 0 | **OK** | 0 | **OK** | 0 | **OK** | 0 |
| (g) Required Footing Thickenss: | NA | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 |
| (h) Development of Horizontal Wall Reinf. Req'd @ Boundary: | NO | NO | 0 | NO | 0 | NO | 0 | NO | 0 |
| Horizontal Wall Reinf. Ends into Boundary: | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked |
| Min Length of Boundary Element for Development: | NA | NA | 0 | NA | 0 | NA | 0 | NA | 0 |

## WHEN S.B. ELEMENTS ARE NOT REQ'D

**(ACI 18.10.6.5)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| $400/F_y$: (ACI 18.10.6.5(a)) | 0.0067 | 0.0067 | 0.0000 | 0.0067 | 0.0000 | 0.0067 | 0.0000 | 0.0067 | 0.0000 |
| ρ BOUNDARY ELEMENT: | 0.0159 | 0.0159 | 0.0000 | 0.0159 | 0.0000 | 0.0159 | 0.0000 | 0.0159 | 0.0000 |
| Provisions of 18.7.5.2(a)-(e ) Required? | YES | YES | 0.0000 | YES | 0.0000 | YES | 0.0000 | YES | 0.0000 |
| TRANSVERSE TIES NEEDED? | YES | YES | 0.0000 | YES | 0.0000 | YES | 0.0000 | YES | 0.0000 |
| TRANSVERSE TIES SPACING (ACI 18.10.6.5(a)) | 5.00 | 5.00 | 0.00 | 5.00 | 0.00 | 5.00 | 0.00 | 5.00 | 0.00 |
| TRANS. BARS REQUIRED TO HAVE HOOKS? (ACI 18.10.6.5(b)) | NO | NO | 0 | NO | 0 | NO | 0 | NO | 0 |

| C | | F | | D | | E | | D | | C | | B | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1794 | | 1493 | | 1641 | | 1641 | | 1641 | | 1794 | | 1493 | |
| 20.27 | | 18.27 | | 19.27 | | 19.27 | | 19.27 | | 20.27 | | 18.27 | |
| **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** |
| 46.00 | | 46.00 | | 46.00 | | 46.00 | | 46.00 | | 46.00 | | 46.00 | |
| 20.27 | | 18.27 | | 19.27 | | 19.27 | | 19.27 | | 20.27 | | 18.27 | |
| 9.25 | | 9.25 | | 9.25 | | 9.25 | | 9.25 | | 9.25 | | 9.25 | |
| 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | |
| 115.63 | 0.00 | 115.63 | 0.00 | 115.63 | 0.00 | 115.63 | 0.00 | 115.63 | 0.00 | 115.63 | 0.00 | 115.63 | 0.00 |
| 115.63 | 0.00 | 115.63 | 0.00 | 115.63 | 0.00 | 115.63 | 0.00 | 115.63 | 0.00 | 115.63 | 0.00 | 115.63 | 0.00 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 |
| 16.216 | 0 | 14.616 | 0 | 15.416 | 0 | 15.416 | 0 | 15.416 | 0 | 16.216 | 0 | 14.616 | 0 |
| 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2.27 | 0.00 | 2.52 | 0.00 | 2.39 | 0.00 | 2.39 | 0.00 | 2.39 | 0.00 | 2.27 | 0.00 | 2.52 | 0.00 |
| 11.69 | 0.00 | 15.96 | 0.00 | 13.60 | 0.00 | 13.60 | 0.00 | 13.60 | 0.00 | 11.69 | 0.00 | 15.96 | 0.00 |
| 0.579 | 0.000 | 0.772 | 0.000 | 0.666 | 0.000 | 0.666 | 0.000 | 0.666 | 0.000 | 0.579 | 0.000 | 0.772 | 0.000 |
| 1.727 | 0.000 | 1.296 | 0.000 | 1.502 | 0.000 | 1.502 | 0.000 | 1.502 | 0.000 | 1.727 | 0.000 | 1.296 | 0.000 |
| | | | **20.707** | | | | | | | | | | |
| 8% | 0% | 6% | 0% | 7% | 0% | 7% | 0% | 7% | 0% | 8% | 0% | 6% | 0% |
| 36.37 | 0.00 | 27.28 | 0.00 | 31.63 | 0.00 | 31.63 | 0.00 | 31.63 | 0.00 | 36.37 | 0.00 | 27.28 | 0.00 |
| 2.84 | 0.00 | 3.15 | 0.00 | 2.98 | 0.00 | 2.98 | 0.00 | 2.98 | 0.00 | 2.84 | 0.00 | 3.15 | 0.00 |
| 0.75 | | 0.75 | | 0.75 | | 0.75 | | 0.75 | | 0.75 | | 0.75 | |
| 2250 | 0 | 2028 | 0 | 2139 | 0 | 2139 | 0 | 2139 | 0 | 2250 | 0 | 2028 | 0 |
| 5106 | 0 | 5106 | 0 | 5106 | 0 | 5106 | 0 | 5106 | 0 | 5106 | 0 | 5106 | 0 |
| 0.0020 | 0.0000 | 0.0020 | 0.0000 | 0.0020 | 0.0000 | 0.0020 | 0.0000 | 0.0020 | 0.0000 | 0.0020 | 0.0000 | 0.0020 | 0.0000 |
| 0.0015 | 0.0000 | 0.0015 | 0.0000 | 0.0015 | 0.0000 | 0.0015 | 0.0000 | 0.0015 | 0.0000 | 0.0015 | 0.0000 | 0.0015 | 0.0000 |
| 683 | 0 | 616 | 0 | 649 | 0 | 649 | 0 | 649 | 0 | 683 | 0 | 616 | 0 |
| 171 | 0 | 154 | 0 | 162 | 0 | 162 | 0 | 162 | 0 | 171 | 0 | 154 | 0 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** | **#5 Bar** |
| **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** | **#6 Bar** |
| 81 | 0 | 73 | 0 | 77 | 0 | 77 | 0 | 77 | 0 | 81 | 0 | 73 | 0 |
| 49 | 0 | 44 | 0 | 46 | 0 | 46 | 0 | 46 | 0 | 49 | 0 | 44 | 0 |
| 28 | 0 | 28 | 0 | 28 | 0 | 28 | 0 | 28 | 0 | 28 | 0 | 28 | 0 |
| **18** | **0** | **18** | **0** | **18** | **0** | **18** | **0** | **18** | **0** | **18** | **0** | **18** | **0** |
| **18** | **0** | **18** | **0** | **18** | **0** | **18** | **0** | **18** | **0** | **18** | **0** | **18** | **0** |
| **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** | **14** |
| **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** |
| 0.27 | 0.00 | 0.27 | 0.00 | 0.27 | 0.00 | 0.27 | 0.00 | 0.27 | 0.00 | 0.27 | 0.00 | 0.27 | 0.00 |
| 1.06 | 0.00 | 1.06 | 0.00 | 1.06 | 0.00 | 1.06 | 0.00 | 1.06 | 0.00 | 1.06 | 0.00 | 1.06 | 0.00 |
| 0.22 | 0.00 | 0.22 | 0.00 | 0.22 | 0.00 | 0.22 | 0.00 | 0.22 | 0.00 | 0.22 | 0.00 | 0.22 | 0.00 |
| 0.17 | 0.00 | 0.17 | 0.00 | 0.17 | 0.00 | 0.17 | 0.00 | 0.17 | 0.00 | 0.17 | 0.00 | 0.17 | 0.00 |
| **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** |
| **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** |
| 285 | 0 | 257 | 0 | 271 | 0 | 271 | 0 | 271 | 0 | 285 | 0 | 257 | 0 |
| **NO** | **0** | **NO** | **0** | **NO** | **0** | **NO** | **0** | **NO** | **0** | **NO** | **0** | **NO** | **0** |
| **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** |
| 2.0 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 | 2.0 | 0.0 |
| 416 | 0 | 375 | 0 | 395 | 0 | 395 | 0 | 395 | 0 | 416 | 0 | 375 | 0 |
| **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** | **OK** | **0** |
| **486** | **0** | **438** | **0** | **462** | **0** | **462** | **0** | **462** | **0** | **486** | **0** | **438** | **0** |
| 778 | 0 | 632 | 0 | 704 | 0 | 704 | 0 | 704 | 0 | 778 | 0 | 632 | 0 |
| 1282 | 0 | 972 | 0 | 1120 | 0 | 1120 | 0 | 1120 | 0 | 1282 | 0 | 972 | 0 |
| 1.48 | 0.00 | 1.24 | 0.00 | 1.36 | 0.00 | 1.36 | 0.00 | 1.36 | 0.00 | 1.48 | 0.00 | 1.24 | 0.00 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.48 | 0.00 | 1.24 | 0.00 | 1.36 | 0.00 | 1.36 | 0.00 | 1.36 | 0.00 | 1.48 | 0.00 | 1.24 | 0.00 |

| #6 Bar | #6 Bar | #6 Bar | #6 Bar | #6 Bar | #6 Bar | #6 Bar | #6 Bar | #6 Bar | #6 Bar | #6 Bar | #6 Bar | #6 Bar | #6 Bar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 |
| 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 |
| OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| 4 | 0 | 4 | 0 | 4 | 0 | 4 | 0 | 4 | 0 | 4 | 0 | 4 | 0 |
| 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 12 | 0 | 12 | 0 | 12 | 0 | 12 | 0 | 12 | 0 | 12 | 0 | 12 | 0 |
| OK | 0 | OK | 0 | OK | 0 | OK | 0 | OK | 0 | OK | 0 | OK | 0 |
| 4.40 | 0.00 | 4.40 | 0.00 | 4.40 | 0.00 | 4.40 | 0.00 | 4.40 | 0.00 | 4.40 | 0.00 | 4.40 | 0.00 |
| OK | 0 | OK | 0 | OK | 0 | OK | 0 | OK | 0 | OK | 0 | OK | 0 |
| 4189 | 0 | 3766 | 0 | 3977 | 0 | 3977 | 0 | 3977 | 0 | 4189 | 0 | 3766 | 0 |
| 3770 | 0 | 3390 | 0 | 3580 | 0 | 3580 | 0 | 3580 | 0 | 3770 | 0 | 3390 | 0 |
| 3606 | 0 | 2929 | 0 | 3259 | 0 | 3259 | 0 | 3259 | 0 | 3606 | 0 | 2929 | 0 |
| OK | 0 | OK | 0 | OK | 0 | OK | 0 | OK | 0 | OK | 0 | OK | 0 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11093420 | 0 | 8123064 | 0 | 9531239 | 0 | 9531239 | 0 | 9531239 | 0 | 11093420 | 0 | 8123064 | 0 |
| 91214 | 0 | 74102 | 0 | 82436 | 0 | 82436 | 0 | 82436 | 0 | 91214 | 0 | 74102 | 0 |
| 169 | 0 | 157 | 0 | 163 | 0 | 163 | 0 | 163 | 0 | 169 | 0 | 157 | 0 |
| 48 | 0 | 48 | 0 | 48 | 0 | 48 | 0 | 48 | 0 | 48 | 0 | 48 | 0 |
| 217 | 0 | 205 | 0 | 211 | 0 | 211 | 0 | 211 | 0 | 217 | 0 | 205 | 0 |
| 800 | 0 | 800 | 0 | 800 | 0 | 800 | 0 | 800 | 0 | 800 | 0 | 800 | 0 |
| NO | 0 | NO | 0 | NO | 0 | NO | 0 | NO | 0 | NO | 0 | NO | 0 |
| 8.39 | 0.00 | 8.39 | 0.00 | 8.39 | 0.00 | 8.39 | 0.00 | 8.39 | 0.00 | 8.39 | 0.00 | 8.39 | 0.00 |
| 9.88 | 0.00 | 9.88 | 0.00 | 9.88 | 0.00 | 9.88 | 0.00 | 9.88 | 0.00 | 9.88 | 0.00 | 9.88 | 0.00 |
| NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 |
| NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 |
| 12 | 0 | 12 | 0 | 12 | 0 | 12 | 0 | 12 | 0 | 12 | 0 | 12 | 0 |
| NG | 0 | NG | 0 | NG | 0 | NG | 0 | NG | 0 | NG | 0 | NG | 0 |
| YES | 0 | YES | 0 | YES | 0 | YES | 0 | YES | 0 | YES | 0 | YES | 0 |
| NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 |
| NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 |
| #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar | #3 Bar |
| 0.55 | 0 | 0.55 | 0 | 0.55 | 0 | 0.55 | 0 | 0.55 | 0 | 0.55 | 0 | 0.55 | 0 |
| OK | 0 | OK | 0 | OK | 0 | OK | 0 | OK | 0 | OK | 0 | OK | 0 |
| 0.22 | 0 | 0.22 | 0 | 0.22 | 0 | 0.22 | 0 | 0.22 | 0 | 0.22 | 0 | 0.22 | 0 |
| OK | 0 | OK | 0 | OK | 0 | OK | 0 | OK | 0 | OK | 0 | OK | 0 |
| NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 | NA | 0.00 |
| NO | 0 | NO | 0 | NO | 0 | NO | 0 | NO | 0 | NO | 0 | NO | 0 |
| Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked | Hooked |
| NA | 0 | NA | 0 | NA | 0 | NA | 0 | NA | 0 | NA | 0 | NA | 0 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0067 | 0.0000 | 0.0067 | 0.0000 | 0.0067 | 0.0000 | 0.0067 | 0.0000 | 0.0067 | 0.0000 | 0.0067 | 0.0000 | 0.0067 | 0.0000 |
| 0.0159 | 0.0000 | 0.0159 | 0.0000 | 0.0159 | 0.0000 | 0.0159 | 0.0000 | 0.0159 | 0.0000 | 0.0159 | 0.0000 | 0.0159 | 0.0000 |
| YES | 0.0000 | YES | 0.0000 | YES | 0.0000 | YES | 0.0000 | YES | 0.0000 | YES | 0.0000 | YES | 0.0000 |
| YES | 0.0000 | YES | 0.0000 | YES | 0.0000 | YES | 0.0000 | YES | 0.0000 | YES | 0.0000 | YES | 0.0000 |
| 5.00 | 0.00 | 5.00 | 0.00 | 5.00 | 0.00 | 5.00 | 0.00 | 5.00 | 0.00 | 5.00 | 0.00 | 5.00 | 0.00 |
| NO | 0 | NO | 0 | NO | 0 | NO | 0 | NO | 0 | NO | 0 | NO | 0 |

| | | |
|---|---|---|
| A | | |
| 2110 | | |
| 22.27 | | |
| **24** | **25** | **26** |
| 46.00 | | |
| 22.27 | | |
| 9.25 | | |
| 0.00 | | |
| 115.63 | 0.00 | 0.00 |
| | | |
| 115.63 | 0.00 | 0.00 |
| 1 | 1 | |
| 0.80 | 0.80 | |
| 17.816 | 0 | 0 |
| 0.85 | 0.85 | 0.85 |
| 0.00 | 0.00 | 0.00 |
| | | |
| 2.07 | 0.00 | 0.00 |
| 8.81 | 0.00 | 0.00 |
| 0.448 | 0.000 | 0.000 |
| 2.232 | 0.000 | 0.000 |
| | | |
| 11% | 0% | 0% |
| 46.99 | 0.00 | 0.00 |
| 2.58 | 0.00 | 0.00 |
| | | |
| 0.75 | | |
| 2472 | 0 | 0 |
| 5106 | 0 | 0 |
| 0.0020 | 0.0000 | 0.0000 |
| 0.0015 | 0.0000 | 0.0000 |
| 750 | 0 | 0 |
| 188 | 0 | 0 |
| 0.00 | 0.00 | 0.00 |
| **#5 Bar** | **#5 Bar** | **#5 Bar** |
| **#6 Bar** | **#6 Bar** | **#6 Bar** |
| | | |
| 89 | 0 | 0 |
| 53 | 0 | 0 |
| 28 | 0 | 0 |
| **18** | **0** | **0** |
| **18** | **0** | **0** |
| **14** | **14** | **14** |
| **5** | **5** | **6** |
| 0.27 | 0.00 | 0.00 |
| 1.06 | 0.00 | 0.00 |
| 0.22 | 0.00 | 0.00 |
| 0.17 | 0.00 | 0.00 |
| **OK** | **0** | **0** |
| **OK** | **0** | **0** |
| | | |
| 313 | 0 | 0 |
| **NO** | **0** | **0** |
| **NO** | **NO** | **NO** |
| 2.0 | 0.0 | 0.0 |
| 457 | 0 | 0 |
| **OK** | **0** | **0** |
| **534** | **0** | **0** |
| | | |
| 940 | 0 | 0 |
| 1648 | 0 | 0 |
| 1.73 | 0.00 | 0.00 |

| | | |
|---|---|---|
| 1.73 | 0.00 | 0.00 |

| | | |
|---|---|---|
| #6 Bar | #6 Bar | #6 Bar |
| 0.75 | 0.75 | 0.75 |
| 0.44 | 0.44 | 0.44 |
| 2 | 2 | 2 |
| 4 | 4 | 4 |
| OK | OK | OK |
| 4 | 0 | 0 |
| 12 | 10 | 10 |
| 12 | 0 | 0 |
| OK | 0 | 0 |
| 5.28 | 0.00 | 0.00 |
| OK | 0 | 0 |
| 5511 | 0 | 0 |
| 4960 | 0 | 0 |
| 4352 | 0 | 0 |
| OK | 0 | 0 |

| | | |
|---|---|---|
| 14711768 | 0 | 0 |
| 110102 | 0 | 0 |
| 180 | 0 | 0 |
| 48 | 0 | 0 |
| 228 | 0 | 0 |
| 800 | 0 | 0 |
| NO | 0 | 0 |
| 10.07 | 0.00 | 0.00 |
| 11.85 | 0.00 | 0.00 |
| NA | 0.00 | 0.00 |
| NA | 0.00 | 0.00 |
| 12 | 0 | 0 |
| NG | 0 | 0 |
| YES | 0 | 0 |
| NA | 0.00 | 0.00 |
| NA | 0.00 | 0.00 |
| #3 Bar | #3 Bar | #3 Bar |
| 0.66 | 0 | 0 |
| OK | 0 | 0 |
| 0.22 | 0 | 0 |
| OK | 0 | 0 |
| NA | 0.00 | 0.00 |
| NO | 0 | 0 |
| Hooked | Hooked | Hooked |
| NA | 0 | 0 |

| | | |
|---|---|---|
| 0.0067 | 0.0000 | 0.0000 |
| 0.0159 | 0.0000 | 0.0000 |
| YES | 0.0000 | 0.0000 |
| YES | 0.0000 | 0.0000 |
| 5.00 | 0.00 | 0.00 |
| NO | 0 | 0 |

## ARW Engineers

**Current Date:** 5/7/2018 3:57 PM
**Units system:** English
**File name:** Y:\Projects 2018\18054 - Kimberly Clark 20000SF Addition\Engineering\Calculations\RAM\tilt-ups\18054_Type A.tup\

# Design Results

## Tilt-Up Wall

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### GENERAL INFORMATION:

**Global status : Warnings in design**

| | | |
|---|---|---|
| Design code | : | ACI 318-14 |

**Geometry:**

| | | |
|---|---|---|
| Total height | : | 46.00 [ft] |
| Total length | : | 22.27 [ft] |
| Base support type | : | Continuous |
| Wall bottom restraint | : | Pinned |

**Materials:**

| | | |
|---|---|---|
| Material | : | RC4.5x60 |
| Steel tension strength (Fy) | : | 60 [Kip/in2] |
| Concrete compressive strength (fc) | : | 4.5 [Kip/in2] |
| Steel elasticity modulus (Es) | : | 29000 [Kip/in2] |
| Concrete modulus of elasticity (E) | : | 3823.68 [Kip/in2] |
| Concrete unit weight | : | 0.149818 [Kip/ft3] |

**Number of stories:** **1**

| Story | Story height [ft] | Wall thickness [in] |
|---|---|---|
| 1 | 44.00 | 9.25 |

**Openings:**

| Reference | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] |
|---|---|---|---|---|
| Lower left | 4.64 | 4.00 | 10.00 | 12.00 |

**Load conditions:**

| ID | Comb. | Category | Description |
|---|---|---|---|
| DL | No | DL | Dead Load |
| SL | No | SNOW | Snow |
| EQip | No | EQ | In plane EQ |
| EQoop | No | EQ | OOP EQ |
| S1 | Yes | | DL |
| S2 | Yes | | DL+SL |
| S3 | Yes | | DL+0.75SL |
| S4 | Yes | | DL+0.7EQip |
| S5 | Yes | | DL+0.525EQip |
| S6 | Yes | | DL+0.75SL |
| S7 | Yes | | DL+0.75SL+0.525EQip |
| S8 | Yes | | 0.6DL+0.7EQip |
| S9 | Yes | | DL+0.7EQoop |
| S10 | Yes | | DL+0.525EQoop |

| | | |
|---|---|---|
| S11 | Yes | DL+0.75SL+0.525EQoop |
| S12 | Yes | 0.6DL+0.7EQoop |
| D1 | Yes | 1.4DL |
| D2 | Yes | 1.2DL+0.5SL |
| D3 | Yes | 1.2DL+1.6SL |
| D4 | Yes | 1.2DL+0.2SL |
| D5 | Yes | 1.2DL+EQip |
| D6 | Yes | 1.2DL+0.2SL+EQip |
| D7 | Yes | 0.9DL+EQip |
| D8 | Yes | 1.2DL+EQoop |
| D9 | Yes | 1.2DL+0.2SL+EQoop |
| D10 | Yes | 0.9DL+EQoop |
| D11 | Yes | 1.2DL-EQip |
| D12 | Yes | 1.2DL+0.2SL-EQip |
| D13 | Yes | 0.9DL-EQip |
| D14 | Yes | 1.2DL-EQoop |
| D15 | Yes | 1.2DL+0.2SL-EQoop |
| D16 | Yes | 0.9DL-EQoop |
| S13 | Yes | DL-0.7EQoop |
| S14 | Yes | DL-0.525EQoop |
| S15 | Yes | DL+0.75SL-0.525EQoop |
| S16 | Yes | 0.6DL-0.7EQoop |

**Consider Self Weight:**

Load condition : No

**Distributed loads:**

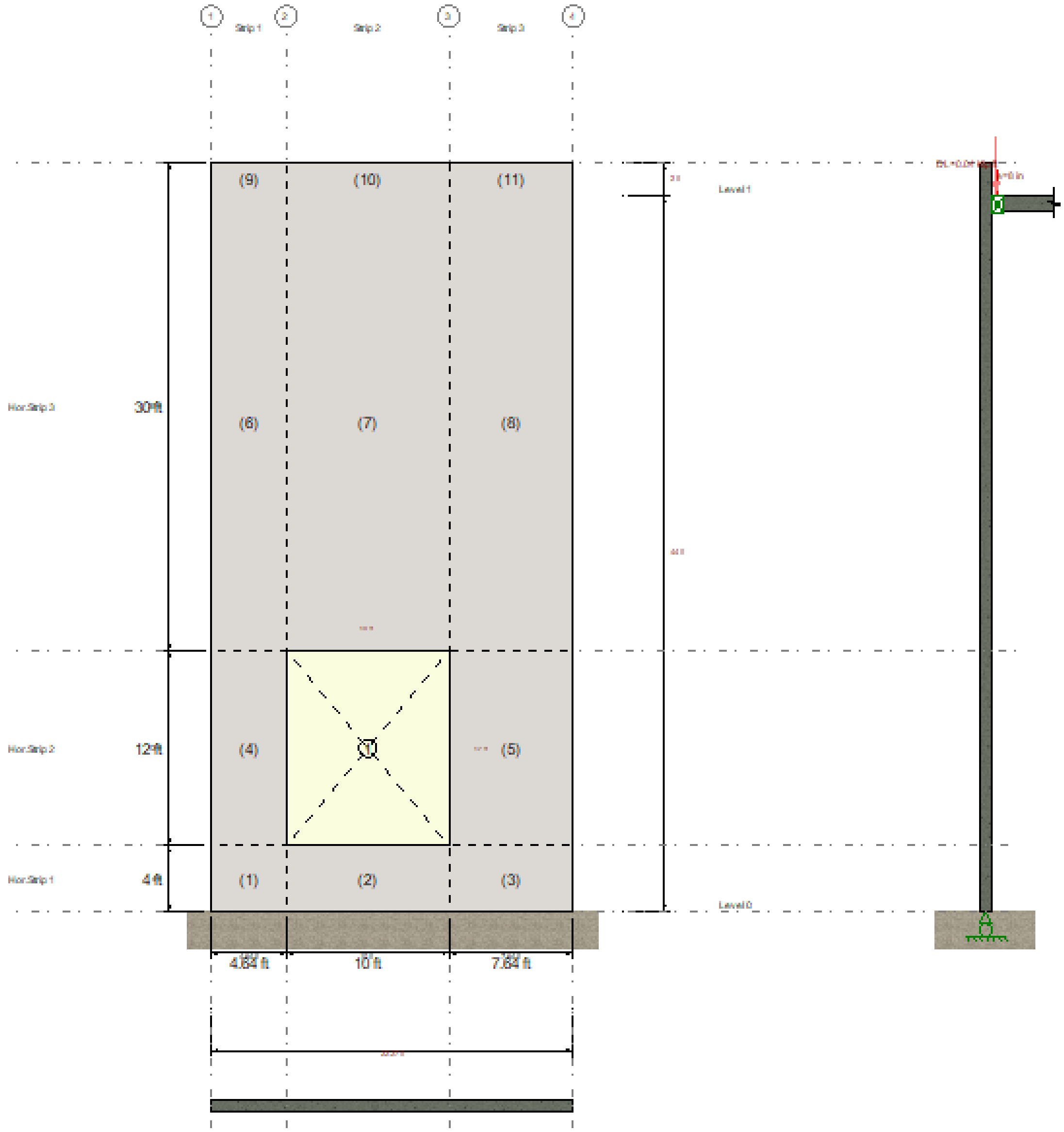
| **Story** | **Condition** | **Direction** | **Magnitude** [Kip/ft] | **Eccentricity** [ft] |
|---|---|---|---|---|
| 1 | DL | Vertical | 0.04 | 0.67 |
| 1 | SL | Vertical | 0.09 | 0.67 |
| 1 | EQip | Horizontal | 1.73 | 0.00 |

**Out-of-plane seismic weight:**

| **Load condition** | **Coefficient** |
|---|---|
| EQoop | 0.40 |

**TILT-UP WALLS DESIGN:**

**Status : Warnings in design**
**- The wall must be tension controlled, Section 11.8.1.1b (Segment 1)**




**Geometry:**

| Segment | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 4.64 | 4.00 |
| 2 | 4.64 | 0.00 | 10.00 | 4.00 |
| 3 | 14.64 | 0.00 | 7.64 | 4.00 |
| 4 | 0.00 | 4.00 | 4.64 | 12.00 |
| 5 | 14.64 | 4.00 | 7.64 | 12.00 |
| 6 | 0.00 | 16.00 | 4.64 | 28.00 |
| 7 | 4.64 | 16.00 | 10.00 | 28.00 |
| 8 | 14.64 | 16.00 | 7.64 | 28.00 |
| 9 | 0.00 | 44.00 | 4.64 | 2.00 |
| 10 | 4.64 | 44.00 | 10.00 | 2.00 |
| 11 | 14.64 | 44.00 | 7.64 | 2.00 |

**Vertical reinforcement:**

Reinforcement layers : 2

| Segment | Bars | Spacing [in] | Ld [in] |
|---|---|---|---|
| 1 | 18-#6 | 3.00 | 26.83 |
| 2 | 12-#6 | 10.00 | 26.83 |
| 3 | 15-#6 | 6.00 | 26.83 |
| 4 | 18-#6 | 3.00 | 26.83 |
| 5 | 15-#6 | 6.00 | 26.83 |
| 6 | 18-#6 | 3.00 | 26.83 |
| 7 | 12-#6 | 10.00 | 26.83 |
| 8 | 15-#6 | 6.00 | 26.83 |
| 9 | 18-#6 | 3.00 | 26.83 |
| 10 | 12-#6 | 10.00 | 26.83 |
| 11 | 15-#6 | 6.00 | 26.83 |

**Vertical reinforcement**

| Segment | Condition | Pu [Kip] | Pu/Ag [Kip/in2] | 0.06*f´c [Kip/in2] | Ratio |
|---|---|---|---|---|---|
| 1 | D12 (Max) | 79.461 | 0.154 | 0.270 | 0.57 |
| 2 | D12 (Max) | 3.133 | 0.003 | 0.270 | 0.01 |
| 3 | D6 (Max) | 82.658 | 0.098 | 0.270 | 0.36 |
| 4 | D12 (Max) | 73.201 | 0.142 | 0.270 | 0.53 |
| 5 | D6 (Max) | 73.358 | 0.087 | 0.270 | 0.32 |
| 6 | D12 (Max) | 27.849 | 0.054 | 0.270 | 0.20 |
| 7 | D12 (Max) | 5.890 | 0.005 | 0.270 | 0.02 |
| 8 | D6 (Max) | 33.461 | 0.039 | 0.270 | 0.15 |
| 9 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |
| 10 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |
| 11 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |

**Intermediate results for axial-bending**

| Segment | Condition | Ase [in2] | a [in] | c [in] | d [in] | $\phi$ | Kb [Kip] |
|---|---|---|---|---|---|---|---|
| 1 | D9 (Top) | 7.93 | 2.53 | 2.97 | 7.63 | 0.87 | 475.83 |
| 2 | D16 (Max) | 5.28 | 0.69 | 0.81 | 7.63 | 0.90 | 1042.10 |
| 3 | D9 (Top) | 6.61 | 1.13 | 1.33 | 7.63 | 0.90 | 795.75 |
| 4 | D9 (Top) | 7.93 | 2.53 | 2.97 | 7.63 | 0.87 | 246.22 |
| 5 | D9 (Top) | 6.61 | 1.13 | 1.33 | 7.63 | 0.90 | 315.72 |
| 6 | D9 (Bottom) | 7.93 | 2.53 | 2.97 | 7.63 | 0.87 | 246.14 |
| 7 | D9 (Max) | 5.29 | 0.69 | 0.81 | 7.63 | 0.90 | 1042.10 |
| 8 | D9 (Bottom) | 6.61 | 1.13 | 1.33 | 7.63 | 0.90 | 315.59 |
| 9 | D1 (Top) | 7.92 | 2.52 | 2.97 | 7.63 | 0.88 | 233778.90 |
| 10 | D1 (Top) | 5.28 | 0.69 | 0.81 | 7.63 | 0.90 | 504377.20 |
| 11 | D1 (Top) | 6.60 | 1.13 | 1.33 | 7.63 | 0.90 | 385142.50 |

**Inertias**

| Segment | Condition | Ig [in4] | Icr [in4] | Ie [in4] |
|---|---|---|---|---|
| 1 | D9 (Top) | 3668.39 | 1788.70 | 3613.86 |
| 2 | D16 (Max) | 7914.53 | 1880.45 | 7914.53 |
| 3 | D9 (Top) | 6043.54 | 2058.45 | 6043.54 |
| 4 | D9 (Top) | 3668.39 | 1788.82 | 1870.00 |
| 5 | D9 (Top) | 6043.54 | 2058.61 | 2397.84 |
| 6 | D9 (Bottom) | 3668.39 | 1788.25 | 1869.38 |

| | | | | |
|---|---|---|---|---|
| 7 | D9 (Max) | 7914.53 | 1882.38 | 7914.53 |
| 8 | D9 (Bottom) | 6043.54 | 2057.86 | 2396.81 |
| 9 | D1 (Top) | 3668.39 | 1787.32 | 3668.39 |
| 10 | D1 (Top) | 7914.53 | 1880.19 | 7914.53 |
| 11 | D1 (Top) | 6043.54 | 2055.81 | 6043.54 |

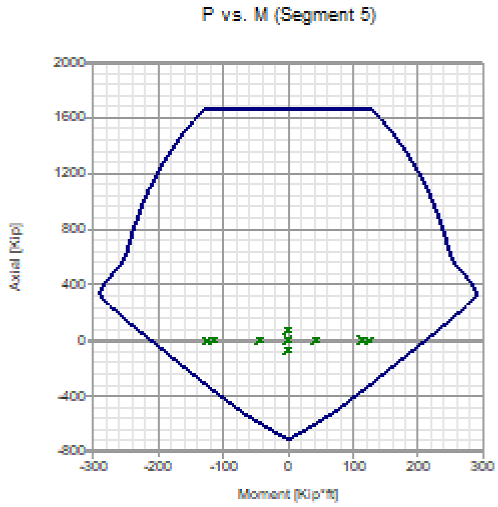
**Combined axial flexure**

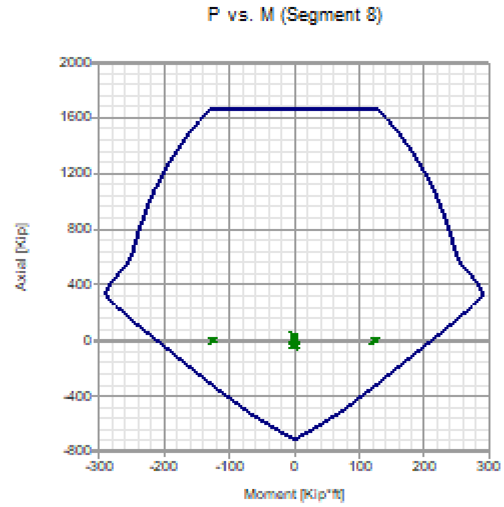
| Segment | Condition | Pu [Kip] | Mua [Kip*ft] | Mu [Kip*ft] | ϕ*Mn [Kip*ft] | Mu/ϕ*Mn |
|---|---|---|---|---|---|---|
| 1 | D9 (Top) | 0.60 | -33.58 | -33.64 | 230.39 | 0.15 |
| 2 | D16 (Max) | 0.05 | 0.92 | 0.92 | 181.16 | 0.01 |
| 3 | D9 (Top) | 0.77 | -43.29 | -43.35 | 210.98 | 0.21 |
| 4 | D9 (Top) | 0.66 | -94.78 | -95.12 | 230.40 | 0.41 |
| 5 | D9 (Top) | 0.81 | -124.54 | -124.97 | 211.00 | 0.59 |
| 6 | D9 (Bottom) | 0.41 | -94.81 | -95.02 | 230.35 | 0.41 |
| 7 | D9 (Max) | 0.47 | -45.03 | -45.05 | 181.28 | 0.25 |
| 8 | D9 (Bottom) | 0.60 | -124.58 | -124.90 | 210.94 | 0.59 |
| 9 | D1 (Top) | 0.00 | 0.00 | 0.00 | 230.28 | 0.00 |
| 10 | D1 (Top) | 0.00 | 0.00 | 0.00 | 181.15 | 0.00 |
| 11 | D1 (Top) | 0.00 | 0.00 | 0.00 | 210.78 | 0.00 |

**Cracking moment**

| Segment | Condition | Pu [Kip] | Mua [Kip*ft] | Mcr [Kip*ft] | ϕ*Mn [Kip*ft] | Mcr/ϕ*Mn |
|---|---|---|---|---|---|---|
| 1 | D7 (Bottom) | -78.53 | 0.00 | 33.25 | 214.17 | 0.16 |
| 2 | D7 (Bottom) | -2.98 | 0.00 | 71.75 | 180.34 | 0.40 |
| 3 | D13 (Top) | -81.47 | -0.03 | 54.79 | 189.22 | 0.29 |
| 4 | D7 (Top) | -72.19 | -0.09 | 33.25 | 215.60 | 0.15 |
| 5 | D13 (Bottom) | -72.10 | -0.03 | 54.79 | 191.70 | 0.29 |
| 6 | D7 (Top) | -27.22 | -0.11 | 33.25 | 225.09 | 0.15 |
| 7 | D7 (Top) | -5.17 | -0.24 | 71.75 | 179.74 | 0.40 |
| 8 | D13 (Top) | -32.54 | -0.18 | 54.79 | 202.17 | 0.27 |
| 9 | D16 (Bottom) | 0.00 | 0.00 | 33.25 | 230.28 | 0.14 |
| 10 | D1 (Top) | 0.00 | 0.00 | 71.75 | 181.15 | 0.40 |
| 11 | D1 (Top) | 0.00 | 0.00 | 54.79 | 210.78 | 0.26 |

**Interaction diagrams, P vs. M:**




**Axial compression**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D12 (Top) | 79.46 | 991.80 | 0.08 |
| 2 | D12 (Bottom) | 3.13 | 2186.79 | 0.00 |
| 3 | D6 (Top) | 82.66 | 1659.61 | 0.05 |
| 4 | D12 (Bottom) | 73.20 | 991.80 | 0.07 |
| 5 | D6 (Top) | 73.36 | 1659.61 | 0.04 |
| 6 | D12 (Bottom) | 27.85 | 991.80 | 0.03 |
| 7 | D12 (Bottom) | 5.89 | 2186.79 | 0.00 |
| 8 | D6 (Top) | 33.46 | 1659.61 | 0.02 |
| 9 | D1 (Top) | 0.00 | 991.80 | 0.00 |
| 10 | D1 (Top) | 0.00 | 2186.79 | 0.00 |
| 11 | D1 (Top) | 0.00 | 1659.61 | 0.00 |

**Axial tension**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D7 (Top) | 78.53 | 855.36 | 0.09 |
| 2 | D7 (Bottom) | 2.98 | 570.24 | 0.01 |
| 3 | D13 (Top) | 81.47 | 712.80 | 0.11 |
| 4 | D7 (Bottom) | 72.19 | 855.36 | 0.08 |
| 5 | D13 (Bottom) | 72.10 | 712.80 | 0.10 |
| 6 | D7 (Bottom) | 27.22 | 855.36 | 0.03 |
| 7 | D7 (Top) | 5.17 | 570.24 | 0.01 |
| 8 | D13 (Bottom) | 32.54 | 712.80 | 0.05 |
| 9 | D1 (Top) | 0.00 | 855.36 | 0.00 |
| 10 | D1 (Top) | 0.00 | 570.24 | 0.00 |
| 11 | D1 (Top) | 0.00 | 712.80 | 0.00 |

**Shear**

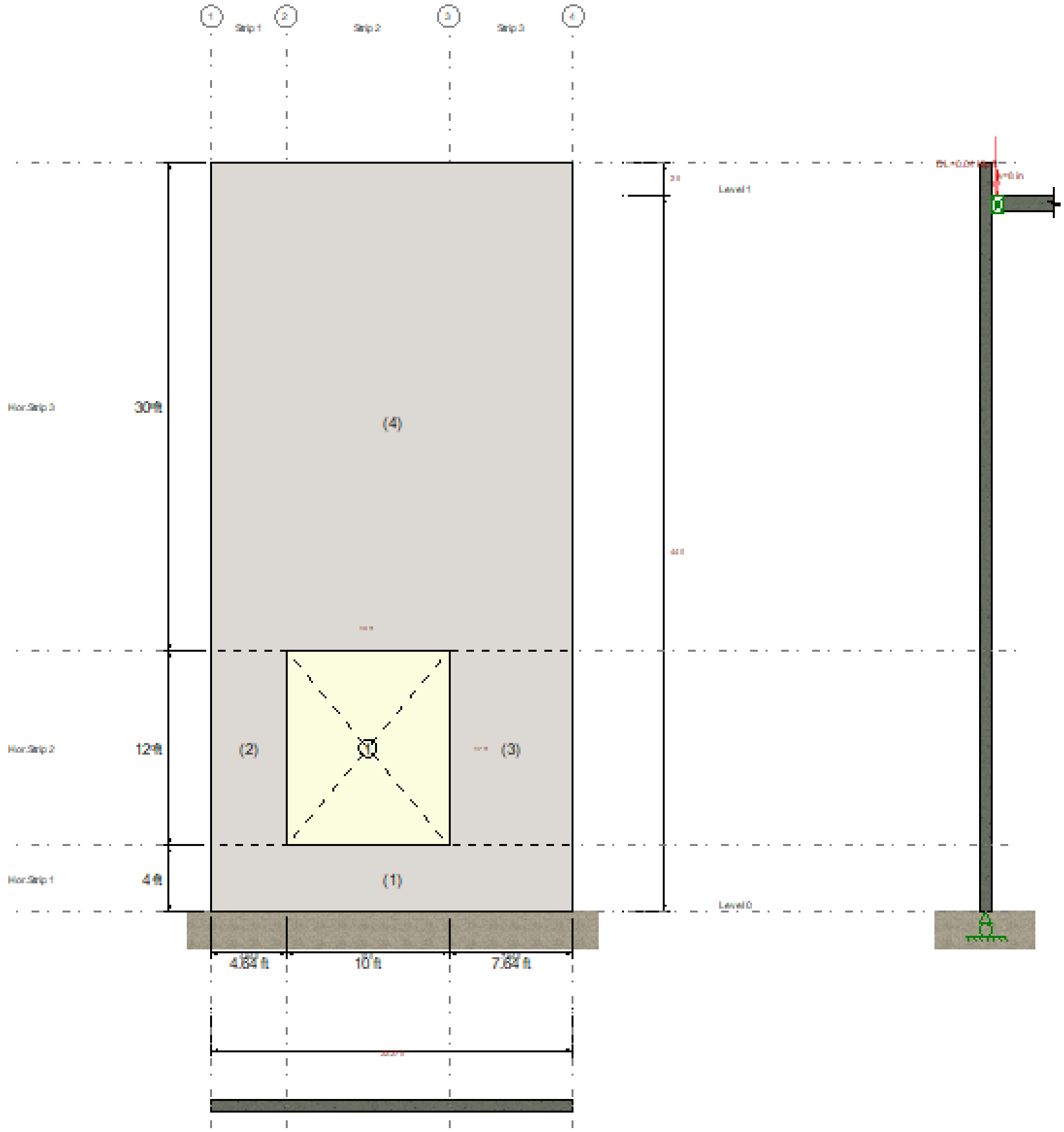
| Segment | Condition | Vu [Kip] | ϕ*Vn [Kip] | Vu/ϕ*Vn |
|---|---|---|---|---|
| 1 | D9 (Bottom) | 8.839 | 42.674 | 0.21 |
| 2 | D16 (Bottom) | 0.920 | 92.070 | 0.01 |
| 3 | D9 (Bottom) | 11.547 | 70.305 | 0.16 |
| 4 | D9 (Bottom) | 6.380 | 42.674 | 0.15 |
| 5 | D9 (Bottom) | 8.880 | 70.305 | 0.13 |
| 6 | D15 (Top) | 6.393 | 42.674 | 0.15 |
| 7 | D15 (Top) | 6.512 | 92.070 | 0.07 |
| 8 | D15 (Top) | 9.408 | 70.305 | 0.13 |
| 9 | D1 (Top) | 0.000 | 42.674 | 0.00 |
| 10 | D1 (Top) | 0.000 | 92.070 | 0.00 |
| 11 | D1 (Top) | 0.000 | 70.305 | 0.00 |

**Deflection**

| Segment | Condition | Δ [in] | Δmax [in] | Δ/Δmax |
|---|---|---|---|---|
| 1 | S9 (Top) | -0.584 | 3.520 | 0.17 |
| 2 | S9 (Max) | -0.007 | 3.520 | 0.00 |
| 3 | S9 (Top) | -0.457 | 3.520 | 0.13 |
| 4 | S9 (Top) | -3.214 | 3.520 | 0.91 |
| 5 | S9 (Top) | -2.799 | 3.520 | 0.80 |
| 6 | S9 (Bottom) | -3.073 | 3.520 | 0.87 |
| 7 | S9 (Max) | -0.363 | 3.520 | 0.10 |
| 8 | S9 (Bottom) | -2.691 | 3.520 | 0.76 |
| 9 | S1 (Top) | 0.000 | 0.160 | 0.00 |
| 10 | S1 (Top) | 0.000 | 0.160 | 0.00 |
| 11 | S1 (Top) | 0.000 | 0.160 | 0.00 |

**SHEAR WALL DESIGN:**

**Status** : OK




**Geometry:**

| Segment | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] | Classification |
|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 22.27 | 4.00 | Shear wall |
| 2 | 0.00 | 4.00 | 4.64 | 12.00 | Shear wall |
| 3 | 14.64 | 4.00 | 7.64 | 12.00 | Shear wall |
| 4 | 0.00 | 16.00 | 22.27 | 28.00 | Shear wall |

**Reinforcement:**

Reinforcement layers : 2

| Segment | Vertical reinforcement Bars | Spacing [in] | Ld [in] | Horizontal reinforcement Bars | Spacing [in] | Ld [in] |
|---|---|---|---|---|---|---|
| 1 | 18-#6 | 3.00 | 26.83 | 3-#4 | 18.00 | 23.26 |
| | 12-#6 | 10.00 | 26.83 | 3-#4 | 18.00 | 23.26 |
| | 15-#6 | 6.00 | 26.83 | 3-#4 | 18.00 | 23.26 |
| 2 | 18-#6 | 3.00 | 26.83 | 8-#4 | 18.00 | 23.26 |
| 3 | 15-#6 | 6.00 | 26.83 | 8-#4 | 18.00 | 23.26 |
| 4 | 18-#6 | 3.00 | 26.83 | 19-#4 | 18.00 | 23.26 |
| | 12-#6 | 10.00 | 26.83 | 19-#4 | 18.00 | 23.26 |
| | 15-#6 | 6.00 | 26.83 | 19-#4 | 18.00 | 23.26 |

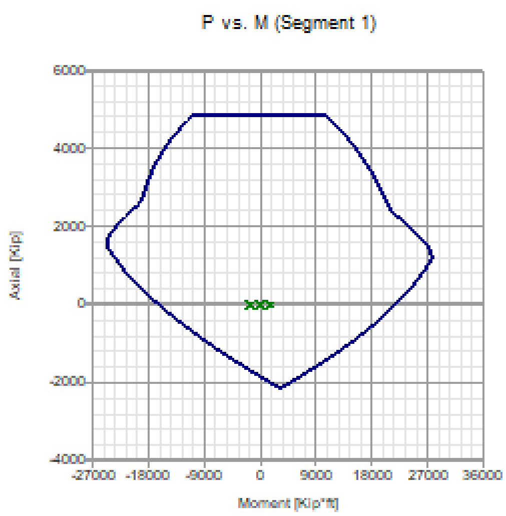
**Intermediate results for axial-bending**

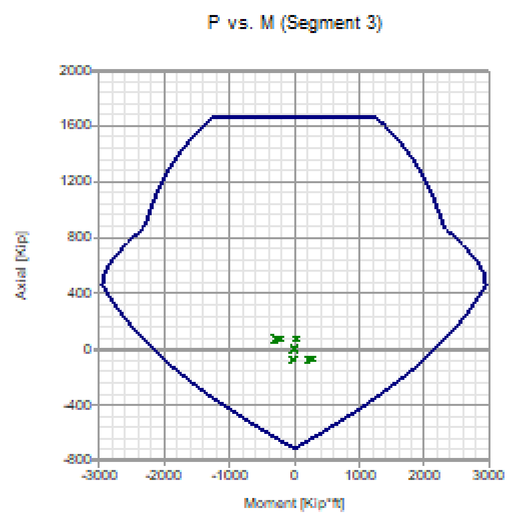
| Segment | Condition | c [in] | d [in] |
|---|---|---|---|
| 1 | D7 (Bottom) | 49.19 | 213.80 |
| 2 | D7 (Bottom) | 17.27 | 44.50 |
| 3 | D13 (Bottom) | 17.89 | 73.31 |
| 4 | D7 (Bottom) | 49.19 | 213.80 |

**Combined axial flexure**

| Segment | Condition | Pu [Kip] | Mu [Kip*ft] | ϕ*Mn [Kip*ft] | Mu/ϕ*Mn |
|---|---|---|---|---|---|
| 1 | D7 (Bottom) | 0.80 | -1694.95 | 16336.16 | 0.10 |
| 2 | D7 (Bottom) | -72.19 | -96.02 | 1221.61 | 0.08 |
| 3 | D13 (Bottom) | -72.10 | 274.29 | 1995.32 | 0.14 |
| 4 | D7 (Bottom) | 0.80 | -1078.49 | 16336.16 | 0.07 |

**Interaction diagrams, P vs. M:**




**Axial compression**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D3 (Bottom) | 4.28 | 4838.20 | 0.00 |
| 2 | D12 (Bottom) | 73.20 | 991.80 | 0.07 |
| 3 | D6 (Top) | 73.36 | 1659.61 | 0.04 |
| 4 | D3 (Bottom) | 4.28 | 4838.20 | 0.00 |

**Axial tension**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D1 (Top) | 0.00 | 2138.40 | 0.00 |
| 2 | D7 (Bottom) | 72.19 | 855.36 | 0.08 |
| 3 | D13 (Bottom) | 72.10 | 712.80 | 0.10 |
| 4 | D1 (Top) | 0.00 | 2138.40 | 0.00 |

**Shear**

| Segment | Condition | Vu [Kip] | ϕ*Vn [Kip] | Vu/ϕ*Vn |
|---|---|---|---|---|
| 1 | D13 (Bottom) | 38.529 | 357.871 | 0.11 |
| 2 | D7 (Bottom) | 13.822 | 74.162 | 0.19 |
| 3 | D13 (Bottom) | 24.668 | 129.325 | 0.19 |
| 4 | D7 (Bottom) | 38.529 | 437.956 | 0.09 |

**STABILITY RESULTS:**

**Status : Warnings in design**
**- The overturning safety factor is smaller than the allowable value**

**Global stability:**

Safety factor : 1.5

| Condition | Position | RM [Kip*ft] | OTM [Kip*ft] | FS |
|---|---|---|---|---|
| S1 | Left corner | -9.92 | 0.00 | -- |
| S8 | Right corner | 5.95 | -1186.69 | 0.01 |

**Notes:**

* Pu = Axial load
* Pn = Nominal axial load
* Mua = Moment at section
* Mu = Magnified moment at section
* Mcr = Cracking moment at section
* Mn = Maximum nominal moment
* Vu = Design shear force
* Vn = Nominal shear force

# ARW Engineers

**Current Date:** 5/7/2018 3:58 PM
**Units system:** English
**File name:** Y:\Projects 2018\18054 - Kimberly Clark 20000SF Addition\Engineering\Calculations\RAM\tilt-ups\18054_Type B.tup\

# Design Results

## Tilt-Up Wall

---

### GENERAL INFORMATION:

**Global status : Warnings in design**

| | | |
|---|---|---|
| Design code | : | ACI 318-14 |

**Geometry:**

| | | |
|---|---|---|
| Total height | : | 46.00 [ft] |
| Total length | : | 18.27 [ft] |
| Base support type | : | Continuous |
| Wall bottom restraint | : | Pinned |

**Materials:**

| | | |
|---|---|---|
| Material | : | RC4.5x60 |
| Steel tension strength (Fy) | : | 60 [Kip/in2] |
| Concrete compressive strength (fc) | : | 4.5 [Kip/in2] |
| Steel elasticity modulus (Es) | : | 29000 [Kip/in2] |
| Concrete modulus of elasticity (E) | : | 3823.68 [Kip/in2] |
| Concrete unit weight | : | 0.149818 [Kip/ft3] |

**Number of stories: 1**

| Story | Story height [ft] | Wall thickness [in] |
|---|---|---|
| 1 | 44.00 | 9.25 |

**Openings:**

| Reference | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] |
|---|---|---|---|---|
| Lower left | 3.64 | 4.00 | 10.00 | 12.00 |

**Load conditions:**

| ID | Comb. | Category | Description |
|---|---|---|---|
| DL | No | DL | Dead Load |
| SL | No | SNOW | Snow |
| EQip | No | EQ | In plane EQ |
| EQoop | No | EQ | OOP EQ |
| S1 | Yes | | DL |
| S2 | Yes | | DL+SL |
| S3 | Yes | | DL+0.75SL |
| S4 | Yes | | DL+0.7EQip |
| S5 | Yes | | DL+0.525EQip |
| S6 | Yes | | DL+0.75SL |
| S7 | Yes | | DL+0.75SL+0.525EQip |
| S8 | Yes | | 0.6DL+0.7EQip |
| S9 | Yes | | DL+0.7EQoop |
| S10 | Yes | | DL+0.525EQoop |

| | | |
|---|---|---|
| S11 | Yes | DL+0.75SL+0.525EQoop |
| S12 | Yes | 0.6DL+0.7EQoop |
| D1 | Yes | 1.4DL |
| D2 | Yes | 1.2DL+0.5SL |
| D3 | Yes | 1.2DL+1.6SL |
| D4 | Yes | 1.2DL+0.2SL |
| D5 | Yes | 1.2DL+EQip |
| D6 | Yes | 1.2DL+0.2SL+EQip |
| D7 | Yes | 0.9DL+EQip |
| D8 | Yes | 1.2DL+EQoop |
| D9 | Yes | 1.2DL+0.2SL+EQoop |
| D10 | Yes | 0.9DL+EQoop |
| D11 | Yes | 1.2DL-EQip |
| D12 | Yes | 1.2DL+0.2SL-EQip |
| D13 | Yes | 0.9DL-EQip |
| D14 | Yes | 1.2DL-EQoop |
| D15 | Yes | 1.2DL+0.2SL-EQoop |
| D16 | Yes | 0.9DL-EQoop |
| S13 | Yes | DL-0.7EQoop |
| S14 | Yes | DL-0.525EQoop |
| S15 | Yes | DL+0.75SL-0.525EQoop |
| S16 | Yes | 0.6DL-0.7EQoop |

**Consider Self Weight:**

Load condition : No

**Distributed loads:**

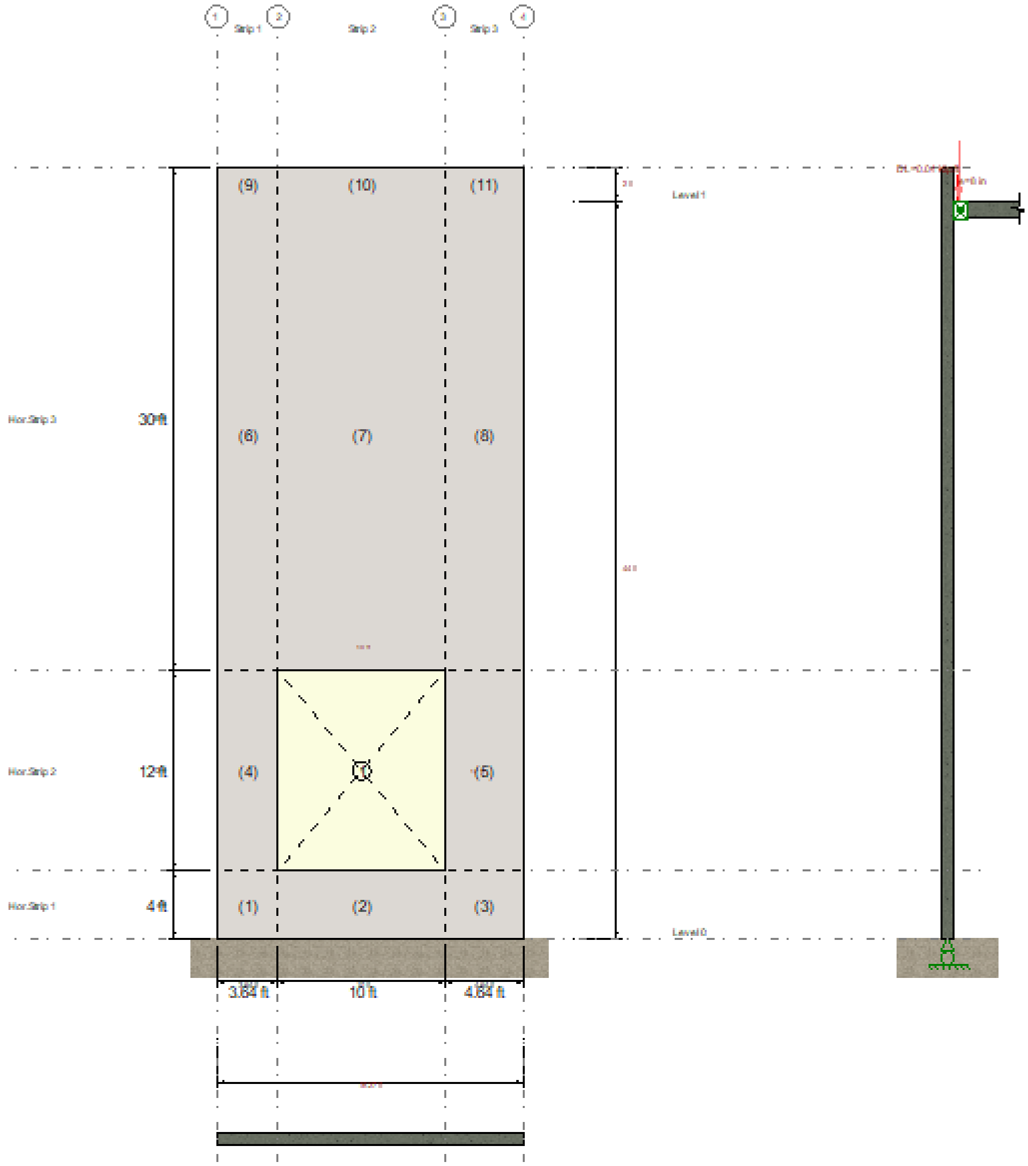
| Story | Condition | Direction | Magnitude [Kip/ft] | Eccentricity [ft] |
|---|---|---|---|---|
| 1 | DL | Vertical | 0.04 | 0.67 |
| 1 | SL | Vertical | 0.09 | 0.67 |
| 1 | EQip | Horizontal | 1.81 | 0.00 |

**Out-of-plane seismic weight:**

| Load condition | Coefficient |
|---|---|
| EQoop | 0.40 |

**TILT-UP WALLS DESIGN:**

**Status : Warnings in design**
**- The wall must be tension controlled, Section 11.8.1.1b (Segment 1)**




**Geometry:**

| Segment | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 3.64 | 4.00 |
| 2 | 3.64 | 0.00 | 10.00 | 4.00 |
| 3 | 13.64 | 0.00 | 4.64 | 4.00 |
| 4 | 0.00 | 4.00 | 3.64 | 12.00 |
| 5 | 13.64 | 4.00 | 4.64 | 12.00 |
| 6 | 0.00 | 16.00 | 3.64 | 28.00 |
| 7 | 3.64 | 16.00 | 10.00 | 28.00 |
| 8 | 13.64 | 16.00 | 4.64 | 28.00 |
| 9 | 0.00 | 44.00 | 3.64 | 2.00 |
| 10 | 3.64 | 44.00 | 10.00 | 2.00 |
| 11 | 13.64 | 44.00 | 4.64 | 2.00 |

**Vertical reinforcement:**

Reinforcement layers : 2

| Segment | Bars | Spacing [in] | Ld [in] |
|---|---|---|---|
| 1 | 14-#7 | 3.00 | 39.13 |
| 2 | 12-#6 | 10.00 | 26.83 |
| 3 | 18-#6 | 3.00 | 26.83 |
| 4 | 14-#7 | 3.00 | 39.13 |
| 5 | 18-#6 | 3.00 | 26.83 |
| 6 | 14-#7 | 3.00 | 39.13 |
| 7 | 12-#6 | 10.00 | 26.83 |
| 8 | 18-#6 | 3.00 | 26.83 |
| 9 | 14-#7 | 3.00 | 39.13 |
| 10 | 12-#6 | 10.00 | 26.83 |
| 11 | 18-#6 | 3.00 | 26.83 |

**Vertical reinforcement**

| Segment | Condition | Pu [Kip] | Pu/Ag [Kip/in2] | 0.06*f´c [Kip/in2] | Ratio |
|---|---|---|---|---|---|
| 1 | D12 (Max) | 84.221 | 0.209 | 0.270 | 0.77 |
| 2 | D12 (Max) | 4.726 | 0.004 | 0.270 | 0.02 |
| 3 | D6 (Max) | 88.878 | 0.173 | 0.270 | 0.64 |
| 4 | D12 (Max) | 77.624 | 0.192 | 0.270 | 0.71 |
| 5 | D6 (Max) | 77.678 | 0.151 | 0.270 | 0.56 |
| 6 | D12 (Max) | 27.878 | 0.069 | 0.270 | 0.26 |
| 7 | D12 (Max) | 1.780 | 0.002 | 0.270 | 0.01 |
| 8 | D6 (Max) | 29.238 | 0.057 | 0.270 | 0.21 |
| 9 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |
| 10 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |
| 11 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |

**Intermediate results for axial-bending**

| Segment | Condition | Ase [in2] | a [in] | c [in] | d [in] | ϕ | Kb [Kip] |
|---|---|---|---|---|---|---|---|
| 1 | D10 (Top) | 8.40 | 3.40 | 4.00 | 7.44 | 0.70 | 340.31 |
| 2 | D10 (Max) | 5.28 | 0.69 | 0.81 | 7.50 | 0.90 | 1042.10 |
| 3 | D9 (Top) | 7.93 | 2.53 | 2.97 | 7.50 | 0.86 | 483.12 |
| 4 | D9 (Top) | 8.41 | 3.41 | 4.01 | 7.44 | 0.70 | 227.04 |
| 5 | D9 (Top) | 7.93 | 2.53 | 2.97 | 7.50 | 0.86 | 238.22 |
| 6 | D9 (Bottom) | 8.41 | 3.40 | 4.00 | 7.44 | 0.70 | 226.91 |
| 7 | D9 (Max) | 5.29 | 0.69 | 0.81 | 7.50 | 0.90 | 1042.10 |
| 8 | D9 (Bottom) | 7.93 | 2.53 | 2.97 | 7.50 | 0.86 | 238.14 |
| 9 | D1 (Top) | 8.40 | 3.40 | 4.00 | 7.44 | 0.70 | 183341.10 |
| 10 | D1 (Top) | 5.28 | 0.69 | 0.81 | 7.50 | 0.90 | 504377.20 |
| 11 | D1 (Top) | 7.92 | 2.52 | 2.97 | 7.50 | 0.86 | 233829.30 |

**Inertias**

| Segment | Condition | Ig [in4] | Icr [in4] | Ie [in4] |
|---|---|---|---|---|
| 1 | D10 (Top) | 2876.93 | 1684.84 | 2584.54 |
| 2 | D10 (Max) | 7914.53 | 1812.90 | 7914.53 |
| 3 | D9 (Top) | 3669.18 | 1719.77 | 3669.18 |
| 4 | D9 (Top) | 2876.93 | 1686.01 | 1724.30 |
| 5 | D9 (Top) | 3669.18 | 1719.91 | 1809.24 |
| 6 | D9 (Bottom) | 2876.93 | 1685.03 | 1723.32 |

| | | | | |
|---|---|---|---|---|
| 7 | D9 (Max) | 7914.53 | 1814.78 | 7914.53 |
| 8 | D9 (Bottom) | 3669.18 | 1719.38 | 1808.65 |
| 9 | D1 (Top) | 2876.93 | 1683.72 | 2876.93 |
| 10 | D1 (Top) | 7914.53 | 1812.61 | 7914.53 |
| 11 | D1 (Top) | 3669.18 | 1718.49 | 3669.18 |

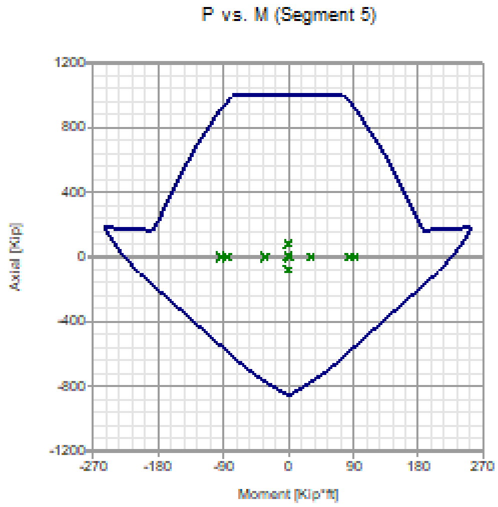
**Combined axial flexure**

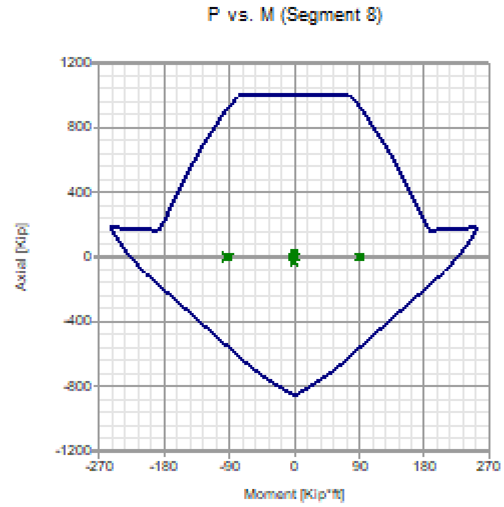
| Segment | Condition | Pu [Kip] | Mua [Kip*ft] | Mu [Kip*ft] | ϕ*Mn [Kip*ft] | Mu/ϕ*Mn |
|---|---|---|---|---|---|---|
| 1 | D10 (Top) | 0.28 | -28.64 | -28.68 | 201.88 | 0.14 |
| 2 | D10 (Max) | 0.06 | -0.92 | -0.92 | 180.63 | 0.01 |
| 3 | D9 (Top) | 0.57 | -32.00 | -32.05 | 226.26 | 0.14 |
| 4 | D9 (Top) | 0.58 | -82.02 | -82.30 | 202.36 | 0.41 |
| 5 | D9 (Top) | 0.63 | -92.94 | -93.27 | 226.27 | 0.41 |
| 6 | D9 (Bottom) | 0.33 | -82.04 | -82.20 | 201.96 | 0.41 |
| 7 | D9 (Max) | 0.48 | -45.03 | -45.06 | 180.74 | 0.25 |
| 8 | D9 (Bottom) | 0.39 | -92.97 | -93.18 | 226.22 | 0.41 |
| 9 | D1 (Top) | 0.00 | 0.00 | 0.00 | 201.42 | 0.00 |
| 10 | D1 (Top) | 0.00 | 0.00 | 0.00 | 180.61 | 0.00 |
| 11 | D1 (Top) | 0.00 | 0.00 | 0.00 | 226.15 | 0.00 |

**Cracking moment**

| Segment | Condition | Pu [Kip] | Mua [Kip*ft] | Mcr [Kip*ft] | ϕ*Mn [Kip*ft] | Mcr/ϕ*Mn |
|---|---|---|---|---|---|---|
| 1 | D6 (Bottom) | -83.19 | 0.00 | 26.08 | 186.19 | 0.14 |
| 2 | D7 (Bottom) | -4.54 | 0.00 | 71.75 | 179.41 | 0.40 |
| 3 | D13 (Bottom) | -88.00 | 0.00 | 33.26 | 208.18 | 0.16 |
| 4 | D6 (Top) | -76.47 | -0.14 | 26.08 | 184.98 | 0.14 |
| 5 | D13 (Top) | -76.70 | -0.08 | 33.26 | 210.66 | 0.16 |
| 6 | D6 (Top) | -27.22 | -0.16 | 26.08 | 175.97 | 0.15 |
| 7 | D7 (Top) | -1.03 | -0.24 | 71.75 | 180.34 | 0.40 |
| 8 | D13 (Bottom) | -28.63 | -0.08 | 33.26 | 220.58 | 0.15 |
| 9 | D1 (Top) | 0.00 | 0.00 | 26.08 | 201.42 | 0.13 |
| 10 | D16 (Bottom) | 0.00 | 0.00 | 71.75 | 180.61 | 0.40 |
| 11 | D16 (Bottom) | 0.00 | 0.00 | 33.26 | 226.15 | 0.15 |

**Interaction diagrams, P vs. M:**




**Axial compression**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D12 (Top) | 84.22 | 769.12 | 0.11 |
| 2 | D12 (Bottom) | 4.73 | 2186.79 | 0.00 |
| 3 | D6 (Top) | 88.88 | 992.03 | 0.09 |
| 4 | D12 (Top) | 77.62 | 769.12 | 0.10 |
| 5 | D6 (Bottom) | 77.68 | 992.03 | 0.08 |
| 6 | D12 (Top) | 27.88 | 769.12 | 0.04 |
| 7 | D12 (Top) | 1.78 | 2186.79 | 0.00 |
| 8 | D6 (Bottom) | 29.24 | 992.03 | 0.03 |
| 9 | D1 (Top) | 0.00 | 769.12 | 0.00 |
| 10 | D1 (Top) | 0.00 | 2186.79 | 0.00 |
| 11 | D1 (Top) | 0.00 | 992.03 | 0.00 |

**Axial tension**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D7 (Top) | 83.42 | 907.20 | 0.09 |
| 2 | D7 (Top) | 4.54 | 570.24 | 0.01 |
| 3 | D13 (Bottom) | 88.00 | 855.36 | 0.10 |
| 4 | D7 (Bottom) | 76.73 | 907.20 | 0.08 |
| 5 | D13 (Top) | 76.70 | 855.36 | 0.09 |
| 6 | D7 (Bottom) | 27.37 | 907.20 | 0.03 |
| 7 | D7 (Top) | 1.03 | 570.24 | 0.00 |
| 8 | D13 (Bottom) | 28.63 | 855.36 | 0.03 |
| 9 | D1 (Top) | 0.00 | 907.20 | 0.00 |
| 10 | D1 (Top) | 0.00 | 570.24 | 0.00 |
| 11 | D1 (Top) | 0.00 | 855.36 | 0.00 |

**Shear**

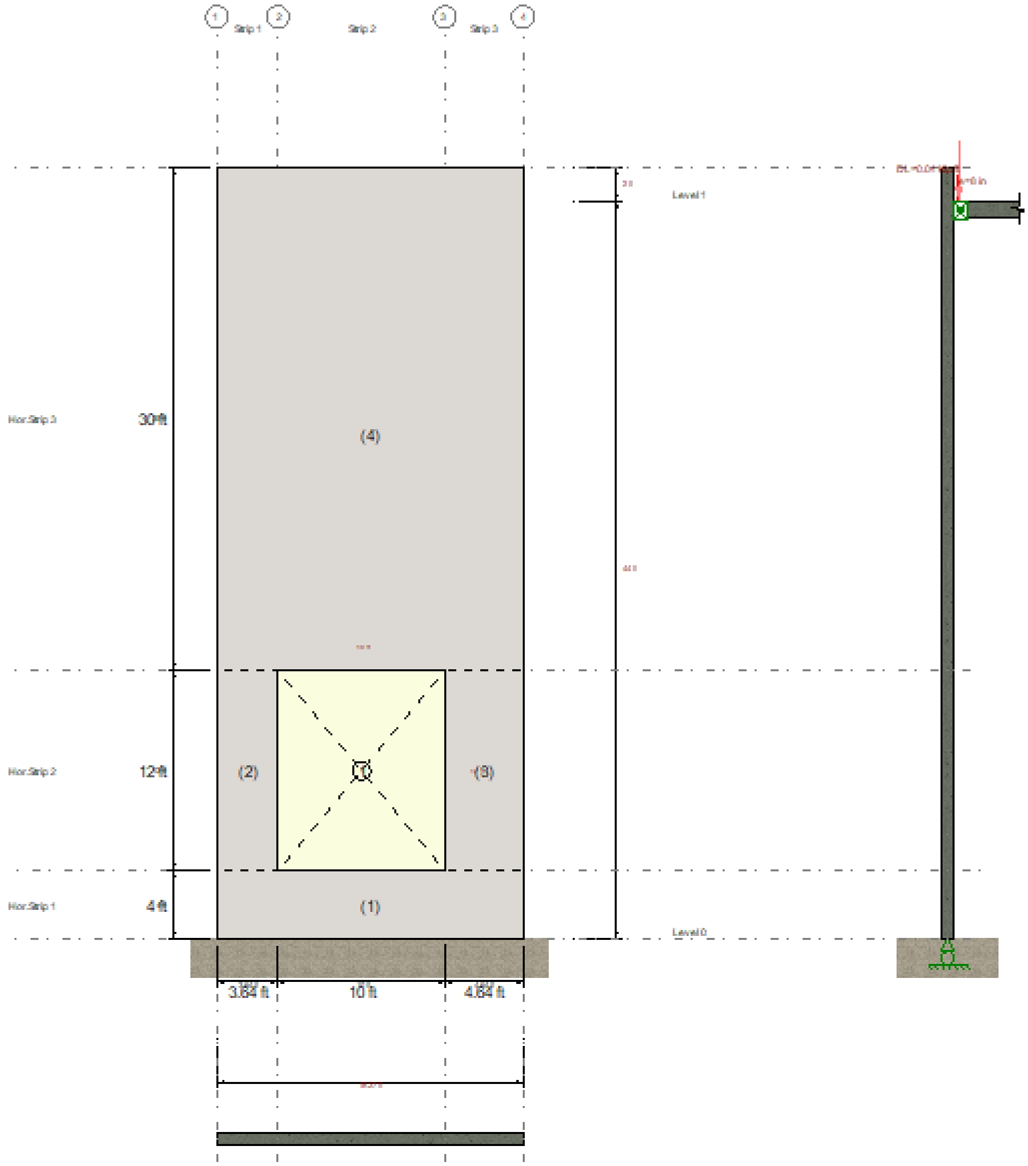
| Segment | Condition | Vu [Kip] | ϕ*Vn [Kip] | Vu/ϕ*Vn |
|---|---|---|---|---|
| 1 | D9 (Bottom) | 7.514 | 32.645 | 0.23 |
| 2 | D8 (Top) | 0.920 | 90.561 | 0.01 |
| 3 | D9 (Bottom) | 8.442 | 41.984 | 0.20 |
| 4 | D9 (Bottom) | 5.450 | 32.645 | 0.17 |
| 5 | D9 (Bottom) | 6.359 | 41.984 | 0.15 |
| 6 | D15 (Top) | 5.287 | 32.645 | 0.16 |
| 7 | D15 (Top) | 6.512 | 90.561 | 0.07 |
| 8 | D15 (Top) | 6.329 | 41.984 | 0.15 |
| 9 | D1 (Top) | 0.000 | 32.645 | 0.00 |
| 10 | D1 (Top) | 0.000 | 90.561 | 0.00 |
| 11 | D1 (Top) | 0.000 | 41.984 | 0.00 |

**Deflection**

| Segment | Condition | Δ [in] | Δmax [in] | Δ/Δmax |
|---|---|---|---|---|
| 1 | S9 (Top) | -0.636 | 3.520 | 0.18 |
| 2 | S9 (Max) | -0.007 | 3.520 | 0.00 |
| 3 | S9 (Top) | -0.557 | 3.520 | 0.16 |
| 4 | S9 (Top) | -3.316 | 3.520 | 0.94 |
| 5 | S9 (Top) | -3.235 | 3.520 | 0.92 |
| 6 | S9 (Bottom) | -3.072 | 3.520 | 0.87 |
| 7 | S9 (Max) | -0.363 | 3.520 | 0.10 |
| 8 | S9 (Bottom) | -3.085 | 3.520 | 0.88 |
| 9 | S1 (Top) | 0.000 | 0.160 | 0.00 |
| 10 | S1 (Top) | 0.000 | 0.160 | 0.00 |
| 11 | S1 (Top) | 0.000 | 0.160 | 0.00 |

**SHEAR WALL DESIGN:**

**Status** : OK




**Geometry:**

| Segment | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] | Classification |
|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 18.27 | 4.00 | Shear wall |
| 2 | 0.00 | 4.00 | 3.64 | 12.00 | Pier |
| 3 | 13.64 | 4.00 | 4.64 | 12.00 | Shear wall |
| 4 | 0.00 | 16.00 | 18.27 | 28.00 | Shear wall |

**Reinforcement:**

Reinforcement layers : 2

| Segment | Bars | Spacing [in] | Ld [in] | Bars | Spacing [in] | Ld [in] |
|---|---|---|---|---|---|---|
| | Vertical reinforcement | | | Horizontal reinforcement | | |
| 1 | 14-#7 | 3.00 | 39.13 | 4-#5 | 14.00 | 29.07 |
| | 12-#6 | 10.00 | 39.13 | 4-#5 | 14.00 | 29.07 |
| | 18-#6 | 3.00 | 39.13 | 4-#5 | 14.00 | 29.07 |
| 2 | 14-#7 | 3.00 | 39.13 | 11-#5 | 14.00 | 29.07 |
| 3 | 18-#6 | 3.00 | 26.83 | 11-#5 | 14.00 | 29.07 |
| 4 | 14-#7 | 3.00 | 39.13 | 24-#5 | 14.00 | 29.07 |
| | 12-#6 | 10.00 | 39.13 | 24-#5 | 14.00 | 29.07 |
| | 18-#6 | 3.00 | 39.13 | 24-#5 | 14.00 | 29.07 |

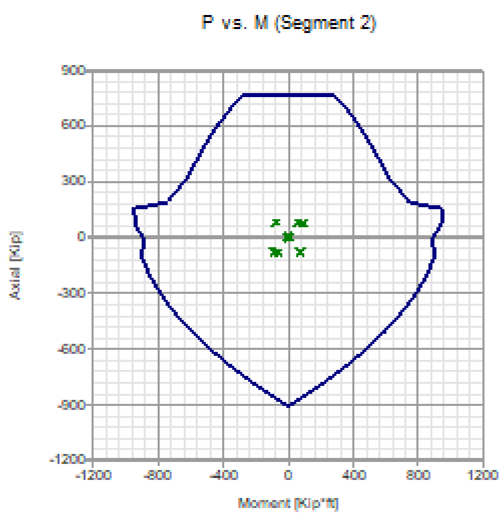
**Intermediate results for axial-bending**

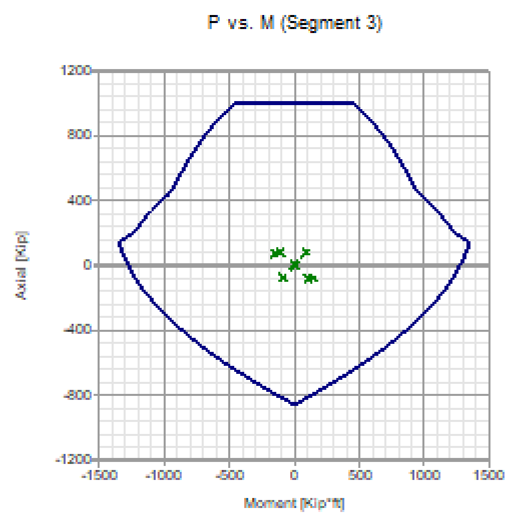
| Segment | Condition | c [in] | d [in] |
|---|---|---|---|
| 1 | D7 (Bottom) | 52.19 | 175.40 |
| 2 | D7 (Bottom) | 15.85 | 34.90 |
| 3 | D13 (Bottom) | 17.17 | 44.51 |
| 4 | D7 (Bottom) | 52.19 | 175.40 |

**Combined axial flexure**

| Segment | Condition | Pu [Kip] | Mu [Kip*ft] | $\phi$*Mn [Kip*ft] | Mu/$\phi$*Mn |
|---|---|---|---|---|---|
| 1 | D7 (Bottom) | 0.66 | -1454.83 | 15666.23 | 0.09 |
| 2 | D7 (Bottom) | -76.73 | -89.01 | 896.27 | 0.10 |
| 3 | D13 (Bottom) | -76.70 | 144.40 | 1218.21 | 0.12 |
| 4 | D7 (Bottom) | 0.66 | -925.70 | 15666.23 | 0.06 |

**Interaction diagrams, P vs. M:**




**Axial compression**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D3 (Bottom) | 3.51 | 3947.93 | 0.00 |
| 2 | D12 (Top) | 77.62 | 769.12 | 0.10 |
| 3 | D6 (Bottom) | 77.68 | 992.03 | 0.08 |
| 4 | D3 (Bottom) | 3.51 | 3947.93 | 0.00 |

**Axial tension**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D1 (Top) | 0.00 | 2332.80 | 0.00 |
| 2 | D7 (Bottom) | 76.73 | 907.20 | 0.08 |
| 3 | D13 (Top) | 76.70 | 855.36 | 0.09 |
| 4 | D1 (Top) | 0.00 | 2332.80 | 0.00 |

**Shear**

| Segment | Condition | Vu [Kip] | ϕ*Vn [Kip] | Vu/ϕ*Vn |
|---|---|---|---|---|
| 1 | D7 (Bottom) | 33.071 | 452.054 | 0.07 |
| 2 | D7 (Bottom) | 13.689 | 87.894 | 0.16 |
| 3 | D13 (Bottom) | 19.349 | 116.156 | 0.17 |
| 4 | D13 (Bottom) | 33.071 | 497.473 | 0.07 |

**STABILITY RESULTS:**

**Status : Warnings in design**
**- The overturning safety factor is smaller than the allowable value**

**Global stability:**

Safety factor : 1.5

| Condition | Position | RM [Kip*ft] | OTM [Kip*ft] | FS |
|---|---|---|---|---|
| S1 | Left corner | -6.68 | 0.00 | -- |
| S8 | Right corner | 4.01 | -1018.57 | 0.00 |

**Notes:**

* Pu = Axial load
* Pn = Nominal axial load
* Mua = Moment at section
* Mu = Magnified moment at section
* Mcr = Cracking moment at section
* Mn = Maximum nominal moment
* Vu = Design shear force
* Vn = Nominal shear force

## ARW Engineers

**Current Date:** 5/7/2018 3:58 PM
**Units system:** English
**File name:** Y:\Projects 2018\18054 - Kimberly Clark 20000SF Addition\Engineering\Calculations\RAM\tilt-ups\18054_Type C.tup\

# Design Results

## Tilt-Up Wall

---

### GENERAL INFORMATION:

**Global status : Warnings in design**

| | | |
|---|---|---|
| Design code | : | ACI 318-14 |

**Geometry:**

| | | |
|---|---|---|
| Total height | : | 46.00 [ft] |
| Total length | : | 18.27 [ft] |
| Base support type | : | Continuous |
| Wall bottom restraint | : | Pinned |

**Materials:**

| | | |
|---|---|---|
| Material | : | RC4.5x60 |
| Steel tension strength (Fy) | : | 60 [Kip/in2] |
| Concrete compressive strength (fc) | : | 4.5 [Kip/in2] |
| Steel elasticity modulus (Es) | : | 29000 [Kip/in2] |
| Concrete modulus of elasticity (E) | : | 3823.68 [Kip/in2] |
| Concrete unit weight | : | 0.149818 [Kip/ft3] |

**Number of stories: 1**

| Story | Story height [ft] | Wall thickness [in] |
|---|---|---|
| 1 | 44.00 | 9.25 |

**Openings:**

| Reference | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] |
|---|---|---|---|---|
| Lower left | 3.64 | 4.00 | 10.00 | 12.00 |

**Load conditions:**

| ID | Comb. | Category | Description |
|---|---|---|---|
| DL | No | DL | Dead Load |
| SL | No | SNOW | Snow |
| EQip | No | EQ | In plane EQ |
| EQoop | No | EQ | OOP EQ |
| S1 | Yes | | DL |
| S2 | Yes | | DL+SL |
| S3 | Yes | | DL+0.75SL |
| S4 | Yes | | DL+0.7EQip |
| S5 | Yes | | DL+0.525EQip |
| S6 | Yes | | DL+0.75SL |
| S7 | Yes | | DL+0.75SL+0.525EQip |
| S8 | Yes | | 0.6DL+0.7EQip |
| S9 | Yes | | DL+0.7EQoop |
| S10 | Yes | | DL+0.525EQoop |

| | | |
|---|---|---|
| S11 | Yes | DL+0.75SL+0.525EQoop |
| S12 | Yes | 0.6DL+0.7EQoop |
| D1 | Yes | 1.4DL |
| D2 | Yes | 1.2DL+0.5SL |
| D3 | Yes | 1.2DL+1.6SL |
| D4 | Yes | 1.2DL+0.2SL |
| D5 | Yes | 1.2DL+EQip |
| D6 | Yes | 1.2DL+0.2SL+EQip |
| D7 | Yes | 0.9DL+EQip |
| D8 | Yes | 1.2DL+EQoop |
| D9 | Yes | 1.2DL+0.2SL+EQoop |
| D10 | Yes | 0.9DL+EQoop |
| D11 | Yes | 1.2DL-EQip |
| D12 | Yes | 1.2DL+0.2SL-EQip |
| D13 | Yes | 0.9DL-EQip |
| D14 | Yes | 1.2DL-EQoop |
| D15 | Yes | 1.2DL+0.2SL-EQoop |
| D16 | Yes | 0.9DL-EQoop |
| S13 | Yes | DL-0.7EQoop |
| S14 | Yes | DL-0.525EQoop |
| S15 | Yes | DL+0.75SL-0.525EQoop |
| S16 | Yes | 0.6DL-0.7EQoop |

**Consider Self Weight:**

Load condition : No

**Distributed loads:**

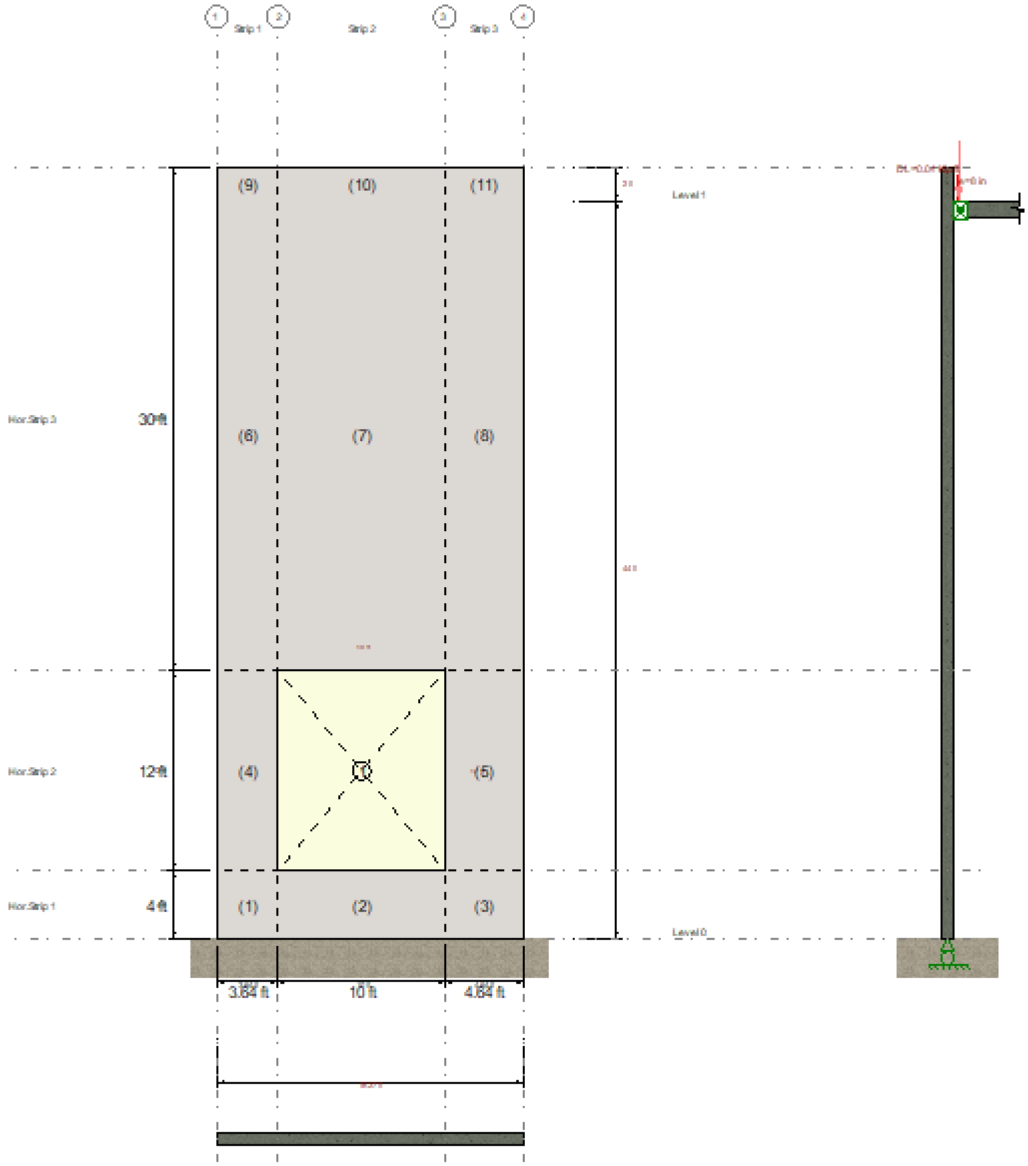
| **Story** | **Condition** | **Direction** | **Magnitude** [Kip/ft] | **Eccentricity** [ft] |
|---|---|---|---|---|
| 1 | DL | Vertical | 0.04 | 0.67 |
| 1 | SL | Vertical | 0.09 | 0.67 |
| 1 | EQip | Horizontal | 1.81 | 0.00 |

**Out-of-plane seismic weight:**

| **Load condition** | **Coefficient** |
|---|---|
| EQoop | 0.40 |

**TILT-UP WALLS DESIGN:**

**Status : Warnings in design**
**- The wall must be tension controlled, Section 11.8.1.1b (Segment 1)**




**Geometry:**

| Segment | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 3.64 | 4.00 |
| 2 | 3.64 | 0.00 | 10.00 | 4.00 |
| 3 | 13.64 | 0.00 | 4.64 | 4.00 |
| 4 | 0.00 | 4.00 | 3.64 | 12.00 |
| 5 | 13.64 | 4.00 | 4.64 | 12.00 |
| 6 | 0.00 | 16.00 | 3.64 | 28.00 |
| 7 | 3.64 | 16.00 | 10.00 | 28.00 |
| 8 | 13.64 | 16.00 | 4.64 | 28.00 |
| 9 | 0.00 | 44.00 | 3.64 | 2.00 |
| 10 | 3.64 | 44.00 | 10.00 | 2.00 |
| 11 | 13.64 | 44.00 | 4.64 | 2.00 |

**Vertical reinforcement:**

Reinforcement layers : 2

| Segment | Bars | Spacing [in] | Ld [in] |
|---|---|---|---|
| 1 | 14-#7 | 3.00 | 39.13 |
| 2 | 12-#6 | 10.00 | 26.83 |
| 3 | 18-#6 | 3.00 | 26.83 |
| 4 | 14-#7 | 3.00 | 39.13 |
| 5 | 18-#6 | 3.00 | 26.83 |
| 6 | 14-#7 | 3.00 | 39.13 |
| 7 | 12-#6 | 10.00 | 26.83 |
| 8 | 18-#6 | 3.00 | 26.83 |
| 9 | 14-#7 | 3.00 | 39.13 |
| 10 | 12-#6 | 10.00 | 26.83 |
| 11 | 18-#6 | 3.00 | 26.83 |

**Vertical reinforcement**

| Segment | Condition | Pu [Kip] | Pu/Ag [Kip/in2] | 0.06*f´c [Kip/in2] | Ratio |
|---|---|---|---|---|---|
| 1 | D12 (Max) | 84.221 | 0.209 | 0.270 | 0.77 |
| 2 | D12 (Max) | 4.726 | 0.004 | 0.270 | 0.02 |
| 3 | D6 (Max) | 88.878 | 0.173 | 0.270 | 0.64 |
| 4 | D12 (Max) | 77.624 | 0.192 | 0.270 | 0.71 |
| 5 | D6 (Max) | 77.678 | 0.151 | 0.270 | 0.56 |
| 6 | D12 (Max) | 27.878 | 0.069 | 0.270 | 0.26 |
| 7 | D12 (Max) | 1.780 | 0.002 | 0.270 | 0.01 |
| 8 | D6 (Max) | 29.238 | 0.057 | 0.270 | 0.21 |
| 9 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |
| 10 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |
| 11 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |

**Intermediate results for axial-bending**

| Segment | Condition | Ase [in2] | a [in] | c [in] | d [in] | ϕ | Kb [Kip] |
|---|---|---|---|---|---|---|---|
| 1 | D10 (Top) | 8.40 | 3.40 | 4.00 | 7.44 | 0.70 | 340.31 |
| 2 | D10 (Max) | 5.28 | 0.69 | 0.81 | 7.50 | 0.90 | 1042.10 |
| 3 | D9 (Top) | 7.93 | 2.53 | 2.97 | 7.50 | 0.86 | 483.12 |
| 4 | D9 (Top) | 8.41 | 3.41 | 4.01 | 7.44 | 0.70 | 227.04 |
| 5 | D9 (Top) | 7.93 | 2.53 | 2.97 | 7.50 | 0.86 | 238.22 |
| 6 | D9 (Bottom) | 8.41 | 3.40 | 4.00 | 7.44 | 0.70 | 226.91 |
| 7 | D9 (Max) | 5.29 | 0.69 | 0.81 | 7.50 | 0.90 | 1042.10 |
| 8 | D9 (Bottom) | 7.93 | 2.53 | 2.97 | 7.50 | 0.86 | 238.14 |
| 9 | D1 (Top) | 8.40 | 3.40 | 4.00 | 7.44 | 0.70 | 183341.10 |
| 10 | D1 (Top) | 5.28 | 0.69 | 0.81 | 7.50 | 0.90 | 504377.20 |
| 11 | D1 (Top) | 7.92 | 2.52 | 2.97 | 7.50 | 0.86 | 233829.30 |

**Inertias**

| Segment | Condition | Ig [in4] | Icr [in4] | Ie [in4] |
|---|---|---|---|---|
| 1 | D10 (Top) | 2876.93 | 1684.84 | 2584.54 |
| 2 | D10 (Max) | 7914.53 | 1812.90 | 7914.53 |
| 3 | D9 (Top) | 3669.18 | 1719.77 | 3669.18 |
| 4 | D9 (Top) | 2876.93 | 1686.01 | 1724.30 |
| 5 | D9 (Top) | 3669.18 | 1719.91 | 1809.24 |
| 6 | D9 (Bottom) | 2876.93 | 1685.03 | 1723.32 |

| | | | | |
|---|---|---|---|---|
| 7 | D9 (Max) | 7914.53 | 1814.78 | 7914.53 |
| 8 | D9 (Bottom) | 3669.18 | 1719.38 | 1808.65 |
| 9 | D1 (Top) | 2876.93 | 1683.72 | 2876.93 |
| 10 | D1 (Top) | 7914.53 | 1812.61 | 7914.53 |
| 11 | D1 (Top) | 3669.18 | 1718.49 | 3669.18 |

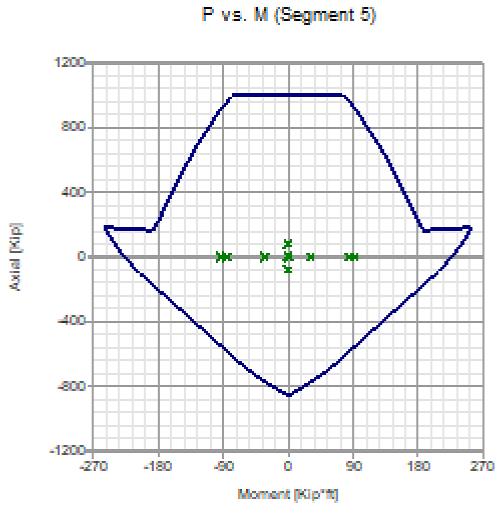
**Combined axial flexure**

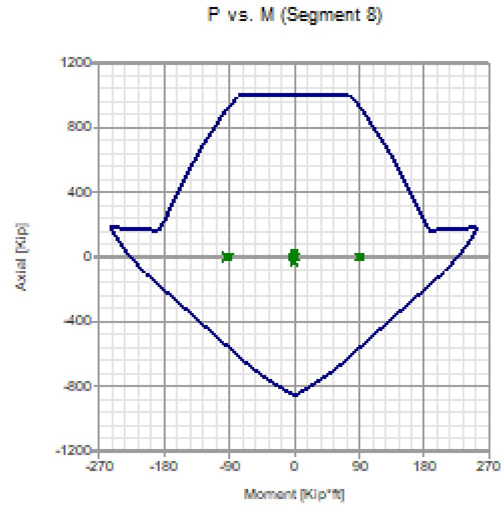
| Segment | Condition | Pu [Kip] | Mua [Kip*ft] | Mu [Kip*ft] | ϕ*Mn [Kip*ft] | Mu/ϕ*Mn |
|---|---|---|---|---|---|---|
| 1 | D10 (Top) | 0.28 | -28.64 | -28.68 | 201.88 | 0.14 |
| 2 | D10 (Max) | 0.06 | -0.92 | -0.92 | 180.63 | 0.01 |
| 3 | D9 (Top) | 0.57 | -32.00 | -32.05 | 226.26 | 0.14 |
| 4 | D9 (Top) | 0.58 | -82.02 | -82.30 | 202.36 | 0.41 |
| 5 | D9 (Top) | 0.63 | -92.94 | -93.27 | 226.27 | 0.41 |
| 6 | D9 (Bottom) | 0.33 | -82.04 | -82.20 | 201.96 | 0.41 |
| 7 | D9 (Max) | 0.48 | -45.03 | -45.06 | 180.74 | 0.25 |
| 8 | D9 (Bottom) | 0.39 | -92.97 | -93.18 | 226.22 | 0.41 |
| 9 | D1 (Top) | 0.00 | 0.00 | 0.00 | 201.42 | 0.00 |
| 10 | D1 (Top) | 0.00 | 0.00 | 0.00 | 180.61 | 0.00 |
| 11 | D1 (Top) | 0.00 | 0.00 | 0.00 | 226.15 | 0.00 |

**Cracking moment**

| Segment | Condition | Pu [Kip] | Mua [Kip*ft] | Mcr [Kip*ft] | ϕ*Mn [Kip*ft] | Mcr/ϕ*Mn |
|---|---|---|---|---|---|---|
| 1 | D6 (Bottom) | -83.19 | 0.00 | 26.08 | 186.19 | 0.14 |
| 2 | D7 (Bottom) | -4.54 | 0.00 | 71.75 | 179.41 | 0.40 |
| 3 | D13 (Bottom) | -88.00 | 0.00 | 33.26 | 208.18 | 0.16 |
| 4 | D6 (Top) | -76.47 | -0.14 | 26.08 | 184.98 | 0.14 |
| 5 | D13 (Top) | -76.70 | -0.08 | 33.26 | 210.66 | 0.16 |
| 6 | D6 (Top) | -27.22 | -0.16 | 26.08 | 175.97 | 0.15 |
| 7 | D7 (Top) | -1.03 | -0.24 | 71.75 | 180.34 | 0.40 |
| 8 | D13 (Bottom) | -28.63 | -0.08 | 33.26 | 220.58 | 0.15 |
| 9 | D1 (Top) | 0.00 | 0.00 | 26.08 | 201.42 | 0.13 |
| 10 | D16 (Bottom) | 0.00 | 0.00 | 71.75 | 180.61 | 0.40 |
| 11 | D16 (Bottom) | 0.00 | 0.00 | 33.26 | 226.15 | 0.15 |

**Interaction diagrams, P vs. M:**




**Axial compression**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D12 (Top) | 84.22 | 769.12 | 0.11 |
| 2 | D12 (Bottom) | 4.73 | 2186.79 | 0.00 |
| 3 | D6 (Top) | 88.88 | 992.03 | 0.09 |
| 4 | D12 (Top) | 77.62 | 769.12 | 0.10 |
| 5 | D6 (Bottom) | 77.68 | 992.03 | 0.08 |
| 6 | D12 (Top) | 27.88 | 769.12 | 0.04 |
| 7 | D12 (Top) | 1.78 | 2186.79 | 0.00 |
| 8 | D6 (Bottom) | 29.24 | 992.03 | 0.03 |
| 9 | D1 (Top) | 0.00 | 769.12 | 0.00 |
| 10 | D1 (Top) | 0.00 | 2186.79 | 0.00 |
| 11 | D1 (Top) | 0.00 | 992.03 | 0.00 |

**Axial tension**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D7 (Top) | 83.42 | 907.20 | 0.09 |
| 2 | D7 (Top) | 4.54 | 570.24 | 0.01 |
| 3 | D13 (Bottom) | 88.00 | 855.36 | 0.10 |
| 4 | D7 (Bottom) | 76.73 | 907.20 | 0.08 |
| 5 | D13 (Top) | 76.70 | 855.36 | 0.09 |
| 6 | D7 (Bottom) | 27.37 | 907.20 | 0.03 |
| 7 | D7 (Top) | 1.03 | 570.24 | 0.00 |
| 8 | D13 (Bottom) | 28.63 | 855.36 | 0.03 |
| 9 | D1 (Top) | 0.00 | 907.20 | 0.00 |
| 10 | D1 (Top) | 0.00 | 570.24 | 0.00 |
| 11 | D1 (Top) | 0.00 | 855.36 | 0.00 |

**Shear**

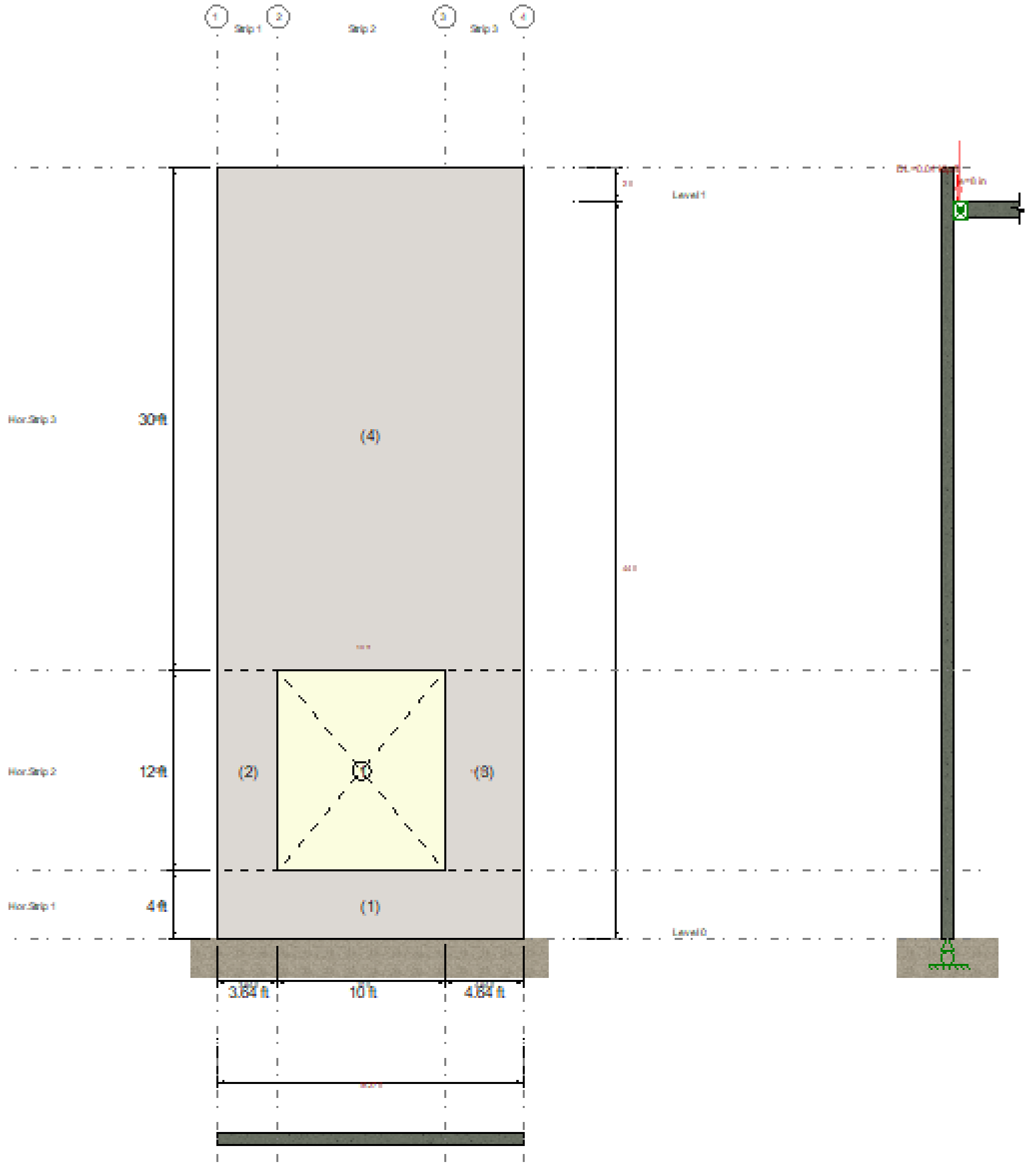
| Segment | Condition | Vu [Kip] | ϕ*Vn [Kip] | Vu/ϕ*Vn |
|---|---|---|---|---|
| 1 | D9 (Bottom) | 7.514 | 32.645 | 0.23 |
| 2 | D8 (Top) | 0.920 | 90.561 | 0.01 |
| 3 | D9 (Bottom) | 8.442 | 41.984 | 0.20 |
| 4 | D9 (Bottom) | 5.450 | 32.645 | 0.17 |
| 5 | D9 (Bottom) | 6.359 | 41.984 | 0.15 |
| 6 | D15 (Top) | 5.287 | 32.645 | 0.16 |
| 7 | D15 (Top) | 6.512 | 90.561 | 0.07 |
| 8 | D15 (Top) | 6.329 | 41.984 | 0.15 |
| 9 | D1 (Top) | 0.000 | 32.645 | 0.00 |
| 10 | D1 (Top) | 0.000 | 90.561 | 0.00 |
| 11 | D1 (Top) | 0.000 | 41.984 | 0.00 |

**Deflection**

| Segment | Condition | Δ [in] | Δmax [in] | Δ/Δmax |
|---|---|---|---|---|
| 1 | S9 (Top) | -0.636 | 3.520 | 0.18 |
| 2 | S9 (Max) | -0.007 | 3.520 | 0.00 |
| 3 | S9 (Top) | -0.557 | 3.520 | 0.16 |
| 4 | S9 (Top) | -3.316 | 3.520 | 0.94 |
| 5 | S9 (Top) | -3.235 | 3.520 | 0.92 |
| 6 | S9 (Bottom) | -3.072 | 3.520 | 0.87 |
| 7 | S9 (Max) | -0.363 | 3.520 | 0.10 |
| 8 | S9 (Bottom) | -3.085 | 3.520 | 0.88 |
| 9 | S1 (Top) | 0.000 | 0.160 | 0.00 |
| 10 | S1 (Top) | 0.000 | 0.160 | 0.00 |
| 11 | S1 (Top) | 0.000 | 0.160 | 0.00 |

**SHEAR WALL DESIGN:**

**Status** : OK




**Geometry:**

| Segment | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] | Classification |
|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 18.27 | 4.00 | Shear wall |
| 2 | 0.00 | 4.00 | 3.64 | 12.00 | Pier |
| 3 | 13.64 | 4.00 | 4.64 | 12.00 | Shear wall |
| 4 | 0.00 | 16.00 | 18.27 | 28.00 | Shear wall |

**Reinforcement:**

Reinforcement layers : 2

| Segment | Vertical reinforcement Bars | Spacing [in] | Ld [in] | Horizontal reinforcement Bars | Spacing [in] | Ld [in] |
|---|---|---|---|---|---|---|
| 1 | 14-#7 | 3.00 | 39.13 | 4-#5 | 14.00 | 29.07 |
| | 12-#6 | 10.00 | 39.13 | 4-#5 | 14.00 | 29.07 |
| | 18-#6 | 3.00 | 39.13 | 4-#5 | 14.00 | 29.07 |
| 2 | 14-#7 | 3.00 | 39.13 | 11-#5 | 14.00 | 29.07 |
| 3 | 18-#6 | 3.00 | 26.83 | 11-#5 | 14.00 | 29.07 |
| 4 | 14-#7 | 3.00 | 39.13 | 24-#5 | 14.00 | 29.07 |
| | 12-#6 | 10.00 | 39.13 | 24-#5 | 14.00 | 29.07 |
| | 18-#6 | 3.00 | 39.13 | 24-#5 | 14.00 | 29.07 |

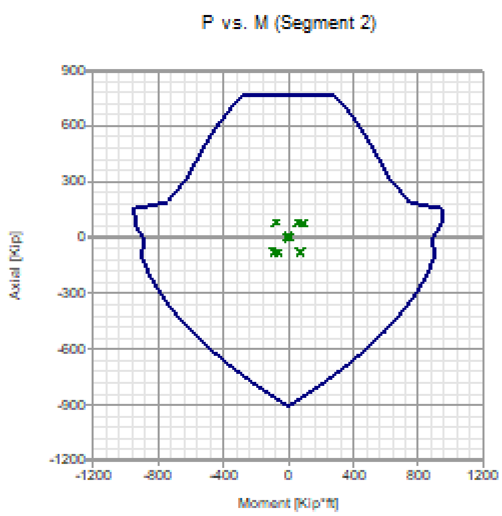
**Intermediate results for axial-bending**

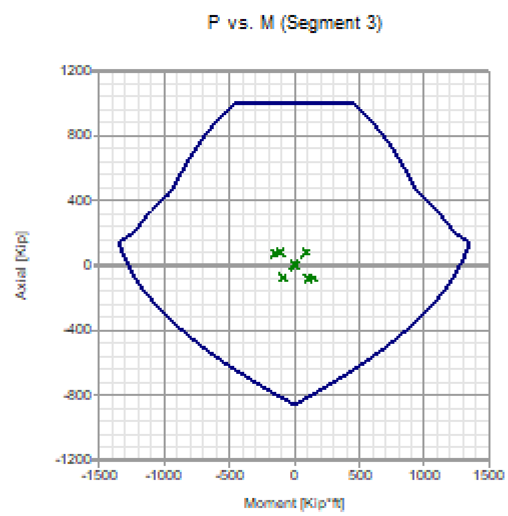
| Segment | Condition | c [in] | d [in] |
|---|---|---|---|
| 1 | D7 (Bottom) | 52.19 | 175.40 |
| 2 | D7 (Bottom) | 15.85 | 34.90 |
| 3 | D13 (Bottom) | 17.17 | 44.51 |
| 4 | D7 (Bottom) | 52.19 | 175.40 |

**Combined axial flexure**

| Segment | Condition | Pu [Kip] | Mu [Kip*ft] | ϕ*Mn [Kip*ft] | Mu/ϕ*Mn |
|---|---|---|---|---|---|
| 1 | D7 (Bottom) | 0.66 | -1454.83 | 15666.23 | 0.09 |
| 2 | D7 (Bottom) | -76.73 | -89.01 | 896.27 | 0.10 |
| 3 | D13 (Bottom) | -76.70 | 144.40 | 1218.21 | 0.12 |
| 4 | D7 (Bottom) | 0.66 | -925.70 | 15666.23 | 0.06 |

**Interaction diagrams, P vs. M:**




**Axial compression**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D3 (Bottom) | 3.51 | 3947.93 | 0.00 |
| 2 | D12 (Top) | 77.62 | 769.12 | 0.10 |
| 3 | D6 (Bottom) | 77.68 | 992.03 | 0.08 |
| 4 | D3 (Bottom) | 3.51 | 3947.93 | 0.00 |

**Axial tension**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D1 (Top) | 0.00 | 2332.80 | 0.00 |
| 2 | D7 (Bottom) | 76.73 | 907.20 | 0.08 |
| 3 | D13 (Top) | 76.70 | 855.36 | 0.09 |
| 4 | D1 (Top) | 0.00 | 2332.80 | 0.00 |

**Shear**

| Segment | Condition | Vu [Kip] | ϕ*Vn [Kip] | Vu/ϕ*Vn |
|---|---|---|---|---|
| 1 | D7 (Bottom) | 33.071 | 452.054 | 0.07 |
| 2 | D7 (Bottom) | 13.689 | 87.894 | 0.16 |
| 3 | D13 (Bottom) | 19.349 | 116.156 | 0.17 |
| 4 | D13 (Bottom) | 33.071 | 497.473 | 0.07 |

**STABILITY RESULTS:**

**Status : Warnings in design**
**- The overturning safety factor is smaller than the allowable value**

**Global stability:**

Safety factor : 1.5

| Condition | Position | RM [Kip*ft] | OTM [Kip*ft] | FS |
|---|---|---|---|---|
| S1 | Left corner | -6.68 | 0.00 | -- |
| S8 | Right corner | 4.01 | -1018.57 | 0.00 |

**Notes:**

* Pu = Axial load
* Pn = Nominal axial load
* Mua = Moment at section
* Mu = Magnified moment at section
* Mcr = Cracking moment at section
* Mn = Maximum nominal moment
* Vu = Design shear force
* Vn = Nominal shear force

## ARW Engineers

**Current Date:** 5/7/2018 3:59 PM
**Units system:** English
**File name:** Y:\Projects 2018\18054 - Kimberly Clark 20000SF Addition\Engineering\Calculations\RAM\tilt-ups\18054_Type DE.tup\

# Design Results

## Tilt-Up Wall

### GENERAL INFORMATION:

**Global status : Warnings in design**

| | | |
|---|---|---|
| Design code | : | ACI 318-14 |

**Geometry:**

| | | |
|---|---|---|
| Total height | : | 46.00 [ft] |
| Total length | : | 19.27 [ft] |
| Base support type | : | Continuous |
| Wall bottom restraint | : | Pinned |

**Materials:**

| | | |
|---|---|---|
| Material | : | RC4.5x60 |
| Steel tension strength (Fy) | : | 60 [Kip/in2] |
| Concrete compressive strength (fc) | : | 4.5 [Kip/in2] |
| Steel elasticity modulus (Es) | : | 29000 [Kip/in2] |
| Concrete modulus of elasticity (E) | : | 3823.68 [Kip/in2] |
| Concrete unit weight | : | 0.149818 [Kip/ft3] |

**Number of stories: 1**

| Story | Story height [ft] | Wall thickness [in] |
|---|---|---|
| 1 | 44.00 | 9.25 |

**Openings:**

| Reference | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] |
|---|---|---|---|---|
| Lower left | 4.64 | 4.00 | 10.00 | 12.00 |

**Load conditions:**

| ID | Comb. | Category | Description |
|---|---|---|---|
| DL | No | DL | Dead Load |
| SL | No | SNOW | Snow |
| EQip | No | EQ | In plane EQ |
| EQoop | No | EQ | OOP EQ |
| S1 | Yes | | DL |
| S2 | Yes | | DL+SL |
| S3 | Yes | | DL+0.75SL |
| S4 | Yes | | DL+0.7EQip |
| S5 | Yes | | DL+0.525EQip |
| S6 | Yes | | DL+0.75SL |
| S7 | Yes | | DL+0.75SL+0.525EQip |
| S8 | Yes | | 0.6DL+0.7EQip |
| S9 | Yes | | DL+0.7EQoop |
| S10 | Yes | | DL+0.525EQoop |

| | | |
|---|---|---|
| S11 | Yes | DL+0.75SL+0.525EQoop |
| S12 | Yes | 0.6DL+0.7EQoop |
| D1 | Yes | 1.4DL |
| D2 | Yes | 1.2DL+0.5SL |
| D3 | Yes | 1.2DL+1.6SL |
| D4 | Yes | 1.2DL+0.2SL |
| D5 | Yes | 1.2DL+EQip |
| D6 | Yes | 1.2DL+0.2SL+EQip |
| D7 | Yes | 0.9DL+EQip |
| D8 | Yes | 1.2DL+EQoop |
| D9 | Yes | 1.2DL+0.2SL+EQoop |
| D10 | Yes | 0.9DL+EQoop |
| D11 | Yes | 1.2DL-EQip |
| D12 | Yes | 1.2DL+0.2SL-EQip |
| D13 | Yes | 0.9DL-EQip |
| D14 | Yes | 1.2DL-EQoop |
| D15 | Yes | 1.2DL+0.2SL-EQoop |
| D16 | Yes | 0.9DL-EQoop |
| S13 | Yes | DL-0.7EQoop |
| S14 | Yes | DL-0.525EQoop |
| S15 | Yes | DL+0.75SL-0.525EQoop |
| S16 | Yes | 0.6DL-0.7EQoop |

**Consider Self Weight:**

Load condition : No

**Distributed loads:**

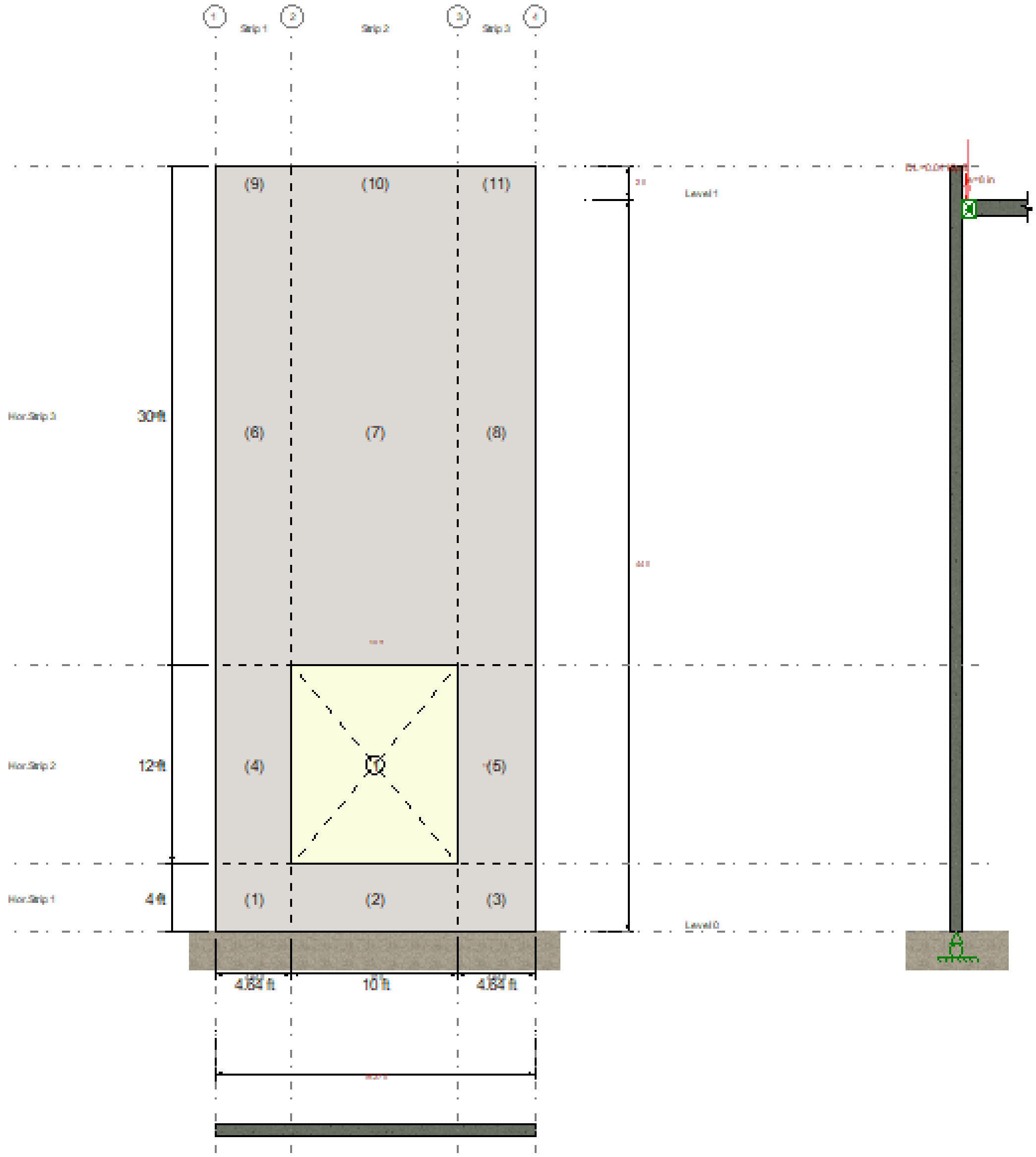
| Story | Condition | Direction | Magnitude [Kip/ft] | Eccentricity [ft] |
|---|---|---|---|---|
| 1 | DL | Vertical | 0.04 | 0.67 |
| 1 | SL | Vertical | 0.09 | 0.67 |
| 1 | EQip | Horizontal | 2.18 | 0.00 |

**Out-of-plane seismic weight:**

| Load condition | Coefficient |
|---|---|
| EQoop | 0.40 |

**TILT-UP WALLS DESIGN:**

**Status : Warnings in design**
**- The wall must be tension controlled, Section 11.8.1.1b (Segment 1)**




**Geometry:**

| Segment | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 4.64 | 4.00 |
| 2 | 4.64 | 0.00 | 10.00 | 4.00 |
| 3 | 14.64 | 0.00 | 4.64 | 4.00 |
| 4 | 0.00 | 4.00 | 4.64 | 12.00 |
| 5 | 14.64 | 4.00 | 4.64 | 12.00 |
| 6 | 0.00 | 16.00 | 4.64 | 28.00 |
| 7 | 4.64 | 16.00 | 10.00 | 28.00 |
| 8 | 14.64 | 16.00 | 4.64 | 28.00 |
| 9 | 0.00 | 44.00 | 4.64 | 2.00 |
| 10 | 4.64 | 44.00 | 10.00 | 2.00 |
| 11 | 14.64 | 44.00 | 4.64 | 2.00 |

**Vertical reinforcement:**

Reinforcement layers : 2

| Segment | Bars | Spacing [in] | Ld [in] |
|---|---|---|---|
| 1 | 18-#6 | 3.00 | 26.83 |
| 2 | 10-#4 | 12.00 | 17.89 |
| 3 | 18-#6 | 3.00 | 26.83 |
| 4 | 18-#6 | 3.00 | 26.83 |
| 5 | 18-#6 | 3.00 | 26.83 |
| 6 | 18-#6 | 3.00 | 26.83 |
| 7 | 10-#4 | 12.00 | 17.89 |
| 8 | 18-#6 | 3.00 | 26.83 |
| 9 | 18-#6 | 3.00 | 26.83 |
| 10 | 10-#4 | 12.00 | 17.89 |
| 11 | 18-#6 | 3.00 | 26.83 |

**Vertical reinforcement**

| Segment | Condition | Pu [Kip] | Pu/Ag [Kip/in2] | 0.06*f´c [Kip/in2] | Ratio |
|---|---|---|---|---|---|
| 1 | D12 (Max) | 105.759 | 0.206 | 0.270 | 0.76 |
| 2 | D3 (Max) | 0.327 | 0.000 | 0.270 | 0.00 |
| 3 | D6 (Max) | 105.763 | 0.206 | 0.270 | 0.76 |
| 4 | D12 (Max) | 94.581 | 0.184 | 0.270 | 0.68 |
| 5 | D6 (Max) | 94.581 | 0.184 | 0.270 | 0.68 |
| 6 | D12 (Max) | 35.751 | 0.069 | 0.270 | 0.26 |
| 7 | D3 (Max) | 1.396 | 0.001 | 0.270 | 0.00 |
| 8 | D6 (Max) | 35.753 | 0.069 | 0.270 | 0.26 |
| 9 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |
| 10 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |
| 11 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |

**Intermediate results for axial-bending**

| Segment | Condition | Ase [in2] | a [in] | c [in] | d [in] | ϕ | Kb [Kip] |
|---|---|---|---|---|---|---|---|
| 1 | D9 (Top) | 7.93 | 2.53 | 2.97 | 7.63 | 0.87 | 483.01 |
| 2 | D16 (Max) | 2.00 | 0.26 | 0.31 | 7.75 | 0.90 | 1042.10 |
| 3 | D9 (Top) | 7.93 | 2.53 | 2.97 | 7.63 | 0.87 | 483.12 |
| 4 | D9 (Top) | 7.93 | 2.53 | 2.97 | 7.63 | 0.87 | 246.83 |
| 5 | D9 (Top) | 7.93 | 2.53 | 2.97 | 7.63 | 0.87 | 246.86 |
| 6 | D9 (Bottom) | 7.93 | 2.53 | 2.97 | 7.63 | 0.87 | 246.75 |
| 7 | D9 (Max) | 2.01 | 0.26 | 0.31 | 7.75 | 0.90 | 1042.10 |
| 8 | D9 (Bottom) | 7.93 | 2.53 | 2.97 | 7.63 | 0.87 | 246.78 |
| 9 | D1 (Top) | 7.92 | 2.52 | 2.97 | 7.63 | 0.88 | 233778.90 |
| 10 | D1 (Top) | 2.00 | 0.26 | 0.31 | 7.75 | 0.90 | 504377.20 |
| 11 | D1 (Top) | 7.92 | 2.52 | 2.97 | 7.63 | 0.88 | 233829.30 |

**Inertias**

| Segment | Condition | Ig [in4] | Icr [in4] | Ie [in4] |
|---|---|---|---|---|
| 1 | D9 (Top) | 3668.39 | 1788.65 | 3668.39 |
| 2 | D16 (Max) | 7914.53 | 841.75 | 7914.53 |
| 3 | D9 (Top) | 3669.18 | 1788.80 | 3669.18 |
| 4 | D9 (Top) | 3668.39 | 1788.78 | 1874.65 |
| 5 | D9 (Top) | 3669.18 | 1788.93 | 1874.86 |
| 6 | D9 (Bottom) | 3668.39 | 1788.23 | 1874.05 |

| | | | | |
|---|---|---|---|---|
| 7 | D9 (Max) | 7914.53 | 844.45 | 7914.53 |
| 8 | D9 (Bottom) | 3669.18 | 1788.38 | 1874.25 |
| 9 | D1 (Top) | 3668.39 | 1787.32 | 3668.39 |
| 10 | D1 (Top) | 7914.53 | 841.35 | 7914.53 |
| 11 | D1 (Top) | 3669.18 | 1787.47 | 3669.18 |

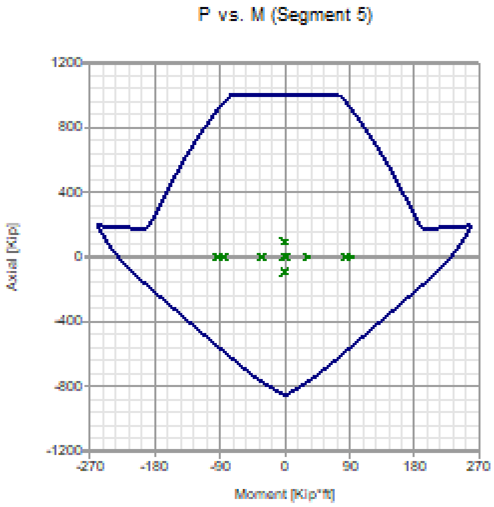
**Combined axial flexure**

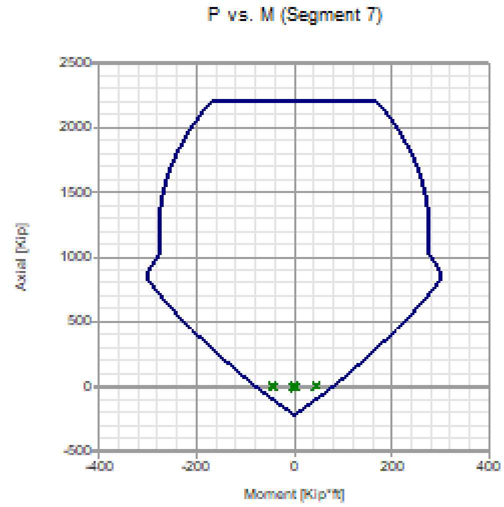
| Segment | Condition | Pu [Kip] | Mua [Kip*ft] | Mu [Kip*ft] | ϕ*Mn [Kip*ft] | Mu/ϕ*Mn |
|---|---|---|---|---|---|---|
| 1 | D9 (Top) | 0.58 | -32.35 | -32.41 | 230.39 | 0.14 |
| 2 | D16 (Max) | 0.06 | 0.92 | 0.92 | 78.33 | 0.01 |
| 3 | D9 (Top) | 0.58 | -32.36 | -32.41 | 230.40 | 0.14 |
| 4 | D9 (Top) | 0.64 | -93.02 | -93.34 | 230.40 | 0.41 |
| 5 | D9 (Top) | 0.64 | -93.03 | -93.35 | 230.41 | 0.41 |
| 6 | D9 (Bottom) | 0.40 | -93.05 | -93.25 | 230.35 | 0.40 |
| 7 | D9 (Max) | 0.48 | -45.03 | -45.06 | 78.47 | 0.57 |
| 8 | D9 (Bottom) | 0.40 | -93.06 | -93.26 | 230.36 | 0.40 |
| 9 | D1 (Top) | 0.00 | 0.00 | 0.00 | 230.28 | 0.00 |
| 10 | D1 (Top) | 0.00 | 0.00 | 0.00 | 78.31 | 0.00 |
| 11 | D1 (Top) | 0.00 | 0.00 | 0.00 | 230.29 | 0.00 |

**Cracking moment**

| Segment | Condition | Pu [Kip] | Mua [Kip*ft] | Mcr [Kip*ft] | ϕ*Mn [Kip*ft] | Mcr/ϕ*Mn |
|---|---|---|---|---|---|---|
| 1 | D7 (Top) | -104.86 | -0.02 | 33.25 | 208.22 | 0.16 |
| 2 | D7 (Bottom) | 0.06 | 0.00 | 71.75 | 78.33 | 0.92 |
| 3 | D13 (Bottom) | -104.87 | 0.00 | 33.26 | 208.22 | 0.16 |
| 4 | D7 (Bottom) | -93.60 | -0.02 | 33.25 | 210.76 | 0.16 |
| 5 | D13 (Top) | -93.60 | -0.08 | 33.26 | 210.77 | 0.16 |
| 6 | D7 (Top) | -35.14 | -0.11 | 33.25 | 223.43 | 0.15 |
| 7 | D7 (Top) | 0.26 | -0.24 | 71.75 | 78.40 | 0.92 |
| 8 | D13 (Bottom) | -35.14 | -0.08 | 33.26 | 223.44 | 0.15 |
| 9 | D16 (Bottom) | 0.00 | 0.00 | 33.25 | 230.28 | 0.14 |
| 10 | D16 (Bottom) | 0.00 | 0.00 | 71.75 | 78.31 | 0.92 |
| 11 | D16 (Bottom) | 0.00 | 0.00 | 33.26 | 230.29 | 0.14 |

**Interaction diagrams, P vs. M:**




**Axial compression**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D12 (Top) | 105.76 | 991.80 | 0.11 |
| 2 | D3 (Bottom) | 0.33 | 2199.83 | 0.00 |
| 3 | D6 (Top) | 105.76 | 992.03 | 0.11 |
| 4 | D12 (Top) | 94.58 | 991.80 | 0.10 |
| 5 | D6 (Top) | 94.58 | 992.03 | 0.10 |
| 6 | D12 (Bottom) | 35.75 | 991.80 | 0.04 |
| 7 | D3 (Top) | 1.40 | 2199.83 | 0.00 |
| 8 | D6 (Top) | 35.75 | 992.03 | 0.04 |
| 9 | D1 (Top) | 0.00 | 991.80 | 0.00 |
| 10 | D1 (Top) | 0.00 | 2199.83 | 0.00 |
| 11 | D1 (Top) | 0.00 | 992.03 | 0.00 |

**Axial tension**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D7 (Bottom) | 104.86 | 855.36 | 0.12 |
| 2 | D1 (Top) | 0.00 | 216.00 | 0.00 |
| 3 | D13 (Top) | 104.87 | 855.36 | 0.12 |
| 4 | D7 (Bottom) | 93.60 | 855.36 | 0.11 |
| 5 | D13 (Top) | 93.60 | 855.36 | 0.11 |
| 6 | D7 (Bottom) | 35.14 | 855.36 | 0.04 |
| 7 | D1 (Top) | 0.00 | 216.00 | 0.00 |
| 8 | D13 (Bottom) | 35.14 | 855.36 | 0.04 |
| 9 | D1 (Top) | 0.00 | 855.36 | 0.00 |
| 10 | D1 (Top) | 0.00 | 216.00 | 0.00 |
| 11 | D1 (Top) | 0.00 | 855.36 | 0.00 |

**Shear**

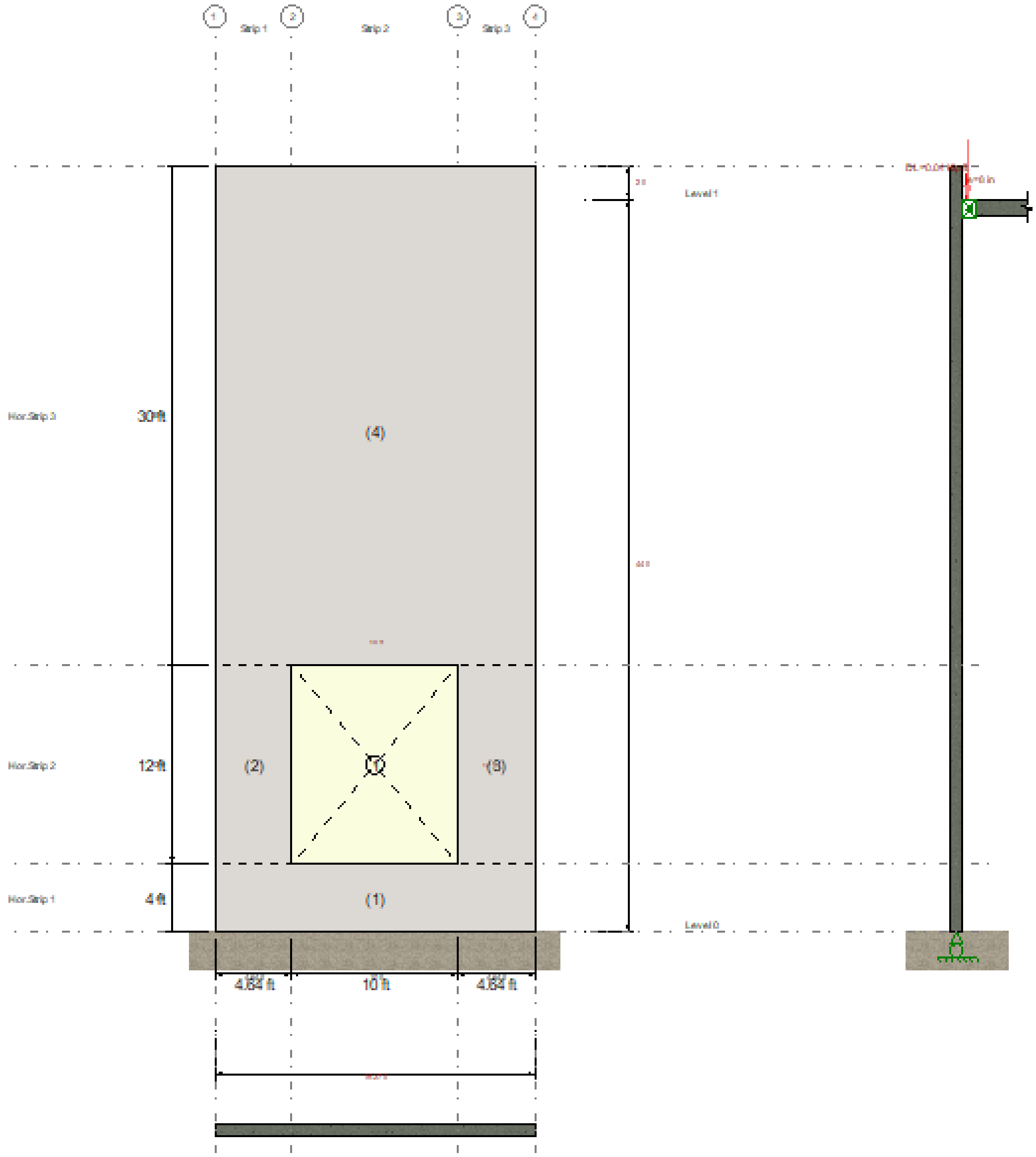
| Segment | Condition | Vu [Kip] | ϕ*Vn [Kip] | Vu/ϕ*Vn |
|---|---|---|---|---|
| 1 | D9 (Bottom) | 8.531 | 42.674 | 0.20 |
| 2 | D8 (Top) | 0.920 | 93.579 | 0.01 |
| 3 | D9 (Bottom) | 8.532 | 42.684 | 0.20 |
| 4 | D9 (Bottom) | 6.336 | 42.674 | 0.15 |
| 5 | D9 (Bottom) | 6.337 | 42.684 | 0.15 |
| 6 | D15 (Top) | 6.331 | 42.674 | 0.15 |
| 7 | D15 (Top) | 6.512 | 93.579 | 0.07 |
| 8 | D15 (Top) | 6.332 | 42.684 | 0.15 |
| 9 | D1 (Top) | 0.000 | 42.674 | 0.00 |
| 10 | D1 (Top) | 0.000 | 93.579 | 0.00 |
| 11 | D1 (Top) | 0.000 | 42.684 | 0.00 |

**Deflection**

| Segment | Condition | Δ [in] | Δmax [in] | Δ/Δmax |
|---|---|---|---|---|
| 1 | S9 (Top) | -0.563 | 3.520 | 0.16 |
| 2 | S13 (Max) | 0.007 | 3.520 | 0.00 |
| 3 | S9 (Top) | -0.563 | 3.520 | 0.16 |
| 4 | S9 (Top) | -3.198 | 3.520 | 0.91 |
| 5 | S9 (Top) | -3.198 | 3.520 | 0.91 |
| 6 | S9 (Bottom) | -3.017 | 3.520 | 0.86 |
| 7 | S9 (Max) | -0.363 | 3.520 | 0.10 |
| 8 | S9 (Bottom) | -3.017 | 3.520 | 0.86 |
| 9 | S1 (Top) | 0.000 | 0.160 | 0.00 |
| 10 | S1 (Top) | 0.000 | 0.160 | 0.00 |
| 11 | S1 (Top) | 0.000 | 0.160 | 0.00 |

**SHEAR WALL DESIGN:**

**Status** : OK




**Geometry:**

| Segment | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] | Classification |
|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 19.27 | 4.00 | Shear wall |
| 2 | 0.00 | 4.00 | 4.64 | 12.00 | Shear wall |
| 3 | 14.64 | 4.00 | 4.64 | 12.00 | Shear wall |
| 4 | 0.00 | 16.00 | 19.27 | 28.00 | Shear wall |

**Reinforcement:**

Reinforcement layers : 2

| | Vertical reinforcement | | | Horizontal reinforcement | | |
|---|---|---|---|---|---|---|
| Segment | Bars | Spacing [in] | Ld [in] | Bars | Spacing [in] | Ld [in] |
| 1 | 18-#6 | 3.00 | 26.83 | 3-#4 | 18.00 | 23.26 |
| | 10-#4 | 12.00 | 26.83 | 3-#4 | 18.00 | 23.26 |
| | 18-#6 | 3.00 | 26.83 | 3-#4 | 18.00 | 23.26 |
| 2 | 18-#6 | 3.00 | 26.83 | 9-#4 | 16.00 | 23.26 |
| 3 | 18-#6 | 3.00 | 26.83 | 9-#4 | 16.00 | 23.26 |
| 4 | 18-#6 | 3.00 | 26.83 | 19-#4 | 18.00 | 23.26 |
| | 10-#4 | 12.00 | 26.83 | 19-#4 | 18.00 | 23.26 |
| | 18-#6 | 3.00 | 26.83 | 19-#4 | 18.00 | 23.26 |

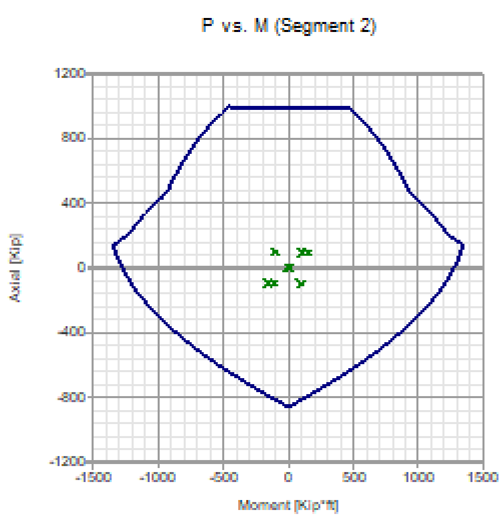
**Intermediate results for axial-bending**

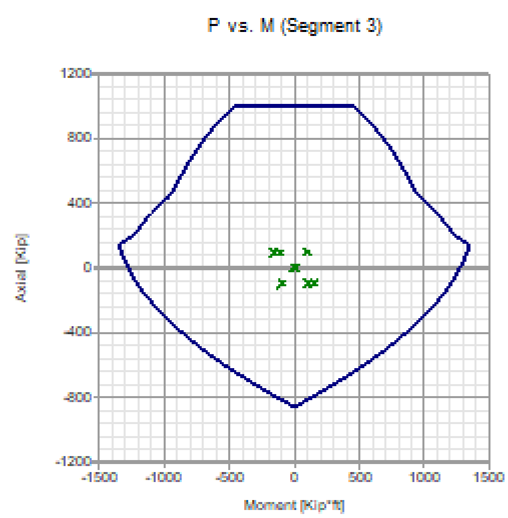
| Segment | Condition | c [in] | d [in] |
|---|---|---|---|
| 1 | D7 (Bottom) | 44.41 | 185.00 |
| 2 | D7 (Bottom) | 16.79 | 44.50 |
| 3 | D13 (Bottom) | 16.79 | 44.51 |
| 4 | D7 (Bottom) | 44.41 | 185.00 |

**Combined axial flexure**

| Segment | Condition | Pu [Kip] | Mu [Kip*ft] | ϕ*Mn [Kip*ft] | Mu/ϕ*Mn |
|---|---|---|---|---|---|
| 1 | D7 (Bottom) | 0.69 | -1848.12 | 15041.59 | 0.12 |
| 2 | D7 (Bottom) | -93.60 | -152.53 | 1203.82 | 0.13 |
| 3 | D13 (Bottom) | -93.60 | 152.59 | 1204.17 | 0.13 |
| 4 | D7 (Bottom) | 0.69 | -1175.95 | 15041.59 | 0.08 |

**Interaction diagrams, P vs. M:**




**Axial compression**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D3 (Bottom) | 3.70 | 4183.66 | 0.00 |
| 2 | D12 (Top) | 94.58 | 991.80 | 0.10 |
| 3 | D6 (Top) | 94.58 | 992.03 | 0.10 |
| 4 | D3 (Bottom) | 3.70 | 4183.66 | 0.00 |

**Axial tension**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D1 (Top) | 0.00 | 1926.72 | 0.00 |
| 2 | D7 (Bottom) | 93.60 | 855.36 | 0.11 |
| 3 | D13 (Top) | 93.60 | 855.36 | 0.11 |
| 4 | D1 (Top) | 0.00 | 1926.72 | 0.00 |

**Shear**

| Segment | Condition | Vu [Kip] | ϕ*Vn [Kip] | Vu/ϕ*Vn |
|---|---|---|---|---|
| 1 | D7 (Bottom) | 42.011 | 297.072 | 0.14 |
| 2 | D7 (Bottom) | 20.984 | 76.200 | 0.28 |
| 3 | D13 (Bottom) | 20.990 | 76.219 | 0.28 |
| 4 | D7 (Bottom) | 42.011 | 349.731 | 0.12 |

**STABILITY RESULTS:**

**Status : Warnings in design**
**- The overturning safety factor is smaller than the allowable value**

**Global stability:**

Safety factor : 1.5

| Condition | Position | RM [Kip*ft] | OTM [Kip*ft] | FS |
|---|---|---|---|---|
| S1 | Left corner | -7.43 | 0.00 | -- |
| S8 | Right corner | 4.46 | -1293.93 | 0.00 |

**Notes:**

* Pu = Axial load
* Pn = Nominal axial load
* Mua = Moment at section
* Mu = Magnified moment at section
* Mcr = Cracking moment at section
* Mn = Maximum nominal moment
* Vu = Design shear force
* Vn = Nominal shear force

## ARW Engineers

**Current Date:** 5/7/2018 4:00 PM
**Units system:** English
**File name:** Y:\Projects 2018\18054 - Kimberly Clark 20000SF Addition\Engineering\Calculations\RAM\tilt-ups\18054_Type FG.tup\

# Design Results

## Tilt-Up Wall

---

### GENERAL INFORMATION:

**Global status : Warnings in design**

| | | |
|---|---|---|
| Design code | : | ACI 318-14 |

**Geometry:**

| | | |
|---|---|---|
| Total height | : | 46.00 [ft] |
| Total length | : | 18.27 [ft] |
| Base support type | : | Continuous |
| Wall bottom restraint | : | Pinned |

**Materials:**

| | | |
|---|---|---|
| Material | : | RC4.5x60 |
| Steel tension strength (Fy) | : | 60 [Kip/in2] |
| Concrete compressive strength (fc) | : | 4.5 [Kip/in2] |
| Steel elasticity modulus (Es) | : | 29000 [Kip/in2] |
| Concrete modulus of elasticity (E) | : | 3823.68 [Kip/in2] |
| Concrete unit weight | : | 0.149818 [Kip/ft3] |

**Number of stories: 1**

| Story | Story height [ft] | Wall thickness [in] |
|---|---|---|
| 1 | 44.00 | 9.25 |

**Openings:**

| Reference | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] |
|---|---|---|---|---|
| Lower left | 3.64 | 4.00 | 10.00 | 12.00 |

**Load conditions:**

| ID | Comb. | Category | Description |
|---|---|---|---|
| DL | No | DL | Dead Load |
| SL | No | SNOW | Snow |
| EQip | No | EQ | In plane EQ |
| EQoop | No | EQ | OOP EQ |
| S1 | Yes | | DL |
| S2 | Yes | | DL+SL |
| S3 | Yes | | DL+0.75SL |
| S4 | Yes | | DL+0.7EQip |
| S5 | Yes | | DL+0.525EQip |
| S6 | Yes | | DL+0.75SL |
| S7 | Yes | | DL+0.75SL+0.525EQip |
| S8 | Yes | | 0.6DL+0.7EQip |
| S9 | Yes | | DL+0.7EQoop |
| S10 | Yes | | DL+0.525EQoop |

| | | |
|---|---|---|
| S11 | Yes | DL+0.75SL+0.525EQoop |
| S12 | Yes | 0.6DL+0.7EQoop |
| D1 | Yes | 1.4DL |
| D2 | Yes | 1.2DL+0.5SL |
| D3 | Yes | 1.2DL+1.6SL |
| D4 | Yes | 1.2DL+0.2SL |
| D5 | Yes | 1.2DL+EQip |
| D6 | Yes | 1.2DL+0.2SL+EQip |
| D7 | Yes | 0.9DL+EQip |
| D8 | Yes | 1.2DL+EQoop |
| D9 | Yes | 1.2DL+0.2SL+EQoop |
| D10 | Yes | 0.9DL+EQoop |
| D11 | Yes | 1.2DL-EQip |
| D12 | Yes | 1.2DL+0.2SL-EQip |
| D13 | Yes | 0.9DL-EQip |
| D14 | Yes | 1.2DL-EQoop |
| D15 | Yes | 1.2DL+0.2SL-EQoop |
| D16 | Yes | 0.9DL-EQoop |
| S13 | Yes | DL-0.7EQoop |
| S14 | Yes | DL-0.525EQoop |
| S15 | Yes | DL+0.75SL-0.525EQoop |
| S16 | Yes | 0.6DL-0.7EQoop |

**Consider Self Weight:**

Load condition : No

**Distributed loads:**

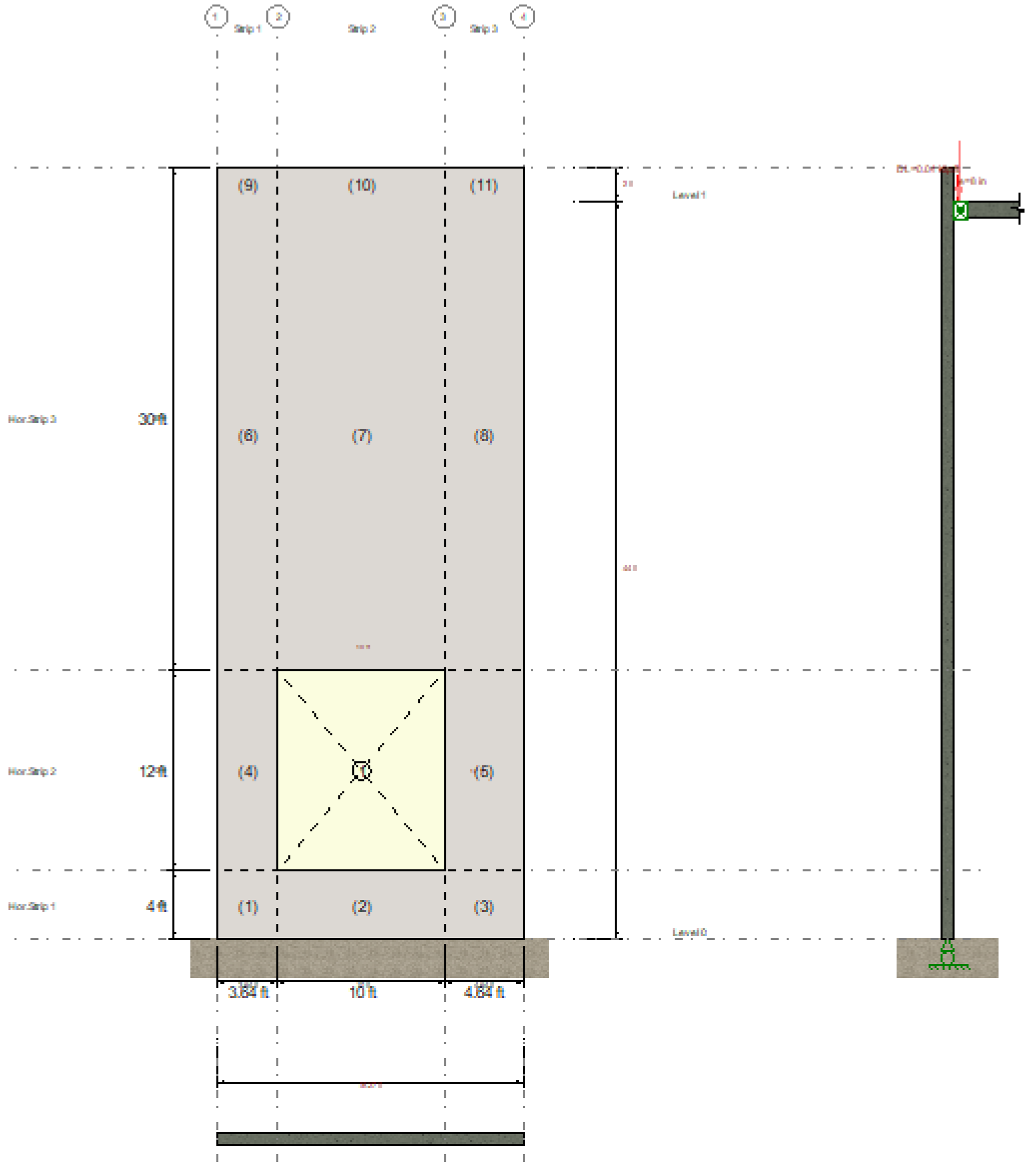
| Story | Condition | Direction | Magnitude [Kip/ft] | Eccentricity [ft] |
|---|---|---|---|---|
| 1 | DL | Vertical | 0.04 | 0.67 |
| 1 | SL | Vertical | 0.09 | 0.67 |
| 1 | EQip | Horizontal | 1.81 | 0.00 |

**Out-of-plane seismic weight:**

| Load condition | Coefficient |
|---|---|
| EQoop | 0.40 |

**TILT-UP WALLS DESIGN:**

**Status : Warnings in design**
**- The wall must be tension controlled, Section 11.8.1.1b (Segment 1)**




**Geometry:**

| Segment | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 3.64 | 4.00 |
| 2 | 3.64 | 0.00 | 10.00 | 4.00 |
| 3 | 13.64 | 0.00 | 4.64 | 4.00 |
| 4 | 0.00 | 4.00 | 3.64 | 12.00 |
| 5 | 13.64 | 4.00 | 4.64 | 12.00 |
| 6 | 0.00 | 16.00 | 3.64 | 28.00 |
| 7 | 3.64 | 16.00 | 10.00 | 28.00 |
| 8 | 13.64 | 16.00 | 4.64 | 28.00 |
| 9 | 0.00 | 44.00 | 3.64 | 2.00 |
| 10 | 3.64 | 44.00 | 10.00 | 2.00 |
| 11 | 13.64 | 44.00 | 4.64 | 2.00 |

**Vertical reinforcement:**

Reinforcement layers : 2

| Segment | Bars | Spacing [in] | Ld [in] |
|---|---|---|---|
| 1 | 14-#7 | 3.00 | 39.13 |
| 2 | 10-#4 | 12.00 | 17.89 |
| 3 | 18-#6 | 3.00 | 26.83 |
| 4 | 14-#7 | 3.00 | 39.13 |
| 5 | 18-#6 | 3.00 | 26.83 |
| 6 | 14-#7 | 3.00 | 39.13 |
| 7 | 10-#4 | 12.00 | 17.89 |
| 8 | 18-#6 | 3.00 | 26.83 |
| 9 | 14-#7 | 3.00 | 39.13 |
| 10 | 10-#4 | 12.00 | 17.89 |
| 11 | 18-#6 | 3.00 | 26.83 |

**Vertical reinforcement**

| Segment | Condition | Pu [Kip] | Pu/Ag [Kip/in2] | 0.06*f´c [Kip/in2] | Ratio |
|---|---|---|---|---|---|
| 1 | D12 (Max) | 84.223 | 0.209 | 0.270 | 0.77 |
| 2 | D12 (Max) | 4.723 | 0.004 | 0.270 | 0.02 |
| 3 | D6 (Max) | 88.877 | 0.173 | 0.270 | 0.64 |
| 4 | D12 (Max) | 77.624 | 0.192 | 0.270 | 0.71 |
| 5 | D6 (Max) | 77.678 | 0.151 | 0.270 | 0.56 |
| 6 | D12 (Max) | 27.878 | 0.069 | 0.270 | 0.26 |
| 7 | D12 (Max) | 1.778 | 0.002 | 0.270 | 0.01 |
| 8 | D6 (Max) | 29.236 | 0.057 | 0.270 | 0.21 |
| 9 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |
| 10 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |
| 11 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |

**Intermediate results for axial-bending**

| Segment | Condition | Ase [in2] | a [in] | c [in] | d [in] | $\phi$ | Kb [Kip] |
|---|---|---|---|---|---|---|---|
| 1 | D10 (Top) | 8.40 | 3.40 | 4.00 | 7.56 | 0.71 | 342.11 |
| 2 | D10 (Max) | 2.00 | 0.26 | 0.31 | 7.75 | 0.90 | 1042.10 |
| 3 | D9 (Top) | 7.93 | 2.53 | 2.97 | 7.63 | 0.87 | 483.01 |
| 4 | D9 (Top) | 8.41 | 3.41 | 4.01 | 7.56 | 0.71 | 234.14 |
| 5 | D9 (Top) | 7.93 | 2.53 | 2.97 | 7.63 | 0.87 | 246.86 |
| 6 | D9 (Bottom) | 8.41 | 3.40 | 4.00 | 7.56 | 0.71 | 234.02 |
| 7 | D9 (Max) | 2.01 | 0.26 | 0.31 | 7.75 | 0.90 | 1042.10 |
| 8 | D9 (Bottom) | 7.93 | 2.53 | 2.97 | 7.63 | 0.87 | 246.79 |
| 9 | D1 (Top) | 8.40 | 3.40 | 4.00 | 7.56 | 0.71 | 183341.10 |
| 10 | D1 (Top) | 2.00 | 0.26 | 0.31 | 7.75 | 0.90 | 504377.20 |
| 11 | D1 (Top) | 7.92 | 2.52 | 2.97 | 7.63 | 0.88 | 233778.90 |

**Inertias**

| Segment | Condition | Ig [in4] | Icr [in4] | Ie [in4] |
|---|---|---|---|---|
| 1 | D10 (Top) | 2876.93 | 1740.62 | 2598.26 |
| 2 | D10 (Max) | 7914.53 | 841.77 | 7914.53 |
| 3 | D9 (Top) | 3668.39 | 1788.62 | 3668.39 |
| 4 | D9 (Top) | 2876.93 | 1741.74 | 1778.24 |
| 5 | D9 (Top) | 3668.39 | 1788.76 | 1874.88 |
| 6 | D9 (Bottom) | 2876.93 | 1740.80 | 1777.29 |

| | | | | |
|---|---|---|---|---|
| 7 | D9 (Max) | 7914.53 | 844.47 | 7914.53 |
| 8 | D9 (Bottom) | 3668.39 | 1788.22 | 1874.28 |
| 9 | D1 (Top) | 2876.93 | 1739.54 | 2876.93 |
| 10 | D1 (Top) | 7914.53 | 841.35 | 7914.53 |
| 11 | D1 (Top) | 3668.39 | 1787.32 | 3668.39 |

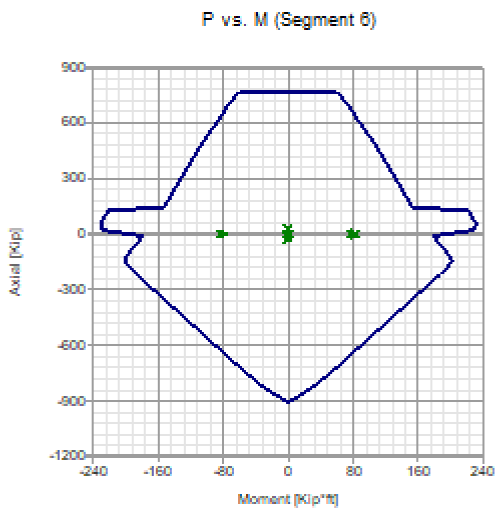
**Combined axial flexure**

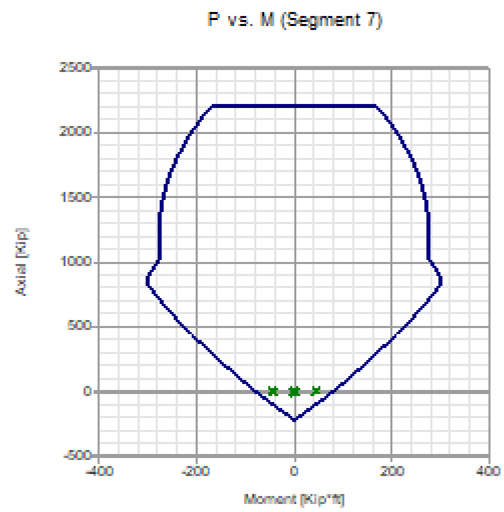
| Segment | Condition | Pu [Kip] | Mua [Kip*ft] | Mu [Kip*ft] | ϕ*Mn [Kip*ft] | Mu/ϕ*Mn |
|---|---|---|---|---|---|---|
| 1 | D10 (Top) | 0.28 | -28.64 | -28.68 | 195.33 | 0.15 |
| 2 | D10 (Max) | 0.06 | -0.92 | -0.92 | 78.33 | 0.01 |
| 3 | D9 (Top) | 0.57 | -32.00 | -32.05 | 230.39 | 0.14 |
| 4 | D9 (Top) | 0.58 | -82.02 | -82.29 | 195.79 | 0.42 |
| 5 | D9 (Top) | 0.63 | -92.93 | -93.25 | 230.40 | 0.40 |
| 6 | D9 (Bottom) | 0.33 | -82.04 | -82.20 | 195.40 | 0.42 |
| 7 | D9 (Max) | 0.48 | -45.03 | -45.06 | 78.48 | 0.57 |
| 8 | D9 (Bottom) | 0.39 | -92.96 | -93.16 | 230.35 | 0.40 |
| 9 | D1 (Top) | 0.00 | 0.00 | 0.00 | 194.88 | 0.00 |
| 10 | D1 (Top) | 0.00 | 0.00 | 0.00 | 78.31 | 0.00 |
| 11 | D1 (Top) | 0.00 | 0.00 | 0.00 | 230.28 | 0.00 |

**Cracking moment**

| Segment | Condition | Pu [Kip] | Mua [Kip*ft] | Mcr [Kip*ft] | ϕ*Mn [Kip*ft] | Mcr/ϕ*Mn |
|---|---|---|---|---|---|---|
| 1 | D6 (Top) | -83.19 | -0.03 | 26.08 | 192.22 | 0.14 |
| 2 | D7 (Top) | -4.54 | 0.00 | 71.75 | 76.76 | 0.93 |
| 3 | D13 (Bottom) | -88.00 | 0.00 | 33.25 | 212.03 | 0.16 |
| 4 | D6 (Bottom) | -76.47 | -0.03 | 26.08 | 190.96 | 0.14 |
| 5 | D13 (Top) | -76.70 | -0.08 | 33.25 | 214.58 | 0.15 |
| 6 | D6 (Top) | -27.22 | -0.16 | 26.08 | 181.51 | 0.14 |
| 7 | D7 (Bottom) | -1.03 | 0.00 | 71.75 | 77.96 | 0.92 |
| 8 | D13 (Top) | -28.63 | -0.11 | 33.25 | 224.80 | 0.15 |
| 9 | D1 (Top) | 0.00 | 0.00 | 26.08 | 194.88 | 0.13 |
| 10 | D16 (Bottom) | 0.00 | 0.00 | 71.75 | 78.31 | 0.92 |
| 11 | D16 (Bottom) | 0.00 | 0.00 | 33.25 | 230.28 | 0.14 |

**Interaction diagrams, P vs. M:**




**Axial compression**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D12 (Bottom) | 84.22 | 769.12 | 0.11 |
| 2 | D12 (Top) | 4.72 | 2199.83 | 0.00 |
| 3 | D6 (Top) | 88.88 | 991.80 | 0.09 |
| 4 | D12 (Top) | 77.62 | 769.12 | 0.10 |
| 5 | D6 (Bottom) | 77.68 | 991.80 | 0.08 |
| 6 | D12 (Bottom) | 27.88 | 769.12 | 0.04 |
| 7 | D12 (Bottom) | 1.78 | 2199.83 | 0.00 |
| 8 | D6 (Top) | 29.24 | 991.80 | 0.03 |
| 9 | D1 (Top) | 0.00 | 769.12 | 0.00 |
| 10 | D1 (Top) | 0.00 | 2199.83 | 0.00 |
| 11 | D1 (Top) | 0.00 | 991.80 | 0.00 |

**Axial tension**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D7 (Bottom) | 83.42 | 907.20 | 0.09 |
| 2 | D7 (Bottom) | 4.54 | 216.00 | 0.02 |
| 3 | D13 (Bottom) | 88.00 | 855.36 | 0.10 |
| 4 | D7 (Top) | 76.73 | 907.20 | 0.08 |
| 5 | D13 (Bottom) | 76.70 | 855.36 | 0.09 |
| 6 | D7 (Top) | 27.37 | 907.20 | 0.03 |
| 7 | D7 (Top) | 1.03 | 216.00 | 0.00 |
| 8 | D13 (Bottom) | 28.63 | 855.36 | 0.03 |
| 9 | D1 (Top) | 0.00 | 907.20 | 0.00 |
| 10 | D1 (Top) | 0.00 | 216.00 | 0.00 |
| 11 | D1 (Top) | 0.00 | 855.36 | 0.00 |

**Shear**

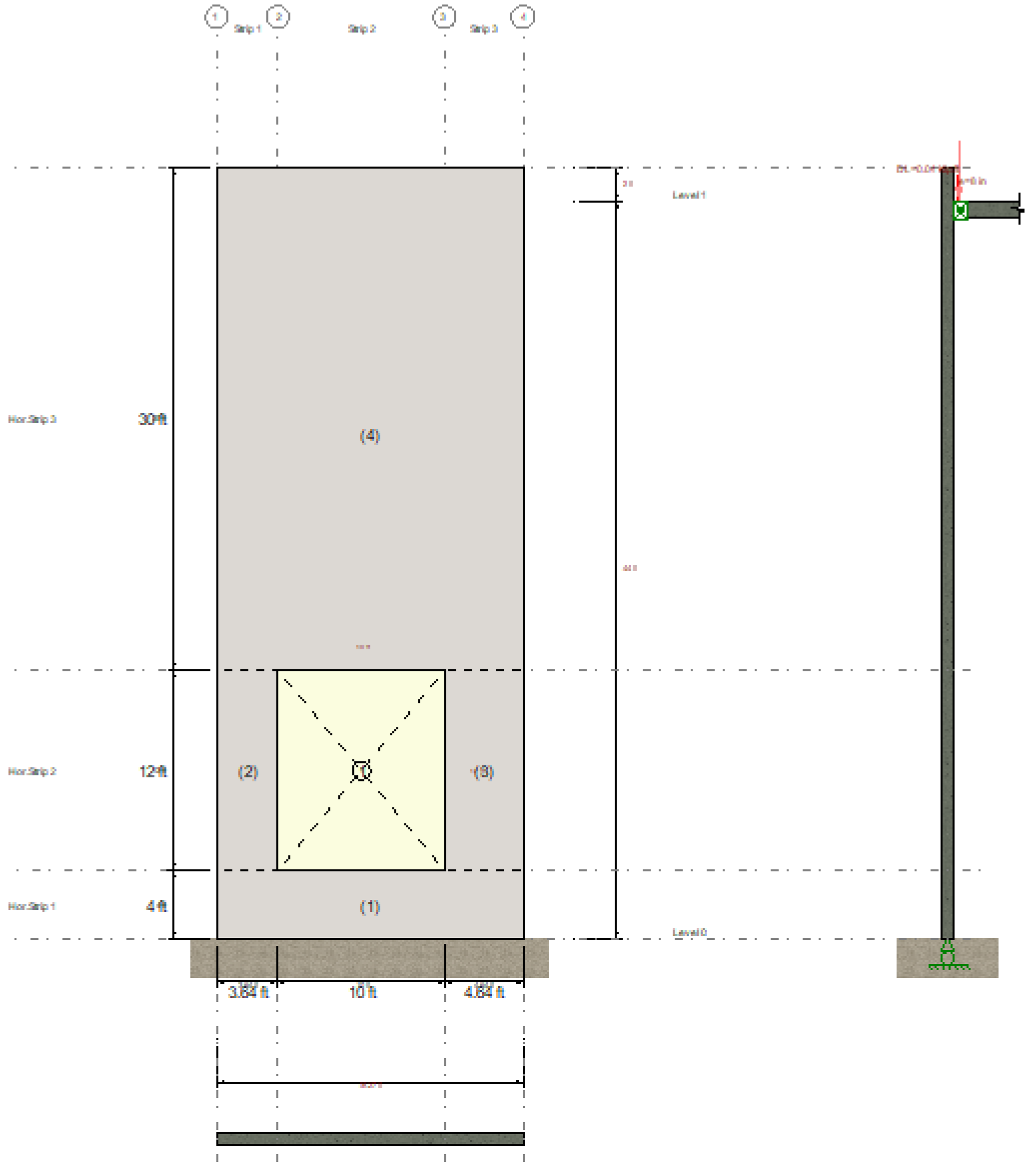
| Segment | Condition | Vu [Kip] | ϕ*Vn [Kip] | Vu/ϕ*Vn |
|---|---|---|---|---|
| 1 | D9 (Bottom) | 7.514 | 33.193 | 0.23 |
| 2 | D8 (Top) | 0.920 | 93.579 | 0.01 |
| 3 | D9 (Bottom) | 8.441 | 42.674 | 0.20 |
| 4 | D9 (Bottom) | 5.450 | 33.193 | 0.16 |
| 5 | D9 (Bottom) | 6.358 | 42.674 | 0.15 |
| 6 | D15 (Top) | 5.287 | 33.193 | 0.16 |
| 7 | D15 (Top) | 6.512 | 93.579 | 0.07 |
| 8 | D15 (Top) | 6.327 | 42.674 | 0.15 |
| 9 | D1 (Top) | 0.000 | 33.193 | 0.00 |
| 10 | D1 (Top) | 0.000 | 93.579 | 0.00 |
| 11 | D1 (Top) | 0.000 | 42.674 | 0.00 |

**Deflection**

| Segment | Condition | Δ [in] | Δmax [in] | Δ/Δmax |
|---|---|---|---|---|
| 1 | S9 (Top) | -0.636 | 3.520 | 0.18 |
| 2 | S9 (Max) | -0.007 | 3.520 | 0.00 |
| 3 | S9 (Top) | -0.557 | 3.520 | 0.16 |
| 4 | S9 (Top) | -3.211 | 3.520 | 0.91 |
| 5 | S9 (Top) | -3.140 | 3.520 | 0.89 |
| 6 | S9 (Bottom) | -2.981 | 3.520 | 0.85 |
| 7 | S9 (Max) | -0.363 | 3.520 | 0.10 |
| 8 | S9 (Bottom) | -2.994 | 3.520 | 0.85 |
| 9 | S1 (Top) | 0.000 | 0.160 | 0.00 |
| 10 | S1 (Top) | 0.000 | 0.160 | 0.00 |
| 11 | S1 (Top) | 0.000 | 0.160 | 0.00 |

**SHEAR WALL DESIGN:**

**Status** : OK




**Geometry:**

| Segment | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] | Classification |
|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 18.27 | 4.00 | Shear wall |
| 2 | 0.00 | 4.00 | 3.64 | 12.00 | Pier |
| 3 | 13.64 | 4.00 | 4.64 | 12.00 | Shear wall |
| 4 | 0.00 | 16.00 | 18.27 | 28.00 | Shear wall |

**Reinforcement:**

Reinforcement layers : 2

| Segment | Vertical reinforcement Bars | Spacing [in] | Ld [in] | Horizontal reinforcement Bars | Spacing [in] | Ld [in] |
|---|---|---|---|---|---|---|
| 1 | 14-#7 | 3.00 | 39.13 | 3-#4 | 18.00 | 23.26 |
| | 10-#4 | 12.00 | 39.13 | 3-#4 | 18.00 | 23.26 |
| | 18-#6 | 3.00 | 39.13 | 3-#4 | 18.00 | 23.26 |
| 2 | 14-#7 | 3.00 | 39.13 | 9-#4 | 16.00 | 23.26 |
| 3 | 18-#6 | 3.00 | 26.83 | 9-#4 | 16.00 | 23.26 |
| 4 | 14-#7 | 3.00 | 39.13 | 19-#4 | 18.00 | 23.26 |
| | 10-#4 | 12.00 | 39.13 | 19-#4 | 18.00 | 23.26 |
| | 18-#6 | 3.00 | 39.13 | 19-#4 | 18.00 | 23.26 |

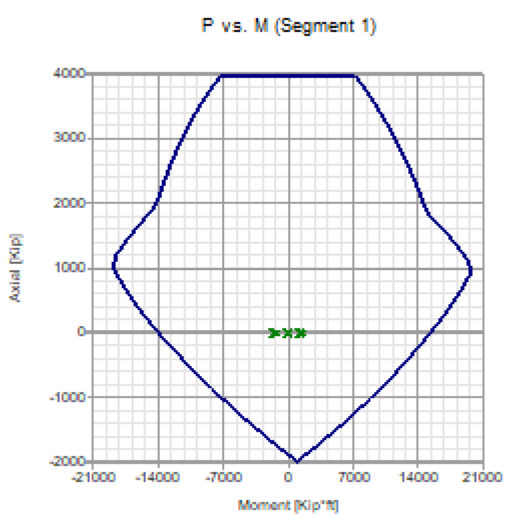
**Intermediate results for axial-bending**

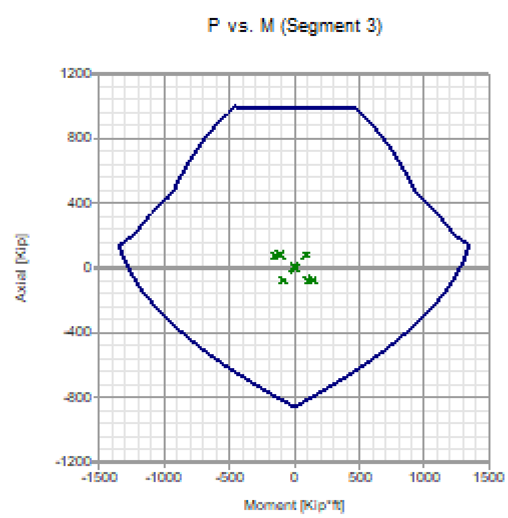
| Segment | Condition | c [in] | d [in] |
|---|---|---|---|
| 1 | D7 (Bottom) | 42.42 | 175.39 |
| 2 | D7 (Bottom) | 15.85 | 34.90 |
| 3 | D13 (Bottom) | 17.16 | 44.50 |
| 4 | D7 (Bottom) | 42.42 | 175.39 |

**Combined axial flexure**

| Segment | Condition | Pu [Kip] | Mu [Kip*ft] | ϕ*Mn [Kip*ft] | Mu/ϕ*Mn |
|---|---|---|---|---|---|
| 1 | D7 (Bottom) | 0.66 | -1454.75 | 13910.39 | 0.10 |
| 2 | D7 (Bottom) | -76.73 | -89.02 | 896.27 | 0.10 |
| 3 | D13 (Bottom) | -76.70 | 144.36 | 1217.85 | 0.12 |
| 4 | D7 (Bottom) | 0.66 | -925.65 | 13910.39 | 0.07 |

**Interaction diagrams, P vs. M:**




**Axial compression**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D3 (Bottom) | 3.51 | 3960.76 | 0.00 |
| 2 | D12 (Top) | 77.62 | 769.12 | 0.10 |
| 3 | D6 (Bottom) | 77.68 | 991.80 | 0.08 |
| 4 | D3 (Bottom) | 3.51 | 3960.76 | 0.00 |

**Axial tension**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D1 (Top) | 0.00 | 1978.56 | 0.00 |
| 2 | D7 (Top) | 76.73 | 907.20 | 0.08 |
| 3 | D13 (Bottom) | 76.70 | 855.36 | 0.09 |
| 4 | D1 (Top) | 0.00 | 1978.56 | 0.00 |

**Shear**

| Segment | Condition | Vu [Kip] | ϕ*Vn [Kip] | Vu/ϕ*Vn |
|---|---|---|---|---|
| 1 | D13 (Bottom) | 33.069 | 277.887 | 0.12 |
| 2 | D7 (Bottom) | 13.691 | 57.609 | 0.24 |
| 3 | D13 (Bottom) | 19.346 | 77.511 | 0.25 |
| 4 | D13 (Bottom) | 33.069 | 323.299 | 0.10 |

**STABILITY RESULTS:**

**Status : Warnings in design**
**- The overturning safety factor is smaller than the allowable value**

**Global stability:**

Safety factor : 1.5

| Condition | Position | RM [Kip*ft] | OTM [Kip*ft] | FS |
|---|---|---|---|---|
| S1 | Left corner | -6.68 | 0.00 | -- |
| S8 | Right corner | 4.01 | -1018.52 | 0.00 |

**Notes:**

* Pu = Axial load
* Pn = Nominal axial load
* Mua = Moment at section
* Mu = Magnified moment at section
* Mcr = Cracking moment at section
* Mn = Maximum nominal moment
* Vu = Design shear force
* Vn = Nominal shear force

## ARW Engineers

**Current Date:** 5/7/2018 4:00 PM
**Units system:** English
**File name:** Y:\Projects 2018\18054 - Kimberly Clark 20000SF Addition\Engineering\Calculations\RAM\tilt-ups\18054_Type H.tup\

# Design Results

## Tilt-Up Wall

**GENERAL INFORMATION:**

**Global status : Warnings in design**

| | | |
|---|---|---|
| Design code | : | ACI 318-14 |

**Geometry:**

| | | |
|---|---|---|
| Total height | : | 46.00 [ft] |
| Total length | : | 19.27 [ft] |
| Base support type | : | Continuous |
| Wall bottom restraint | : | Pinned |

**Materials:**

| | | |
|---|---|---|
| Material | : | RC4.5x60 |
| Steel tension strength (Fy) | : | 60 [Kip/in2] |
| Concrete compressive strength (fc) | : | 4.5 [Kip/in2] |
| Steel elasticity modulus (Es) | : | 29000 [Kip/in2] |
| Concrete modulus of elasticity (E) | : | 3823.68 [Kip/in2] |
| Concrete unit weight | : | 0.149818 [Kip/ft3] |

**Number of stories: 1**

| Story | Story height [ft] | Wall thickness [in] |
|---|---|---|
| 1 | 44.00 | 9.25 |

**Openings:**

| Reference | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] |
|---|---|---|---|---|
| Lower left | 2.63 | 4.00 | 14.00 | 14.00 |

**Load conditions:**

| ID | Comb. | Category | Description |
|---|---|---|---|
| DL | No | DL | Dead Load |
| SL | No | SNOW | Snow |
| EQip | No | EQ | In plane EQ |
| EQoop | No | EQ | OOP EQ |
| S1 | Yes | | DL |
| S2 | Yes | | DL+SL |
| S3 | Yes | | DL+0.75SL |
| S4 | Yes | | DL+0.7EQip |
| S5 | Yes | | DL+0.525EQip |
| S6 | Yes | | DL+0.75SL |
| S7 | Yes | | DL+0.75SL+0.525EQip |
| S8 | Yes | | 0.6DL+0.7EQip |
| S9 | Yes | | DL+0.7EQoop |
| S10 | Yes | | DL+0.525EQoop |

| | | |
|---|---|---|
| S11 | Yes | DL+0.75SL+0.525EQoop |
| S12 | Yes | 0.6DL+0.7EQoop |
| D1 | Yes | 1.4DL |
| D2 | Yes | 1.2DL+0.5SL |
| D3 | Yes | 1.2DL+1.6SL |
| D4 | Yes | 1.2DL+0.2SL |
| D5 | Yes | 1.2DL+EQip |
| D6 | Yes | 1.2DL+0.2SL+EQip |
| D7 | Yes | 0.9DL+EQip |
| D8 | Yes | 1.2DL+EQoop |
| D9 | Yes | 1.2DL+0.2SL+EQoop |
| D10 | Yes | 0.9DL+EQoop |
| D11 | Yes | 1.2DL-EQip |
| D12 | Yes | 1.2DL+0.2SL-EQip |
| D13 | Yes | 0.9DL-EQip |
| D14 | Yes | 1.2DL-EQoop |
| D15 | Yes | 1.2DL+0.2SL-EQoop |
| D16 | Yes | 0.9DL-EQoop |
| S13 | Yes | DL-0.7EQoop |
| S14 | Yes | DL-0.525EQoop |
| S15 | Yes | DL+0.75SL-0.525EQoop |
| S16 | Yes | 0.6DL-0.7EQoop |

**Consider Self Weight:**

Load condition : No

**Distributed loads:**

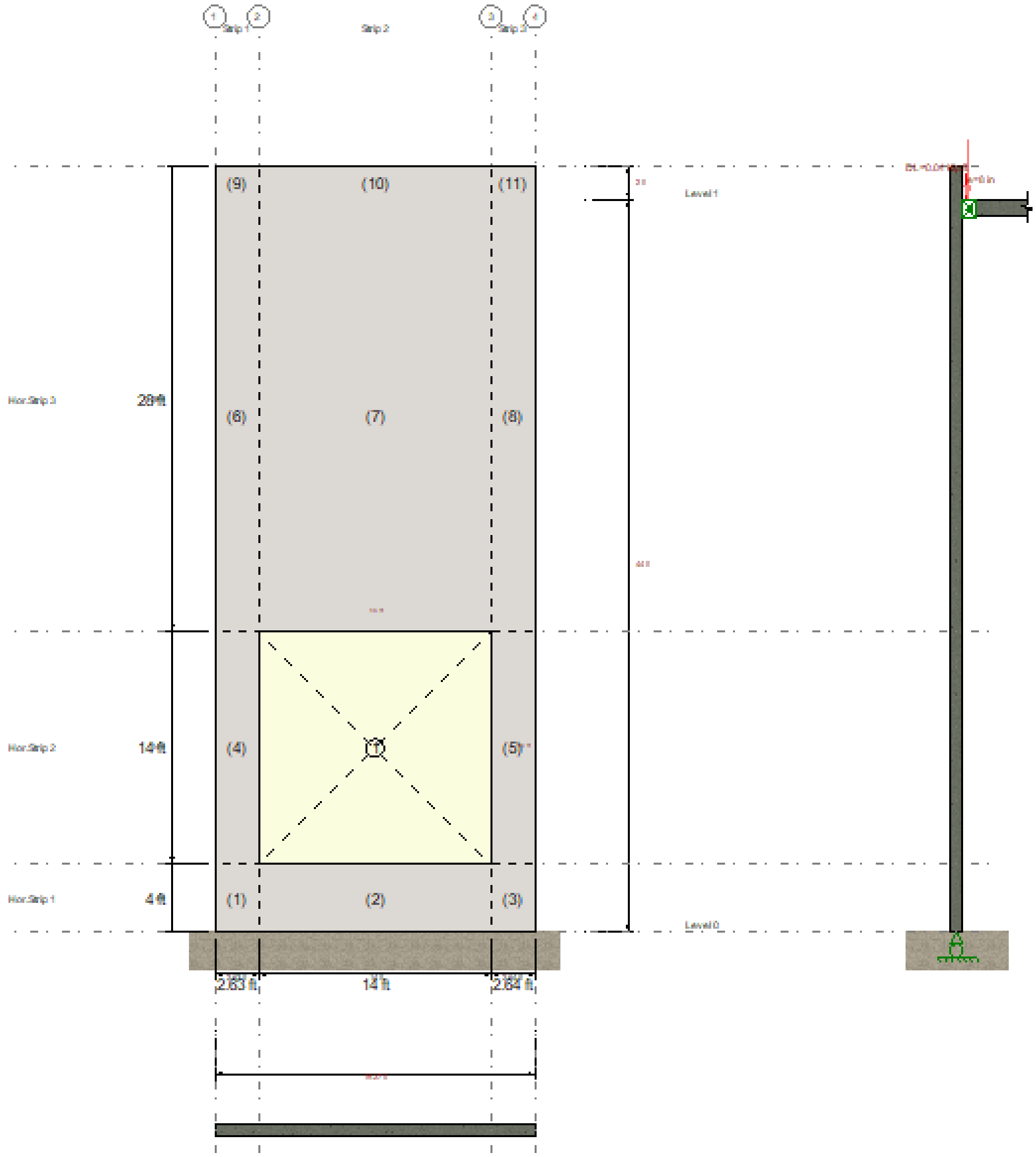
| Story | Condition | Direction | Magnitude [Kip/ft] | Eccentricity [ft] |
|---|---|---|---|---|
| 1 | DL | Vertical | 0.04 | 0.67 |
| 1 | SL | Vertical | 0.09 | 0.67 |
| 1 | EQip | Horizontal | 0.55 | 0.00 |

**Out-of-plane seismic weight:**

| Load condition | Coefficient |
|---|---|
| EQoop | 0.40 |

**TILT-UP WALLS DESIGN:**

**Status** : **Warnings in design**
**- The wall must be tension controlled, Section 11.8.1.1b (Segment 1)**




**Geometry:**

| Segment | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 2.63 | 4.00 |
| 2 | 2.63 | 0.00 | 14.00 | 4.00 |
| 3 | 16.63 | 0.00 | 2.64 | 4.00 |
| 4 | 0.00 | 4.00 | 2.63 | 14.00 |
| 5 | 16.63 | 4.00 | 2.64 | 14.00 |
| 6 | 0.00 | 18.00 | 2.63 | 26.00 |
| 7 | 2.63 | 18.00 | 14.00 | 26.00 |
| 8 | 16.63 | 18.00 | 2.64 | 26.00 |
| 9 | 0.00 | 44.00 | 2.63 | 2.00 |
| 10 | 2.63 | 44.00 | 14.00 | 2.00 |
| 11 | 16.63 | 44.00 | 2.64 | 2.00 |

**Vertical reinforcement:**

Reinforcement layers : 2

| Segment | Bars | Spacing [in] | Ld [in] |
|---|---|---|---|
| 1 | 15-#7 | 2.00 | 39.13 |
| 2 | 14-#4 | 12.00 | 17.89 |
| 3 | 15-#7 | 2.00 | 39.13 |
| 4 | 15-#7 | 2.00 | 39.13 |
| 5 | 15-#7 | 2.00 | 39.13 |
| 6 | 15-#7 | 2.00 | 39.13 |
| 7 | 14-#4 | 12.00 | 17.89 |
| 8 | 15-#7 | 2.00 | 39.13 |
| 9 | 15-#7 | 2.00 | 39.13 |
| 10 | 14-#4 | 12.00 | 17.89 |
| 11 | 15-#7 | 2.00 | 39.13 |

**Vertical reinforcement**

| Segment | Condition | Pu [Kip] | Pu/Ag [Kip/in2] | 0.06*f´c [Kip/in2] | Ratio |
|---|---|---|---|---|---|
| 1 | D12 (Max) | 24.899 | 0.085 | 0.270 | 0.32 |
| 2 | D3 (Max) | 0.259 | 0.000 | 0.270 | 0.00 |
| 3 | D6 (Max) | 24.899 | 0.085 | 0.270 | 0.32 |
| 4 | D12 (Max) | 21.377 | 0.073 | 0.270 | 0.27 |
| 5 | D6 (Max) | 21.377 | 0.073 | 0.270 | 0.27 |
| 6 | D12 (Max) | 6.799 | 0.023 | 0.270 | 0.09 |
| 7 | D3 (Max) | 1.769 | 0.001 | 0.270 | 0.00 |
| 8 | D6 (Max) | 6.799 | 0.023 | 0.270 | 0.09 |
| 9 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |
| 10 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |
| 11 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |

**Intermediate results for axial-bending**

| Segment | Condition | Ase [in2] | a [in] | c [in] | d [in] | $\phi$ | Kb [Kip] |
|---|---|---|---|---|---|---|---|
| 1 | D9 (Top) | 9.01 | 4.13 | 4.85 | 7.56 | 0.65 | 240.20 |
| 2 | D16 (Max) | 2.80 | 0.26 | 0.31 | 7.75 | 0.90 | 1458.94 |
| 3 | D9 (Top) | 9.01 | 4.13 | 4.85 | 7.56 | 0.65 | 240.20 |
| 4 | D9 (Top) | 9.01 | 4.13 | 4.85 | 7.56 | 0.65 | 225.20 |
| 5 | D9 (Top) | 9.01 | 4.13 | 4.85 | 7.56 | 0.65 | 225.20 |
| 6 | D9 (Bottom) | 9.01 | 4.12 | 4.85 | 7.56 | 0.65 | 225.10 |
| 7 | D9 (Max) | 2.81 | 0.26 | 0.31 | 7.75 | 0.90 | 1458.94 |
| 8 | D9 (Bottom) | 9.01 | 4.12 | 4.85 | 7.56 | 0.65 | 225.10 |
| 9 | D1 (Top) | 9.00 | 4.12 | 4.85 | 7.56 | 0.65 | 132903.40 |
| 10 | D1 (Top) | 2.80 | 0.26 | 0.31 | 7.75 | 0.90 | 706128.10 |
| 11 | D1 (Top) | 9.00 | 4.12 | 4.85 | 7.56 | 0.65 | 132903.40 |

**Inertias**

| Segment | Condition | Ig [in4] | Icr [in4] | Ie [in4] |
|---|---|---|---|---|
| 1 | D9 (Top) | 2085.48 | 1706.43 | 1824.26 |
| 2 | D16 (Max) | 11080.34 | 1178.20 | 11080.34 |
| 3 | D9 (Top) | 2085.48 | 1706.43 | 1824.26 |
| 4 | D9 (Top) | 2085.48 | 1706.54 | 1710.36 |
| 5 | D9 (Top) | 2085.48 | 1706.54 | 1710.36 |
| 6 | D9 (Bottom) | 2085.48 | 1705.79 | 1709.62 |

| | | | | |
|---|---|---|---|---|
| 7 | D9 (Max) | 11080.34 | 1181.81 | 11080.34 |
| 8 | D9 (Bottom) | 2085.48 | 1705.79 | 1709.62 |
| 9 | D1 (Top) | 2085.48 | 1704.97 | 2085.48 |
| 10 | D1 (Top) | 11080.34 | 1177.89 | 11080.34 |
| 11 | D1 (Top) | 2085.48 | 1704.97 | 2085.48 |

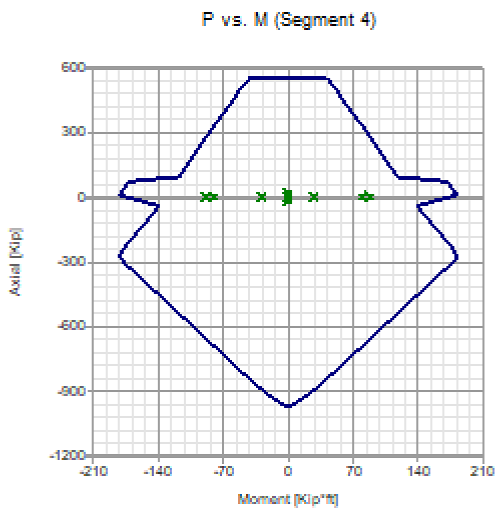
**Combined axial flexure**

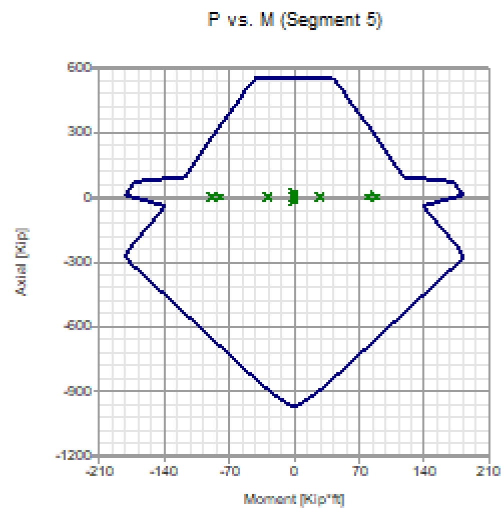
| Segment | Condition | Pu [Kip] | Mua [Kip*ft] | Mu [Kip*ft] | ϕ*Mn [Kip*ft] | Mu/ϕ*Mn |
|---|---|---|---|---|---|---|
| 1 | D9 (Top) | 0.59 | -27.91 | -28.00 | 174.25 | 0.16 |
| 2 | D16 (Max) | 0.05 | 1.29 | 1.29 | 109.65 | 0.01 |
| 3 | D9 (Top) | 0.59 | -27.91 | -28.00 | 174.25 | 0.16 |
| 4 | D9 (Top) | 0.64 | -87.46 | -87.79 | 174.29 | 0.50 |
| 5 | D9 (Top) | 0.64 | -87.46 | -87.79 | 174.29 | 0.50 |
| 6 | D9 (Bottom) | 0.33 | -87.48 | -87.65 | 174.03 | 0.50 |
| 7 | D9 (Max) | 0.61 | -54.31 | -54.34 | 109.84 | 0.49 |
| 8 | D9 (Bottom) | 0.33 | -87.48 | -87.65 | 174.03 | 0.50 |
| 9 | D1 (Top) | 0.00 | 0.00 | 0.00 | 173.75 | 0.00 |
| 10 | D1 (Top) | 0.00 | 0.00 | 0.00 | 109.63 | 0.00 |
| 11 | D1 (Top) | 0.00 | 0.00 | 0.00 | 173.75 | 0.00 |

**Cracking moment**

| Segment | Condition | Pu [Kip] | Mua [Kip*ft] | Mcr [Kip*ft] | ϕ*Mn [Kip*ft] | Mcr/ϕ*Mn |
|---|---|---|---|---|---|---|
| 1 | D7 (Bottom) | -23.99 | 0.00 | 18.91 | 153.40 | 0.12 |
| 2 | D16 (Bottom) | 0.05 | 0.01 | 100.44 | 109.65 | 0.92 |
| 3 | D13 (Bottom) | -23.99 | 0.00 | 18.91 | 153.40 | 0.12 |
| 4 | D7 (Bottom) | -20.39 | -0.02 | 18.91 | 156.45 | 0.12 |
| 5 | D13 (Bottom) | -20.39 | -0.02 | 18.91 | 156.45 | 0.12 |
| 6 | D7 (Bottom) | -6.29 | -0.09 | 18.91 | 168.41 | 0.11 |
| 7 | D7 (Top) | 0.33 | -0.34 | 100.44 | 109.75 | 0.92 |
| 8 | D13 (Bottom) | -6.29 | -0.09 | 18.91 | 168.41 | 0.11 |
| 9 | D16 (Bottom) | 0.00 | 0.00 | 18.91 | 173.75 | 0.11 |
| 10 | D16 (Bottom) | 0.00 | 0.00 | 100.44 | 109.63 | 0.92 |
| 11 | D16 (Bottom) | 0.00 | 0.00 | 18.91 | 173.75 | 0.11 |

**Interaction diagrams, P vs. M:**




**Axial compression**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D12 (Top) | 24.90 | 545.95 | 0.05 |
| 2 | D3 (Bottom) | 0.26 | 3079.77 | 0.00 |
| 3 | D6 (Top) | 24.90 | 545.95 | 0.05 |
| 4 | D12 (Bottom) | 21.38 | 545.95 | 0.04 |
| 5 | D6 (Bottom) | 21.38 | 545.95 | 0.04 |
| 6 | D12 (Top) | 6.80 | 545.95 | 0.01 |
| 7 | D3 (Top) | 1.77 | 3079.77 | 0.00 |
| 8 | D6 (Top) | 6.80 | 545.95 | 0.01 |
| 9 | D1 (Top) | 0.00 | 545.95 | 0.00 |
| 10 | D1 (Top) | 0.00 | 3079.77 | 0.00 |
| 11 | D1 (Top) | 0.00 | 545.95 | 0.00 |

**Axial tension**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D7 (Bottom) | 23.99 | 972.00 | 0.02 |
| 2 | D1 (Top) | 0.00 | 302.40 | 0.00 |
| 3 | D13 (Bottom) | 23.99 | 972.00 | 0.02 |
| 4 | D7 (Bottom) | 20.39 | 972.00 | 0.02 |
| 5 | D13 (Bottom) | 20.39 | 972.00 | 0.02 |
| 6 | D7 (Top) | 6.29 | 972.00 | 0.01 |
| 7 | D1 (Top) | 0.00 | 302.40 | 0.00 |
| 8 | D13 (Top) | 6.29 | 972.00 | 0.01 |
| 9 | D1 (Top) | 0.00 | 972.00 | 0.00 |
| 10 | D1 (Top) | 0.00 | 302.40 | 0.00 |
| 11 | D1 (Top) | 0.00 | 972.00 | 0.00 |

**Shear**

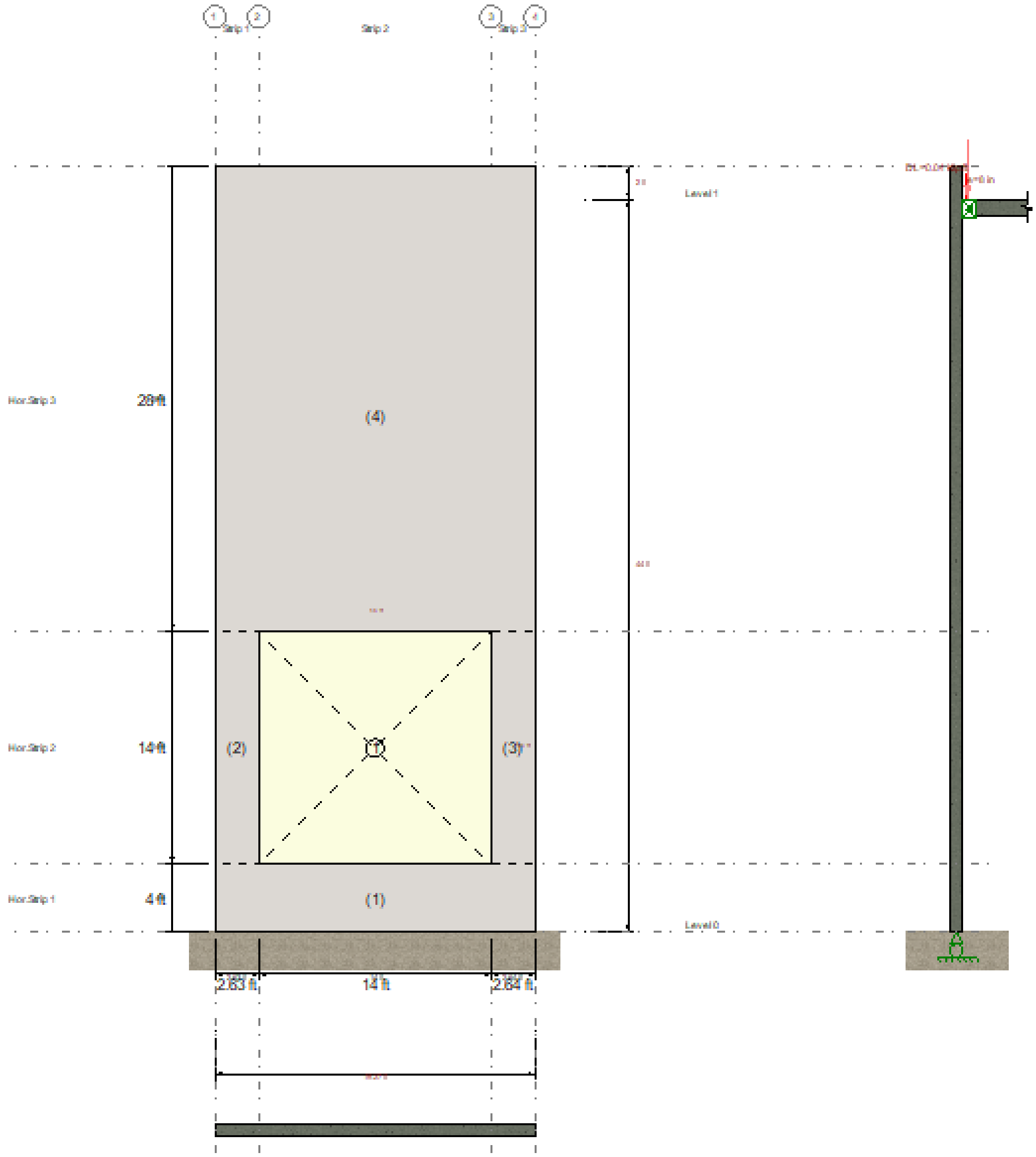
| Segment | Condition | Vu [Kip] | ϕ*Vn [Kip] | Vu/ϕ*Vn |
|---|---|---|---|---|
| 1 | D9 (Bottom) | 7.233 | 24.062 | 0.30 |
| 2 | D8 (Top) | 1.288 | 131.011 | 0.01 |
| 3 | D9 (Bottom) | 7.233 | 24.062 | 0.30 |
| 4 | D9 (Bottom) | 5.103 | 24.062 | 0.21 |
| 5 | D9 (Bottom) | 5.103 | 24.062 | 0.21 |
| 6 | D9 (Top) | 4.951 | 24.062 | 0.21 |
| 7 | D15 (Top) | 8.475 | 131.011 | 0.06 |
| 8 | D9 (Top) | 4.951 | 24.062 | 0.21 |
| 9 | D1 (Top) | 0.000 | 24.062 | 0.00 |
| 10 | D1 (Top) | 0.000 | 131.011 | 0.00 |
| 11 | D1 (Top) | 0.000 | 24.062 | 0.00 |

**Deflection**

| Segment | Condition | Δ [in] | Δmax [in] | Δ/Δmax |
|---|---|---|---|---|
| 1 | S9 (Top) | -0.872 | 3.520 | 0.25 |
| 2 | S9 (Max) | -0.007 | 3.520 | 0.00 |
| 3 | S9 (Top) | -0.872 | 3.520 | 0.25 |
| 4 | S9 (Top) | -3.351 | 3.520 | 0.95 |
| 5 | S9 (Top) | -3.351 | 3.520 | 0.95 |
| 6 | S9 (Bottom) | -3.283 | 3.520 | 0.93 |
| 7 | S9 (Max) | -0.313 | 3.520 | 0.09 |
| 8 | S9 (Bottom) | -3.283 | 3.520 | 0.93 |
| 9 | S1 (Top) | 0.000 | 0.160 | 0.00 |
| 10 | S1 (Top) | 0.000 | 0.160 | 0.00 |
| 11 | S1 (Top) | 0.000 | 0.160 | 0.00 |

**SHEAR WALL DESIGN:**

**Status** : OK




**Geometry:**

| Segment | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] | Classification |
|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 19.27 | 4.00 | Shear wall |
| 2 | 0.00 | 4.00 | 2.63 | 14.00 | Pier |
| 3 | 16.63 | 4.00 | 2.64 | 14.00 | Pier |
| 4 | 0.00 | 18.00 | 19.27 | 26.00 | Shear wall |

**Reinforcement:**

Reinforcement layers : 2

| Segment | Vertical reinforcement Bars | Spacing [in] | Ld [in] | Horizontal reinforcement Bars | Spacing [in] | Ld [in] |
|---|---|---|---|---|---|---|
| 1 | 15-#7 | 2.00 | 39.13 | 3-#4 | 18.00 | 23.26 |
| | 14-#4 | 12.00 | 39.13 | 3-#4 | 18.00 | 23.26 |
| | 15-#7 | 2.00 | 39.13 | 3-#4 | 18.00 | 23.26 |
| 2 | 15-#7 | 2.00 | 39.13 | 10-#4 | 18.00 | 23.26 |
| 3 | 15-#7 | 2.00 | 39.13 | 10-#4 | 18.00 | 23.26 |
| 4 | 15-#7 | 2.00 | 39.13 | 18-#4 | 18.00 | 23.26 |
| | 14-#4 | 12.00 | 39.13 | 18-#4 | 18.00 | 23.26 |
| | 15-#7 | 2.00 | 39.13 | 18-#4 | 18.00 | 23.26 |

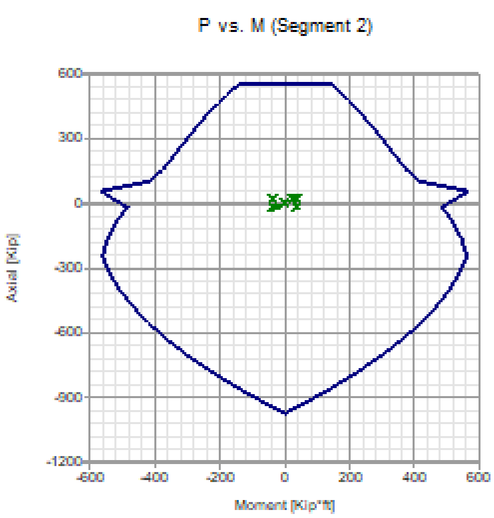
**Intermediate results for axial-bending**

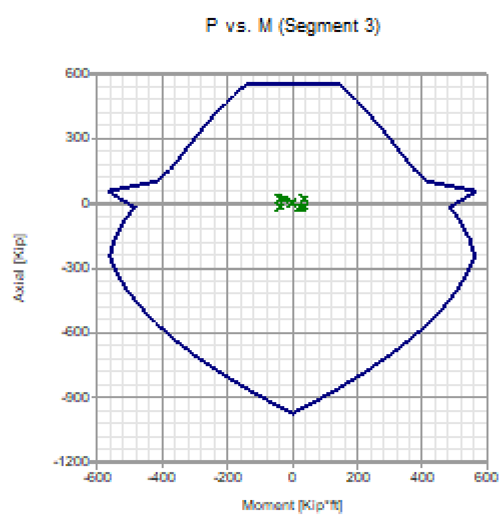
| Segment | Condition | c [in] | d [in] |
|---|---|---|---|
| 1 | D7 (Bottom) | 49.85 | 184.99 |
| 2 | D7 (Bottom) | 14.55 | 25.30 |
| 3 | D13 (Bottom) | 14.55 | 25.30 |
| 4 | D13 (Bottom) | 49.85 | 184.99 |

**Combined axial flexure**

| Segment | Condition | Pu [Kip] | Mu [Kip*ft] | ϕ*Mn [Kip*ft] | Mu/ϕ*Mn |
|---|---|---|---|---|---|
| 1 | D7 (Bottom) | 0.69 | -462.01 | 18064.77 | 0.03 |
| 2 | D7 (Bottom) | -20.39 | -37.44 | 484.76 | 0.08 |
| 3 | D13 (Bottom) | -20.39 | 37.44 | 484.76 | 0.08 |
| 4 | D13 (Bottom) | 0.69 | 272.97 | 18064.77 | 0.02 |

**Interaction diagrams, P vs. M:**




**Axial compression**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D3 (Top) | 3.70 | 4171.67 | 0.00 |
| 2 | D12 (Bottom) | 21.38 | 545.95 | 0.04 |
| 3 | D6 (Bottom) | 21.38 | 545.95 | 0.04 |
| 4 | D3 (Top) | 3.70 | 4171.67 | 0.00 |

**Axial tension**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D1 (Top) | 0.00 | 2246.40 | 0.00 |
| 2 | D7 (Bottom) | 20.39 | 972.00 | 0.02 |
| 3 | D13 (Bottom) | 20.39 | 972.00 | 0.02 |
| 4 | D1 (Top) | 0.00 | 2246.40 | 0.00 |

**Shear**

| Segment | Condition | Vu [Kip] | ϕ*Vn [Kip] | Vu/ϕ*Vn |
|---|---|---|---|---|
| 1 | D7 (Bottom) | 10.502 | 297.053 | 0.04 |
| 2 | D7 (Bottom) | 5.237 | 37.903 | 0.14 |
| 3 | D13 (Bottom) | 5.237 | 37.903 | 0.14 |
| 4 | D7 (Bottom) | 10.502 | 363.528 | 0.03 |

**STABILITY RESULTS:**

**Status : Warnings in design**
**- The overturning safety factor is smaller than the allowable value**

**Global stability:**

Safety factor : 1.5

| Condition | Position | RM [Kip*ft] | OTM [Kip*ft] | FS |
|---|---|---|---|---|
| S1 | Left corner | -7.43 | 0.00 | -- |
| S8 | Right corner | 4.46 | -323.47 | 0.01 |

**Notes:**

* Pu = Axial load
* Pn = Nominal axial load
* Mua = Moment at section
* Mu = Magnified moment at section
* Mcr = Cracking moment at section
* Mn = Maximum nominal moment
* Vu = Design shear force
* Vn = Nominal shear force

# ARW Engineers

**Current Date:** 5/7/2018 4:08 PM
**Units system:** English
**File name:** Y:\Projects 2018\18054 - Kimberly Clark 20000SF Addition\Engineering\Calculations\RAM\tilt-ups\18054_South wall.tup\

# Design Results

## Tilt-Up Wall

---

### GENERAL INFORMATION:

**Global status : Warnings in design**

| | | |
|---|---|---|
| Design code | : | ACI 318-14 |

**Geometry:**

| | | |
|---|---|---|
| Total height | : | 45.00 [ft] |
| Total length | : | 19.27 [ft] |
| Base support type | : | Continuous |
| Wall bottom restraint | : | Pinned |

**Materials:**

| | | |
|---|---|---|
| Material | : | RC4.5x60 |
| Steel tension strength (Fy) | : | 60 [Kip/in2] |
| Concrete compressive strength (fc) | : | 4.5 [Kip/in2] |
| Steel elasticity modulus (Es) | : | 29000 [Kip/in2] |
| Concrete modulus of elasticity (E) | : | 3823.68 [Kip/in2] |
| Concrete unit weight | : | 0.149818 [Kip/ft3] |

**Number of stories: 1**

| Story | Story height [ft] | Wall thickness [in] |
|---|---|---|
| 1 | 43.00 | 9.25 |

**Load conditions:**

| ID | Comb. | Category | Description |
|---|---|---|---|
| DL | No | DL | Dead Load |
| SL | No | SNOW | Snow |
| EQip | No | EQ | In plane EQ |
| EQoop | No | EQ | OOP EQ |
| S1 | Yes | | DL |
| S2 | Yes | | DL+SL |
| S3 | Yes | | DL+0.75SL |
| S4 | Yes | | DL+0.7EQip |
| S5 | Yes | | DL+0.525EQip |
| S6 | Yes | | DL+0.75SL |
| S7 | Yes | | DL+0.75SL+0.525EQip |
| S8 | Yes | | 0.6DL+0.7EQip |
| S9 | Yes | | DL+0.7EQoop |
| S10 | Yes | | DL+0.525EQoop |
| S11 | Yes | | DL+0.75SL+0.525EQoop |
| S12 | Yes | | 0.6DL+0.7EQoop |
| D1 | Yes | | 1.4DL |
| D2 | Yes | | 1.2DL+0.5SL |
| D3 | Yes | | 1.2DL+1.6SL |
| D4 | Yes | | 1.2DL+0.2SL |
| D5 | Yes | | 1.2DL+EQip |
| D6 | Yes | | 1.2DL+0.2SL+EQip |

| | | |
|---|---|---|
| D7 | Yes | 0.9DL+EQip |
| D8 | Yes | 1.2DL+EQoop |
| D9 | Yes | 1.2DL+0.2SL+EQoop |
| D10 | Yes | 0.9DL+EQoop |
| D11 | Yes | 1.2DL-EQip |
| D12 | Yes | 1.2DL+0.2SL-EQip |
| D13 | Yes | 0.9DL-EQip |
| D14 | Yes | 1.2DL-EQoop |
| D15 | Yes | 1.2DL+0.2SL-EQoop |
| D16 | Yes | 0.9DL-EQoop |
| S13 | Yes | DL-0.7EQoop |
| S14 | Yes | DL-0.525EQoop |
| S15 | Yes | DL+0.75SL-0.525EQoop |
| S16 | Yes | 0.6DL-0.7EQoop |

**Consider Self Weight:**

Load condition : No

**Distributed loads:**

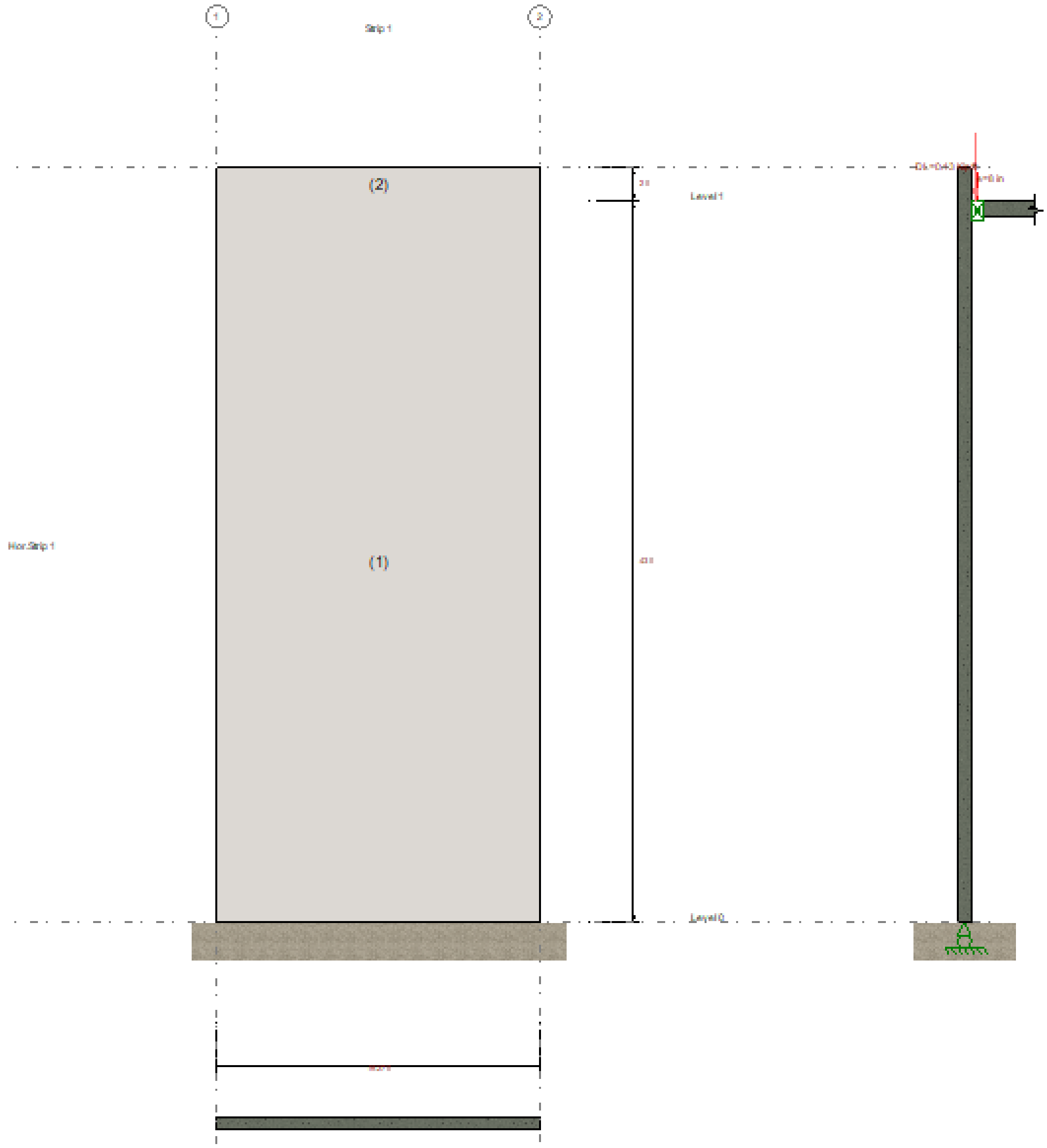
| Story | Condition | Direction | Magnitude [Kip/ft] | Eccentricity [ft] |
|---|---|---|---|---|
| 1 | DL | Vertical | 0.13 | 0.67 |
| 1 | SL | Vertical | 0.30 | 0.67 |
| 1 | EQip | Horizontal | 1.77 | 0.00 |

**Out-of-plane seismic weight:**

| Load condition | Coefficient |
|---|---|
| EQoop | 0.40 |

**TILT-UP WALLS DESIGN:**

**Status** : OK



**Geometry:**

| Segment | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 19.27 | 43.00 |
| 2 | 0.00 | 43.00 | 19.27 | 2.00 |

**Vertical reinforcement:**

Reinforcement layers : 2

| Segment | Bars | Spacing [in] | Ld [in] |
|---|---|---|---|
| 1 | 29-#6 | 8.00 | 26.83 |
| 2 | 29-#6 | 8.00 | 26.83 |

**Vertical reinforcement**

| Segment | Condition | Pu [Kip] | Pu/Ag [Kip/in2] | 0.06*f´c [Kip/in2] | Ratio |
|---|---|---|---|---|---|
| 1 | D3 (Max) | 12.256 | 0.006 | 0.270 | 0.02 |
| 2 | D1 (Top) | 0.000 | 0.000 | 0.270 | 0.00 |

**Intermediate results for axial-bending**

| Segment | Condition | Ase [in2] | a [in] | c [in] | d [in] | $\phi$ | Kb [Kip] |
|---|---|---|---|---|---|---|---|
| 1 | D9 (Max) | 12.83 | 0.87 | 1.02 | 7.50 | 0.90 | 1034.54 |
| 2 | D1 (Top) | 12.76 | 0.87 | 1.02 | 7.50 | 0.90 | 971935.00 |

**Inertias**

| Segment | Condition | Ig [in4] | Icr [in4] | Ie [in4] |
|---|---|---|---|---|
| 1 | D9 (Max) | 15251.30 | 4163.61 | 7504.05 |
| 2 | D1 (Top) | 15251.30 | 4147.15 | 15251.30 |

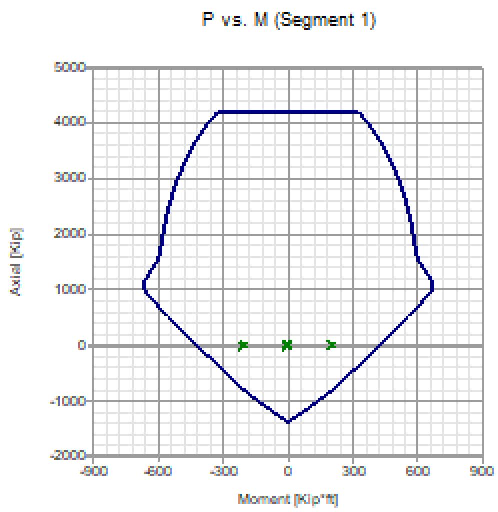
**Combined axial flexure**

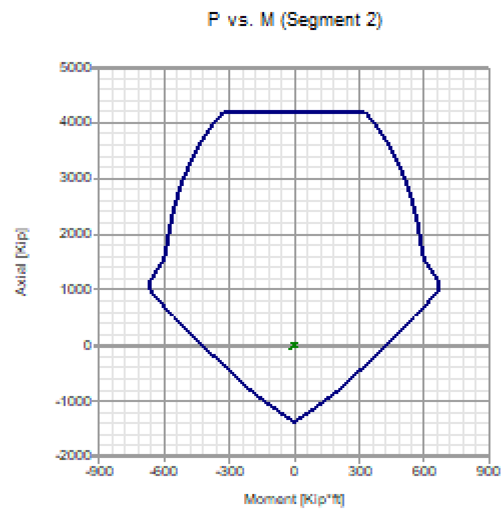
| Segment | Condition | Pu [Kip] | Mua [Kip*ft] | Mu [Kip*ft] | $\phi$*Mn [Kip*ft] | Mu/$\phi$*Mn |
|---|---|---|---|---|---|---|
| 1 | D9 (Max) | 4.16 | -206.23 | -207.35 | 420.52 | 0.49 |
| 2 | D1 (Top) | 0.00 | 0.00 | 0.00 | 419.44 | 0.00 |

**Cracking moment**

| Segment | Condition | Pu [Kip] | Mua [Kip*ft] | Mcr [Kip*ft] | $\phi$*Mn [Kip*ft] | Mcr/$\phi$*Mn |
|---|---|---|---|---|---|---|
| 1 | D16 (Bottom) | 2.25 | 0.16 | 138.26 | 420.02 | 0.33 |
| 2 | D1 (Top) | 0.00 | 0.00 | 138.26 | 419.44 | 0.33 |

**Interaction diagrams, P vs. M:**




**Axial compression**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D3 (Bottom) | 12.26 | 4203.65 | 0.00 |
| 2 | D1 (Top) | 0.00 | 4203.65 | 0.00 |

**Axial tension**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D1 (Top) | 0.00 | 1378.08 | 0.00 |
| 2 | D1 (Top) | 0.00 | 1378.08 | 0.00 |

**Shear**

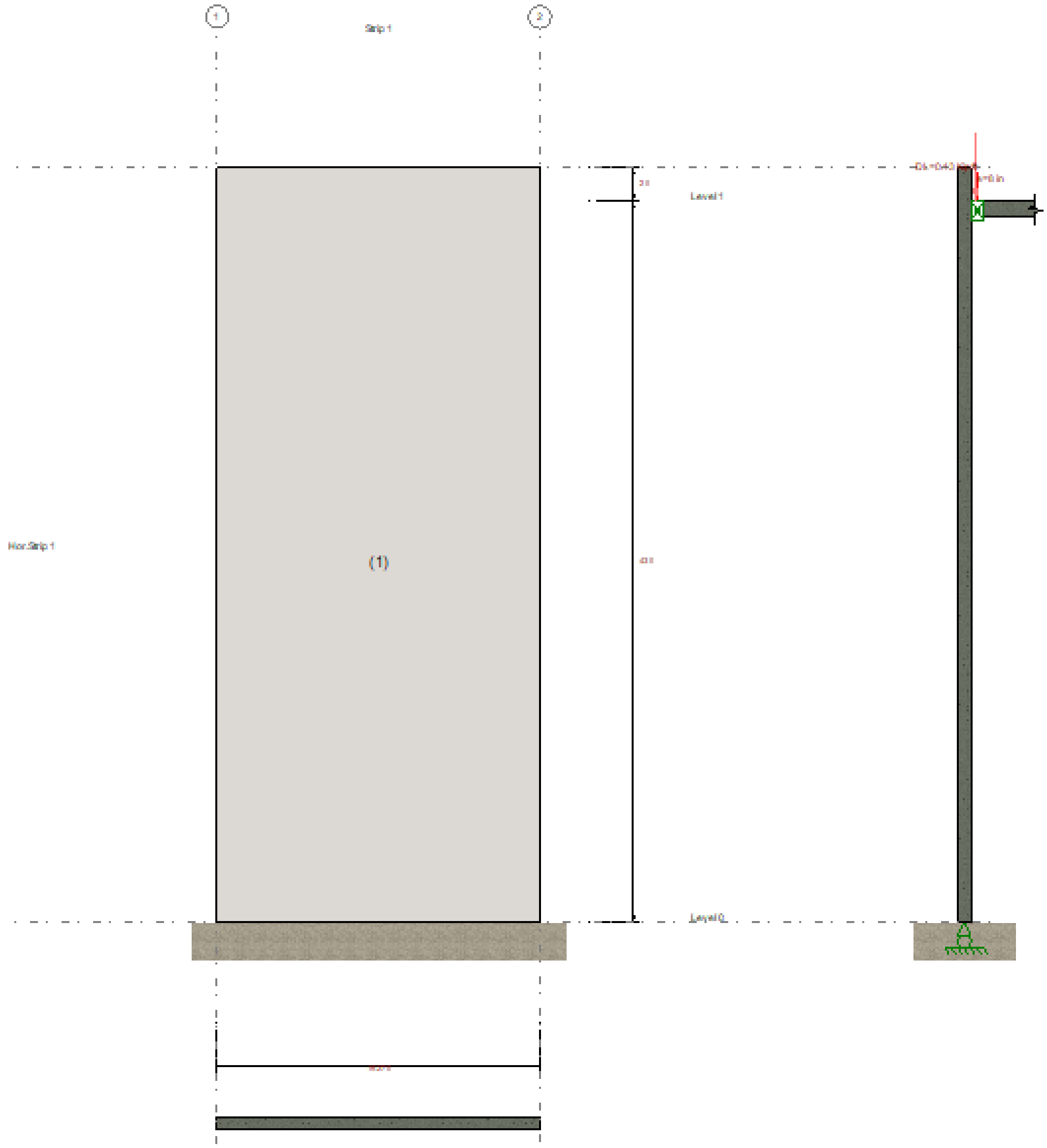
| Segment | Condition | Vu [Kip] | ϕ*Vn [Kip] | Vu/ϕ*Vn |
|---|---|---|---|---|
| 1 | D15 (Top) | 19.237 | 174.511 | 0.11 |
| 2 | D1 (Top) | 0.000 | 174.511 | 0.00 |

**Deflection**

| Segment | Condition | Δ [in] | Δmax [in] | Δ/Δmax |
|---|---|---|---|---|
| 1 | S9 (Max) | -0.905 | 3.440 | 0.26 |
| 2 | S1 (Top) | 0.000 | 0.160 | 0.00 |

**SHEAR WALL DESIGN:**

**Status** : OK




**Geometry:**

| Segment | X Coordinate [ft] | Y Coordinate [ft] | Width [ft] | Height [ft] | Classification |
|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 19.27 | 43.00 | Shear wall |

**Reinforcement:**

Reinforcement layers : 2

| | Vertical reinforcement | | | Horizontal reinforcement | | |
|---|---|---|---|---|---|---|
| Segment | Bars | Spacing [in] | Ld [in] | Bars | Spacing [in] | Ld [in] |
| 1 | 29-#6 | 8.00 | 26.83 | 37-#5 | 14.00 | 29.07 |

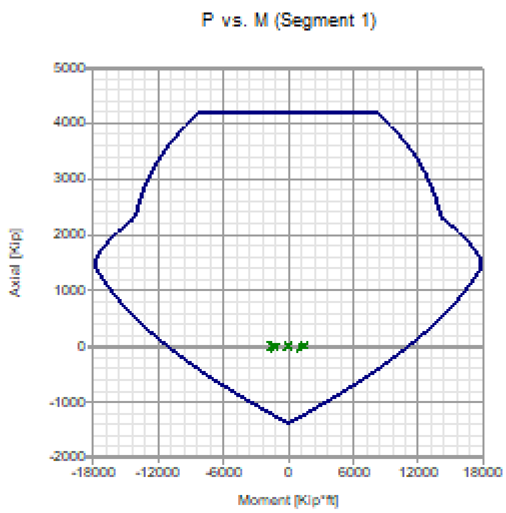
**Intermediate results for axial-bending**

| Segment | Condition | c [in] | d [in] |
|---|---|---|---|
| 1 | D7 (Bottom) | 41.34 | 184.99 |

**Combined axial flexure**

| Segment | Condition | Pu [Kip] | Mu [Kip*ft] | ϕ*Mn [Kip*ft] | Mu/ϕ*Mn |
|---|---|---|---|---|---|
| 1 | D7 (Bottom) | 2.25 | -1466.36 | 11088.96 | 0.13 |

**Interaction diagrams, P vs. M:**




**Axial compression**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D3 (Bottom) | 12.26 | 4203.65 | 0.00 |

**Axial tension**

| Segment | Condition | Pu [Kip] | ϕ*Pn [Kip] | Pu/ϕ*Pn |
|---|---|---|---|---|
| 1 | D1 (Top) | 0.00 | 1378.08 | 0.00 |

**Shear**

| Segment | Condition | Vu [Kip] | ϕ*Vn [Kip] | Vu/ϕ*Vn |
|---|---|---|---|---|
| 1 | D13 (Bottom) | 34.108 | 482.643 | 0.07 |

**STABILITY RESULTS:**

**Status** : **Warnings in design**
**- The overturning safety factor is smaller than the allowable value**

**Global stability:**

Safety factor : 1.5

| **Condition** | **Position** | **RM** [Kip*ft] | **OTM** [Kip*ft] | **FS** |
|---|---|---|---|---|
| S1 | Left corner | -24.14 | 0.00 | -- |
| S8 | Right corner | 14.48 | -1026.65 | 0.01 |

**Notes:**

* Pu = Axial load
* Pn = Nominal axial load
* Mua = Moment at section
* Mu = Magnified moment at section
* Mcr = Cracking moment at section
* Mn = Maximum nominal moment
* Vu = Design shear force
* Vn = Nominal shear force

Tilt Panel Overturning Connection

$V = 2183$ plf (ult) - worst case

height = 44'

$M = 96.05$ k·ft/ft

↓↑ $T = C = 96.05$ k·ft/ft $\left(\frac{\text{Panel length}}{\text{Panel length}}\right) = \underline{\underline{96.1K}}$

Dead load = 40'(9.25")(19'4")(145 pcf) = 86.4 Kips

86.4 K (19'4"/2) = 835.2 k·ft / 19'4" = $\underline{43.2K}$

-0.9 (43.2 K) + 96.1K = $\underline{57.22K}$

Steel (3/4" PL)

57.22 K = (0.9)(0.6)(36 ksi)(3/4" x w) ⇒ $\underline{\underline{4"}}$ of 3/4" PL

Weld

57.22 k = 1.392(4) l => l = $\underline{\underline{10.5"}}$ of 1/4" weld

DBA

114.44 = 0.9(60)(0.44 x n) => $\underline{(5) \#6 \text{ Bars}}$

***RISAConnection version 8.0.0***

*05/07/2018*

## *Global Parameters - Description:*

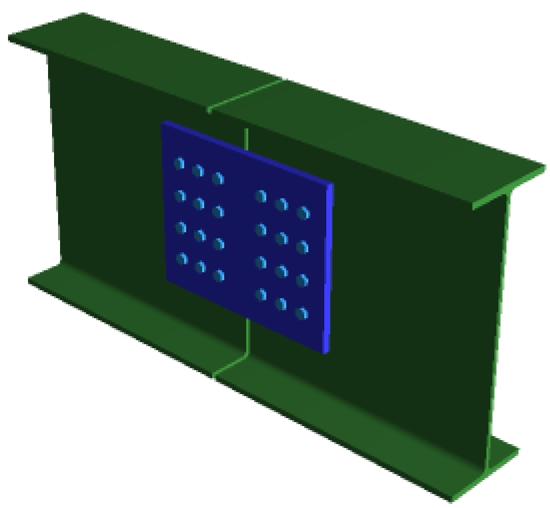
| | |
|---|---|
| **Project Title** | Kimberly Clark Warehouse Addition |
| **Company** | ARW Engineers |
| **Designer** | SJV |
| **Job Number** | 18054 |
| **Notes** | Chord Connection |

## *Global Parameters - Solution:*

| | |
|---|---|
| **Design Method** | AISC 14th (360-10): LRFD |
| **Bolt Group Analysis Method** | Center of Rotation |
| **Weld Analysis Method** | Center of Rotation |
| **Consider Bolt 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 |

# *Connection 1: 3D View*

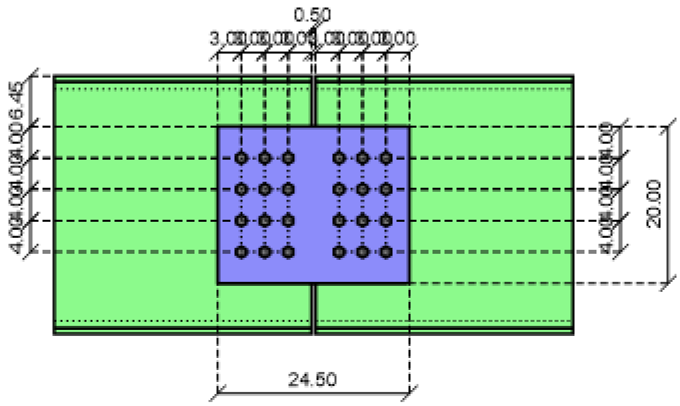
*Beam Shear Tab Splice Connection*



# *Connection 1: 2D Views*

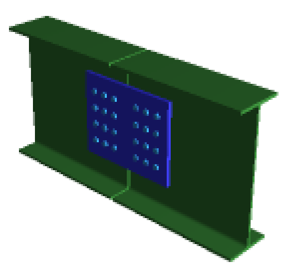
*Beam Shear Tab Splice Connection*

Side view




## *Connection 1: LRFD Results Report*

**LRFD**
*Beam Shear Tab Splice Connection*



Material Properties:

| | | | | |
|---|---|---|---|---|
| **Left Beam** | W33x118 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Right Beam** | W33x118 | A992 | $F_y$ = 50.00 ksi | $F_u$ = 65.00 ksi |
| **Plate** | P1.00x24.50x20.00 | A36 | $F_y$ = 36.00 ksi | $F_u$ = 58.00 ksi |

Input Data:

| | | |
|---|---|---|
| **Shear Load** | 0.00 kips | *User Input Shear Load* |
| **Axial Load** | 276.00 kips | *User Input Axial Force (compression)* |

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

| Limit State | Required | Available | Unity Check | Result |
|---|---|---|---|---|
| **Geometry Restrictions at Left Beam** | | | | PASS |
| **Geometry Restrictions at Right Beam** | | | | PASS |
| **Plate Shear Yield** | 0.00 kips | 432.00 kips | **0.00** | PASS |
| **Left Beam Shear Yield** | 0.00 kips | 488.56 kips | **0.00** | PASS |
| **Right Beam Shear Yield** | 0.00 kips | 488.56 kips | **0.00** | PASS |
| **Plate Shear Rupture at Left Beam** | 0.00 kips | 430.65 kips | **0.00** | PASS |
| **Plate Shear Rupture at Right Beam** | 0.00 kips | 430.65 kips | **0.00** | PASS |
| **Left Beam Shear Rupture** | 0.00 kips | 472.97 kips | **0.00** | PASS |

| | | | | |
|---|---|---|---|---|
| **Right Beam Shear Rupture** | 0.00 kips | 460.91 kips | **0.00** | **PASS** |
| **Plate Axial Yield** | 138.00 kips | 648.00 kips | **0.21** | **PASS** |
| **Left Beam Axial Yield** | 276.00 kips | 1561.50 kips | **0.18** | **PASS** |
| **Right Beam Axial Yield** | 276.00 kips | 1561.50 kips | **0.18** | **PASS** |
| **Compression Buckling of the Plate** | 138.00 kips | 648.00 kips | **0.21** | **PASS** |
| **Plate Flexural Yield** | | | **0.05** | **PASS** |
| **Plate Flexural Rupture** | | | **0.00** | **PASS** |
| **Bolt Bearing on Left Beam** | 276.00 kips | 429.42 kips | **0.64** | **PASS** |
| **Bolt Bearing on Plate at Left Beam** | 276.00 kips | 429.42 kips | **0.64** | **PASS** |
| **Bolt Bearing on Right Beam** | 276.00 kips | 429.42 kips | **0.64** | **PASS** |
| **Bolt Bearing on Plate at Right Beam** | 276.00 kips | 429.42 kips | **0.64** | **PASS** |
| **Bolt Shear at Left Beam** | 276.00 kips | 421.48 kips | **0.65** | **PASS** |
| **Bolt Group Eccentricity at Left Beam** | | ***0.98*** | | |
| **Bolt Shear at Right Beam** | 276.00 kips | 421.48 kips | **0.65** | **PASS** |
| **Bolt Group Eccentricity at Right Beam** | | ***0.98*** | | |

## *Connection 1: Connection Properties*

*Beam Shear Tab Splice Connection*

| | |
|---|---|
| ***Connection*** | |
| **Connection Title** | Connection 1 |
| **Connection Type** | Beam Shear Tab Splice Connection |
| ***Connection Category*** | |
| **Beam Web Connection** | Bolted |
| ***Loading*** | |
| **Shear Load** | 0.00 kips |
| **Axial Load** | 276.00 kips |
| ***Components*** | |
| **Left Beam Section** | W33x118 |
| Material | A992 |
| Hole Type | STD |
| **Right Beam Section** | W33x118 |
| Material | A992 |
| Hole Type | SSLV |
| **Plate Section** | P1.00x24.50x20.00 |
| Material | A36 |
| Thickness | 1.00 in |
| Width | 24.50 in |
| Depth | 20.00 in |
| No. of Plates | Double |
| Hole Type | STD |
| **Left Beam Web Bolts** | 3/4" A325-N |
| Left Beam Web Bolts | A325-N |
| Diameter, in. | 3/4" |
| Rows | 3 |
| Bolts per Row | 4 |
| Longitudinal Spacing | 4.00 in |
| Transverse Spacing | 3.00 in |
| Slip Critical | No |
| **Right Beam Web Bolts** | 3/4" A325-N |
| Right Beam Web Bolts | A325-N |
| Diameter, in. | 3/4" |
| Rows | 3 |

| | |
|---|---|
| Bolts per Row | 4 |
| Longitudinal Spacing | 4.00 in |
| Transverse Spacing | 3.00 in |
| Slip Critical | No |
| ***Assembly*** | |
| **Splice Gap** | 0.50 in |
| **Plate Vertical Position** | 6.45 in |
| **Cope Dimensions - Left Beam** | No |
| **Cope Dimensions - Right Beam** | No |
| **Left Beam Web Bolts Edge Distance Dimensions** | |
| Web Bolts/Beam Long. Edge Distance | 3.00 in |
| Web Bolts/Plate Long. Edge Distance | 3.00 in |
| Web Bolts/Beam Vert Edge Distance | 10.45 in |
| Web Bolts/Plate Vert Edge Distance | 4.00 in |
| **Right Beam Web Bolts Edge Distance Dimensions** | |
| Web Bolts/Beam Long. Edge Distance | 3.00 in |
| Web Bolts/Plate Long. Edge Distance | 3.00 in |
| Web Bolts/Beam Vert Edge Distance | 10.45 in |
| Web Bolts/Plate Vert Edge Distance | 4.00 in |

# Footings and Foundations

# Gravity Column Design Summary

RAM Structural System
Bentley
RAM Steel 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416
Building Code: IBC

04/25/18 18:02:13
Steel Code: AISC 360-10 ASD

**Column Line 2-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 51.0 | 35.1 | 0.0 | 1 | 0.73 Eq (H1-1a) | 0.0 | 46 | HSS12X12X1/4 |

5'

**Column Line 2-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 69.8 | 48.2 | 0.0 | 1 | 0.74 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |

5.5'

**Column Line 2-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 69.8 | 48.2 | 0.0 | 1 | 0.74 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |

5.5'

**Column Line 2-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 69.9 | 48.3 | 0.0 | 1 | 0.74 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |

5.5'

**Column Line 2-H.1**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 38.5 | 26.5 | 0.0 | 1 | 0.80 Eq (H1-1a) | 0.0 | 46 | HSS12X12X3/16 |

4'

**Column Line 3-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.8 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |

5.5

**Column Line 3-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 96.0 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

6.5'

**Column Line 3-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 96.0 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

6.5'

**Column Line 3-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 96.2 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

6.5'

**Column Line 3-H.1**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 57.6 | 16.1 | 5.2 | 8 | 0.88 Eq (H1-1a) | 0.0 | 46 | HSS12X12X3/16 |

5'

**Column Line 4-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|

# Gravity Column Design Summary



| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.7 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |
| | 5.5' | | | | | | | |

**Column Line 4-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |
| | 6.5' | | | | | | | |

**Column Line 4-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 153.1 | 6.4 | 10.9 | 8 | 0.90 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |
| | 8' | | | | | | | |

**Column Line 4-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 161.7 | 0.0 | 32.3 | 1 | 0.85 Eq (H1-1a) | 90.0 | 50 | HSS12X12X3/8 |
| | 8.5' | | | | | | | |

**Column Line 4-H.1**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 70.9 | 24.9 | 5.7 | 8 | 0.75 Eq (H1-1a) | 0.0 | 46 | HSS12X12X1/4 |
| | 5.5 | | | | | | | |

**Column Line 5-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.7 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |
| | 5.5' | | | | | | | |

**Column Line 5-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |
| | 6.5' | | | | | | | |

**Column Line 5-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 124.5 | 1.9 | 36.8 | 6 | 0.91 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |
| | 7.5' | | | | | | | |

**Column Line 5-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 152.9 | 0.0 | 41.3 | 6 | 0.87 Eq (H1-1a) | 90.0 | 50 | HSS12X12X3/8 |
| | 8' | | | | | | | |

**Column Line 6-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.7 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |
| | 5.5 | | | | | | | |

**Column Line 6-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |
| | 6.5 | | | | | | | |

RAM Structural System
Bentley

RAM Steel 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416
Building Code: IBC


04/25/18 18:02:13
Steel Code: AISC 360-10 ASD

**Column Line 6-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 124.5 | 1.9 | 36.8 | 6 | 0.91 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

7.5'

**Column Line 6-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 152.9 | 0.0 | 41.3 | 6 | 0.87 Eq (H1-1a) | 90.0 | 50 | HSS12X12X3/8 |

8'

**Column Line 7-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.7 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |

5.5'

**Column Line 7-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

6.5'

**Column Line 7-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 124.5 | 1.9 | 36.8 | 6 | 0.91 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

7.5'

**Column Line 7-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 152.9 | 0.0 | 41.3 | 6 | 0.87 Eq (H1-1a) | 90.0 | 50 | HSS12X12X3/8 |

8'

**Column Line 8-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.7 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |

5.5'

**Column Line 8-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

6.5'

**Column Line 8-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 124.5 | 1.9 | 36.8 | 6 | 0.91 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |

7.5'

**Column Line 8-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 152.9 | 0.0 | 41.3 | 6 | 0.87 Eq (H1-1a) | 90.0 | 50 | HSS12X12X3/8 |

8'

**Column Line 9-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.7 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |
| | 5.5' | | | | | | | |

**Column Line 9-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |
| | 6.5' | | | | | | | |

**Column Line 9-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 153.1 | 6.4 | -10.9 | 8 | 0.90 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |
| | 8' | | | | | | | |

**Column Line 9-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 161.7 | 0.0 | -32.3 | 1 | 0.85 Eq (H1-1a) | 90.0 | 50 | HSS12X12X3/8 |
| | 8.5' | | | | | | | |

**Column Line 10-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.7 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |
| | 5.5' | | | | | | | |

**Column Line 10-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |
| | 6.5' | | | | | | | |

**Column Line 10-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |
| | 6.5' | | | | | | | |

**Column Line 10-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 96.1 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |
| | 6.5' | | | | | | | |

**Column Line 11-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.7 | 4.6 | 21.8 | 14 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |
| | 5.5' | | | | | | | |

**Column Line 11-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |
| | 6.5' | | | | | | | |

**Column Line 11-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 95.9 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |
| | 6.5' | | | | | | | |

# Gravity Column Design Summary

RAM Structural System
Bentley
RAM Steel 15.08.00.37
DataBase: 18054_Kimberly Clark Addition_20180416
Building Code: IBC


04/25/18 18:02:13
Steel Code: AISC 360-10 ASD

**Column Line 11-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 96.1 | 3.6 | 32.2 | 14 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |
| | 6.5' | | | | | | | |

**Column Line 11-H.1**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 57.5 | 16.1 | 5.1 | 8 | 0.88 Eq (H1-1a) | 0.0 | 46 | HSS12X12X3/16 |
| | 5' | | | | | | | |

**Column Line 12-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 73.8 | 4.6 | -21.8 | 17 | 0.76 Eq (H1-1a) | 90.0 | 50 | HSS12X12X1/4 |
| | 5.5' | | | | | | | |

**Column Line 12-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 96.0 | -3.6 | -32.2 | 16 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |
| | 6.5' | | | | | | | |

**Column Line 12-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 96.0 | -3.6 | -32.2 | 16 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |
| | 6.5' | | | | | | | |

**Column Line 12-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 96.2 | 3.6 | -32.2 | 17 | 0.75 Eq (H1-1a) | 90.0 | 50 | HSS12X12X5/16 |
| | 6.5' | | | | | | | |

**Column Line 12-H.1**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 57.6 | -16.1 | 5.2 | 12 | 0.88 Eq (H1-1a) | 0.0 | 46 | HSS12X12X3/16 |
| | 5' | | | | | | | |

**Column Line 13-M**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 51.0 | -35.1 | 0.0 | 1 | 0.73 Eq (H1-1a) | 0.0 | 46 | HSS12X12X1/4 |
| | 5' | | | | | | | |

**Column Line 13-L**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 69.8 | -48.2 | 0.0 | 1 | 0.74 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |
| | 5.5' | | | | | | | |

**Column Line 13-K**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 69.8 | -48.2 | 0.0 | 1 | 0.74 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |
| | 5.5' | | | | | | | |

**Column Line 13-J**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Roof | 69.9 | -48.3 | 0.0 | 1 | 0.74 Eq (H1-1a) | 0.0 | 46 | HSS12X12X5/16 |
| | 5.5' | | | | | | | |

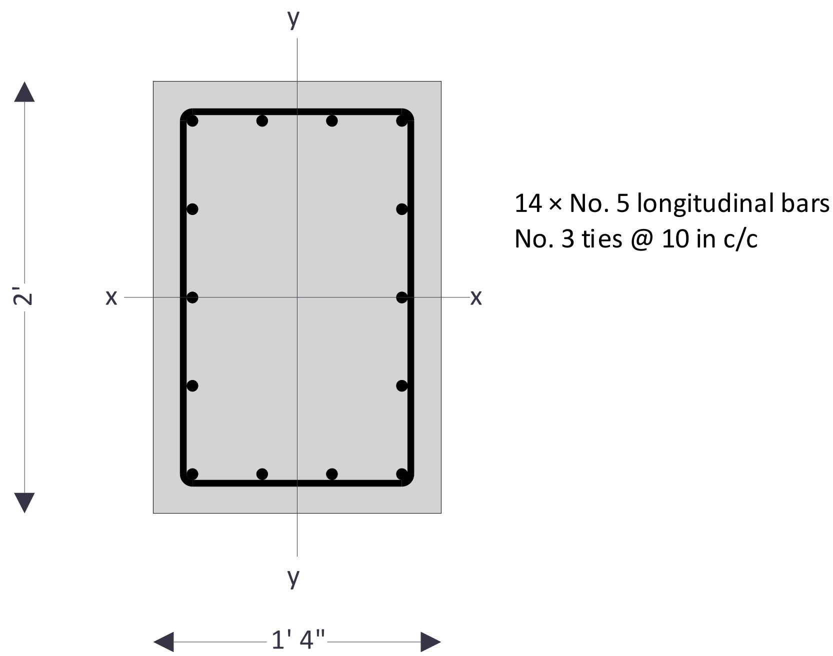
**Column Line 13-H.1**

| Level | Pa | Max | May | LC | Interaction Eq. | Angle | Fy | Size |
|---|---|---|---|---|---|---|---|---|
| Roof | 38.5 | -26.5 | 0.0 | 1 | 0.80 Eq (H1-1a) | 0.0 | 46 | HSS12X12X3/16 |
| | 4' | | | | | | | |

| ARW Engineers<br>1954 W. Park Circle<br>Ogden, Utah 84404<br>(801) 782-6008 | Project<br>Kimberly Clark | | | | Job Ref.<br>18054 | |
|---|---|---|---|---|---|---|
| | Section<br>Grade Beam | | | | Sheet no./rev.<br>1 | |
| | Calc. by<br>SJV | Date<br>4/26/2018 | Chk'd by | Date | App'd by | Date |

## RC RECTANGULAR COLUMN DESIGN (ACI318-14)

Tedds calculation version 2.2.01




### Applied loads

Ultimate axial force acting on column $P_{u\_act}$ = **400** kips

Ratio of DL moment to total moment $\beta_d$ = **0.600**

### Geometry of column

Depth of column (larger dimension of column) h = **24.0** in

Width of column (smaller dimension of column) b = **16.0** in

Clear cover to reinforcement (both sides) $c_c$ = **1.5** in

Unsupported height of column about x axis $l_{ux}$ = **14.5** ft

Effective height factor about x axis $k_x$ = **1.00**

Column state about the x axis Braced

Unsupported height of column about y axis $l_{uy}$ = **14.5** ft

Effective height factor about y axis $k_y$ = **1.00**

Column state about the y axis Braced

### Check on overall column dimensions

***Column dimensions are OK - h < 4b***

### Reinforcement of column

Numbers of bars of longitudinal steel N = **14**

Longitudinal steel bar diameter number $D_{bar\_num}$ = **5**

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Diameter of longitudinal bar $D_{long}$ = **0.625** in

Stirrup bar diameter number $D_{stir\_num}$ = **3**

Diameter of stirrup bar $D_{stir}$ = **0.375** in

Specified yield strength of reinforcement $f_y$ = **60000** psi

Specified compressive strength of concrete $f'_c$ = **4500** psi

Modulus of elasticity of bar reinforcement $E_s = \mathbf{29 \times 10^6}$ psi

Modulus of elasticity of concrete $E_c = 57000 \times f'_c{}^{1/2} \times (1psi)^{1/2}$ = **3823676** psi

Yield strain $\varepsilon_y = f_y / E_s$ = **0.00207**

Ultimate design strain $\varepsilon_c$ = **0.003** in/in

**Check for minimum area of steel - 10.6.1.1**

Gross area of column $A_g = h \times b$ = **384.000** in$^2$

Area of steel $A_{st} = N \times ( \pi \times D_{long}^2) / 4$ = **4.295** in$^2$

Minimum area of steel required $A_{st\_min} = 0.01 \times A_g$ = **3.840** in$^2$

***$A_{st} > A_{st\_min}$, PASS- Minimum steel check***

**Check for maximum area of steel - 10.6.1.1**

Permissible maximum area of steel $A_{st\_max} = 0.08 \times A_g$ = **30.720** in$^2$

***$A_{st} < A_{st\_max}$, PASS - Maximum steel check***

**Slenderness check about x axis**

Radius of gyration $r_x = 0.3 \times h$ = **7.2** in

Actual slenderness ratio $s_{rx\_act} = k_x \times l_{ux} / r_x$ = **24.17**

Permissible slenderness ratio $s_{rx\_perm} = \min(34 - 12 \times (M_{1x\_act} / M_{2x\_act}),40)$ = **34**

***Slenderness effects may be neglected about the X axis***

**Slenderness check about y axis**

Radius of gyration $r_y = 0.3 \times b$ = **4.8** in

Actual slenderness ratio $s_{ry\_act} = k_y \times l_{uy} / r_y$ = **36.25**

Permissible slenderness ratio $s_{ry\_perm} = \min(34 - 12 \times (M_{1y\_act} / M_{2y\_act}),40)$ = **34**

***Column is slender about the Y axis***

**Magnified moments about y axis**

Moment of inertia of section $I_{gy} = (h \times b^3) / 12$ = **8192** in$^4$

Euler's buckling load $P_{cy} = (\pi^2 / (k_y \times l_{uy})^2) \times (0.4 \times E_c \times I_{gy} / (1+\beta_d))$ = **2552.77** kips

Correction factor for actual to equiv. mmt.diagram $C_{my}$ = 1.0

Moment magnifier $\delta_{nsy} = \max(C_{my} / (1 - ( P_{u\_act} / (0.75 \times P_{cy} ))),1.0)$ = **1.264**

Minimum factored moment about y axis $M_{2y\_min} = P_{u\_act} \times (0.6 \text{ in} + 0.03 \times b)$ = **36** kip_ft

Minimum magnified moment about y axis $M_{cy\_min} = \delta_{nsy} \times M_{2y\_min}$ = **45.51** kip_ft

**Axial load capacity of axially loaded column**

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Strength reduction factor $\phi = 0.65$

Area of steel on compression face $A'_s = A_{st} / 2 =$ **2.148** $in^2$

Area of steel on tension face $A_s = A_{st} / 2 =$ **2.148** $in^2$

Net axial load capacity of column $P_n = 0.8 \times (0.85 \times f'_c \times (A_g - A_{st}) + f_y \times A_{st}) =$ **1368.064** kips

Ultimate axial load capacity of column $P_u = \phi \times P_n =$ **889.242** kips

***PASS : Column is safe in axial loading***

**Uniaxially loaded column about minor axis**

**Details of column cross-section**

$c/d_t$ ratio $r_{yb} =$ **0.593**

Effective cover to reinforcement $d' = c_c + D_{stir} + (D_{long}/2) =$ **2.188** in

Spacing between bars $s = ((b - (2\times d')))/ ((N/2)-1) =$ **1.938** in

Depth of tension steel $b_t = b - d' =$ **13.813** in

Depth of NA from extreme compression face $c_y = r_{yb} \times b_t =$ **8.194** in

Factor of depth of compressive stress block $\beta_1 =$ **0.825**

Depth of equivalent rectangular stress block $a_y = \min((\beta_1 \times c_y), b) =$ **6.760** in

Yield strain in steel $\varepsilon_{sy} = f_y / E_s =$ **0.002**

Strength reduction factor $\phi_y =$ **0.650**

**Details of concrete block**

**Force carried by concrete**

Forces carried by concrete $P_{ycon} = 0.85 \times f'_c \times h \times a_y =$ **620.554** kips

**Moment carried by concrete**

Moment carried by concrete $M_{ycon} = P_{ycon} \times ((b/2) - (a_y/2)) =$ **238.917** kip_ft

**Details of steel layer 1**

Depth of layer $x_{y1} =$ **2.188** in

Strain of layer $\varepsilon_{y1} = \varepsilon_c \times (1 - x_{y1} / c_y) =$ **0.00220**

Stress in layer $\sigma_{y1} = \min(f_y, E_s \times \varepsilon_{y1}) - 0.85 \times f'_c =$ **56175.00** psi

Force carried by layer $P_{y1} = N_y \times A_{bar} \times \sigma_{y1} =$ **86.171** kips

Moment carried by steel layer $M_{y1} = P_{y1} \times ((b / 2) - x_{y1}) =$ **41.739** kip_ft

**Details of steel layer 2**

Depth of layer $x_{y2} =$ **6.063** in

Strain of layer $\varepsilon_{y2} = \varepsilon_c \times (1 - x_{y2} / c_y) =$ **0.00078**

Stress in layer $\sigma_{y2} = \min(f_y, E_s \times \varepsilon_{y2}) - 0.85 \times f'_c =$ **18804.37** psi

Force carried by layer $P_{y2} = 2 \times A_{bar} \times \sigma_{y2} =$ **11.538** kips

Moment carried by steel layer $M_{y2} = P_{y2} \times ((b / 2) - x_{y2}) =$ **1.863** kip_ft

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**Details of steel layer 3**

Depth of layer $x_{y3}$ = **9.938** in

Strain of layer $\varepsilon_{y3} = \varepsilon_c \times (1 - x_{y3} / c_y)$ = **-0.00064**

Stress in layer $\sigma_{y3} = \max(-1 \times f_y, E_s \times \varepsilon_{y3})$ = **-18514.74** psi

Force carried by layer $P_{y3} = 2 \times A_{bar} \times \sigma_{y3}$ = **-11.361** kips

Moment carried by steel layer $M_{y3} = P_{y3} \times ((b / 2) - x_{y3})$ = **1.834** kip_ft

**Details of steel layer 4**

Depth of layer $x_{y4}$ = **13.813** in

Strain of layer $\varepsilon_{y4} = \varepsilon_c \times (1 - x_{y4} / c_y)$ = **-0.00206**

Stress in layer $\sigma_{y4} = \max(-1 \times f_y, E_s \times \varepsilon_{y4})$ = **-59658.85** psi

Force carried by layer $P_{y4} = N_y \times A_{bar} \times \sigma_{y4}$ = **-91.516** kips

Moment carried by steel layer $M_{y4} = P_{y4} \times ((b / 2) - x_{y4})$ = **44.328** kip_ft

**Force carried by steel**

Sum of forces by steel $P_{ys}$ = **-5.2** kips

**Total force carried by column**

Nominal axial load strength $P_{ny}$ = **615.388** kips

Strength reduction factor $\phi_y$ = **0.650**

Ultimate axial load carrying capacity of column $P_{uy} = \phi_y \times P_{ny}$ = **400.002** kips

**Total moment carried by column**

Total moment carried by column $M_{oy}$ = **328.682** kip_ft

Ultimate moment strength capacity of column $M_{uy} = \phi_y \times M_{oy}$ = **213.643**kip_ft

**Check load capacity for uniaxial loads about the y axis**

Factored axial load $P_{u\_act}$ = **400** kips

Ultimate axial capacity $P_{uy}$ = **400** kips

***PASS - Ultimate axial capacity exceeds factored axial load***

Factored moment about y axis $M_{cy\_min}$ = **45.5** kip_ft

Ultimate moment capacity about the y axis $M_{uy}$ = **213.6** kip_ft

***PASS - Ultimate moment capacity exceeds factored moment about y axis***

**Design of column ties - 25.7.2**

Spacing of lateral ties $s_{v\_ties}$ = **10.000** in

16 times longitudinal bar diameter $s_{v1} = 16 \times D_{long}$ = **10.000** in

48 times tie bar diameter $s_{v2} = 48 \times D_{stir}$ = **18.000** in

Least column dimension $s_{v3} = \min(h,b)$ = **16.00** in

Required tie spacing $s = \min(s_{v1},s_{v2},s_{v3})$ = **10.000** in

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***$s_{v\_ties}$ < s PASS***

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## FOUNDATION ANALYSIS & DESIGN (ACI318)

**In accordance with ACI318-14**

Tedds calculation version 3.2.07

### FOOTING ANALYSIS

Length of foundation $L_x$ = **1** ft

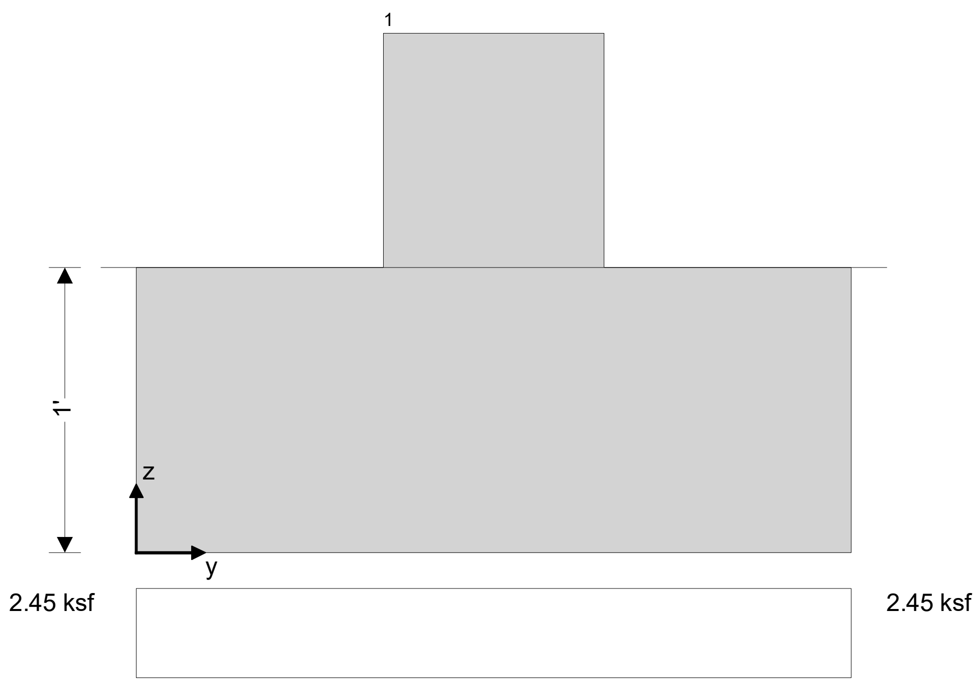
Width of foundation $L_y$ = **2.5** ft

Foundation area $A = L_x \times L_y$ = **2.5** $ft^2$

Depth of foundation h = **12** in

Depth of soil over foundation $h_{soil}$ = **0** in

Density of concrete $\gamma_{conc}$ = **150.0** $lb/ft^3$




**Wall no.1 details**

Width of wall $l_{y1}$ = **9.25** in

position in y-axis $y_1$ = **15** in

**Soil properties**

Gross allowable bearing pressure $q_{allow\_Gross}$ = **2.5** ksf

Density of soil $\gamma_{soil}$ = **120.0** $lb/ft^3$

Angle of internal friction $\phi_b$ = **30.0** deg

Design base friction angle $\delta_{bb}$ = **30.0** deg

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Coefficient of base friction $\tan(\delta_{bb})$ = **0.577**

Self weight $F_{swt} = h \times \gamma_{conc}$ = **150** psf

**Wall no.1 loads per linear foot**

Dead load in z $F_{Dz1}$ = **5.5** kips

Live roof load in z $F_{Lrz1}$ = **0.2** kips

Snow load in z $F_{Sz1}$ = **0.3** kips

**Footing analysis for soil and stability**

**Load combinations per ASCE 7-10**

1.0D (0.932)

1.0D + 1.0Lr (0.964)

1.0D + 1.0S (0.980)

**Combination 4 results: 1.0D + 1.0S**

**Forces on foundation per linear foot**

Force in z-axis $F_{dz} = \gamma_D \times A \times F_{swt} + \gamma_D \times F_{Dz1} + \gamma_S \times F_{Sz1}$ = **6.1** kips

**Moments on foundation per linear foot**

Moment in y-axis, about y is 0 $M_{dy} = \gamma_D \times A \times F_{swt} \times L_y / 2 + \gamma_D \times (F_{Dz1} \times y_1) + \gamma_S \times (F_{Sz1} \times y_1)$ = **7.7** kip_ft

**Uplift verification**

Vertical force $F_{dz}$ = **6.125** kips

***PASS - Foundation is not subject to uplift***

**Stability against sliding**

Resistance due to base friction $F_{RFriction} = \max(F_{dz}, 0 \text{ kN}) \times \tan(\delta_{bb})$ = **3.536** kips

**Bearing resistance**

**Eccentricity of base reaction**

Eccentricity of base reaction in y-axis $e_{dy} = M_{dy} / F_{dz} - L_y / 2$ = **0.000** in

**Strip base pressures**

$q_1 = F_{dz} \times (1 - 6 \times e_{dy} / L_y) / (L_y \times 1 \text{ ft})$ = **2.45** ksf

$q_2 = F_{dz} \times (1 + 6 \times e_{dy} / L_y) / (L_y \times 1 \text{ ft})$ = **2.45** ksf

Minimum base pressure $q_{min} = \min(q_1, q_2)$ = **2.45** ksf

Maximum base pressure $q_{max} = \max(q_1, q_2)$ = **2.45** ksf

**Allowable bearing capacity**

Allowable bearing capacity $q_{allow} = q_{allow\_Gross}$ = **2.5** ksf

$q_{max} / q_{allow}$ = **0.980**

***PASS - Allowable bearing capacity exceeds design base pressure***

**FOOTING DESIGN (ACI318)**

**In accordance with ACI318-14**

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**Material details**

Compressive strength of concrete $f'_c$ = **4500** psi

Yield strength of reinforcement $f_y$ = **60000** psi

Cover to reinforcement $c_{nom}$ = **3** in

Concrete type Normal weight

Concrete modification factor $\lambda$ = **1.00**

Wall type Concrete

**Analysis and design of concrete footing**

**Load combinations per ASCE 7-10**

1.4D (0.096)

1.2D + 1.6L + 0.5Lr (0.084)

1.2D + 1.6L + 0.5S (0.084)

1.2D + 1.0L + 1.6S (0.089)

**Combination 1 results: 1.4D**

**Forces on foundation per linear foot**

Ultimate force in z-axis $F_{uz} = \gamma_D \times A \times F_{swt} + \gamma_D \times F_{Dz1}$ = **8.2** kips

**Moments on foundation per linear foot**

Ultimate moment in y-axis, about y is 0 $M_{uy} = \gamma_D \times A \times F_{swt} \times L_y / 2 + \gamma_D \times (F_{Dz1} \times y_1)$ = **10.2** kip_ft

**Eccentricity of base reaction**

Eccentricity of base reaction in y-axis $e_{uy} = M_{uy} / F_{uz} - L_y / 2$ = **0.000** in

**Strip base pressures**

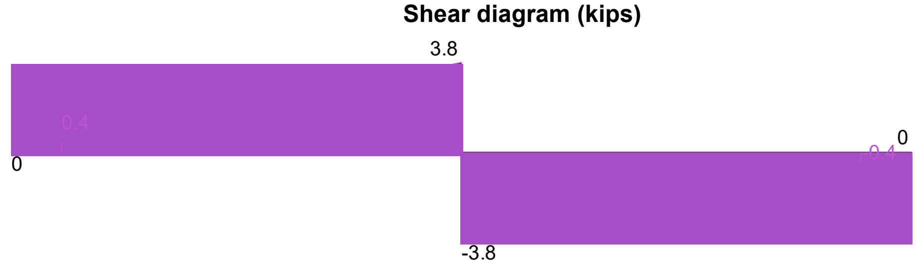
$q_{u1} = F_{uz} \times (1 - 6 \times e_{uy} / L_y) / (L_y \times 1\ ft)$ = **3.262** ksf

$q_{u2} = F_{uz} \times (1 + 6 \times e_{uy} / L_y) / (L_y \times 1\ ft)$ = **3.262** ksf

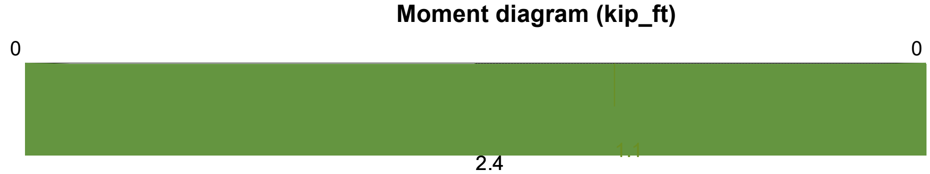
Minimum ultimate base pressure $q_{umin} = \min(q_{u1}, q_{u2})$ = **3.262** ksf

Maximum ultimate base pressure $q_{umax} = \max(q_{u1}, q_{u2})$ = **3.262** ksf

**Shear diagram (kips)**




**Moment diagram (kip_ft)**



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**Moment design, y direction, positive moment**

Ultimate bending moment $M_{u.y.max}$ = **1.141** kip_ft

Tension reinforcement provided No.5 bars at 12.0 in c/c bottom

Area of tension reinforcement provided $A_{sy.bot.prov}$ = **0.31** $in^2$

Minimum area of reinforcement (7.6.1.1) $A_{s.min} = 0.0018 \times L_x \times h$ = **0.259** $in^2$

***PASS - Area of reinforcement provided exceeds minimum***

Maximum spacing of reinforcement (7.7.2.3) $s_{max} = \min(3 \times h, 18\ in)$ = **18** in

***PASS - Maximum permissible reinforcement spacing exceeds actual spacing***

Depth to tension reinforcement $d = h - c_{nom} - \phi_{y.bot} / 2$ = **8.688** in

Depth of compression block $a = A_{sy.bot.prov} \times f_y / (0.85 \times f'_c \times L_x)$ = **0.405** in

Neutral axis factor $\beta_1$ = **0.83**

Depth to neutral axis $c = a / \beta_1$ = **0.491** in

Strain in tensile reinforcement (7.3.3.1) $\varepsilon_t = 0.003 \times d / c - 0.003$ = **0.05006**

***PASS - Tensile strain exceeds minimum required, 0.004***

Nominal moment capacity $M_n = A_{sy.bot.prov} \times f_y \times (d - a / 2)$ = **13.152** kip_ft

Flexural strength reduction factor $\phi_f = \min(\max(0.65 + (\varepsilon_t - 0.002) \times (250 / 3), 0.65), 0.9)$ = **0.900**

Design moment capacity $\phi M_n = \phi_f \times M_n$ = **11.836** kip_ft

$M_{u.y.max} / \phi M_n$ = **0.096**

***PASS - Design moment capacity exceeds ultimate moment load***

**One-way shear design, y direction**

Ultimate shear force $V_{u.y}$ = **0.429** kips

Depth to reinforcement $d_v = h - c_{nom} - \phi_{y.bot} / 2$ = **8.688** in

Shear strength reduction factor $\phi_v$ = **0.75**

Nominal shear capacity (Eq. 22.5.5.1) $V_n = 2 \times \lambda \times \sqrt{(f'_c \times 1\ psi)} \times L_x \times d_v$ = **13.987** kips

Design shear capacity $\phi V_n = \phi_v \times V_n$ = **10.49** kips

$V_{u.y} / \phi V_n$ = **0.041**

***PASS - Design shear capacity exceeds ultimate shear load***

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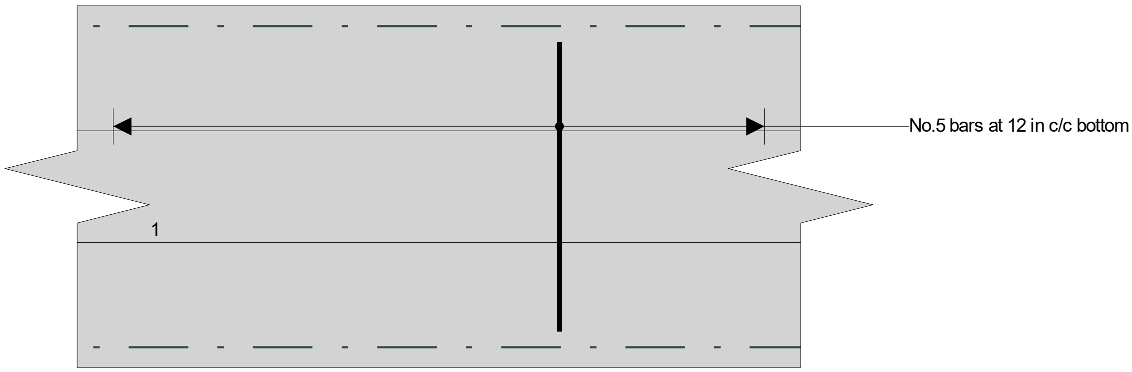

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## FOUNDATION ANALYSIS & DESIGN (ACI318)

**In accordance with ACI318-14**

Tedds calculation version 3.2.07

## FOOTING ANALYSIS

Length of foundation $L_x$ = **1** ft

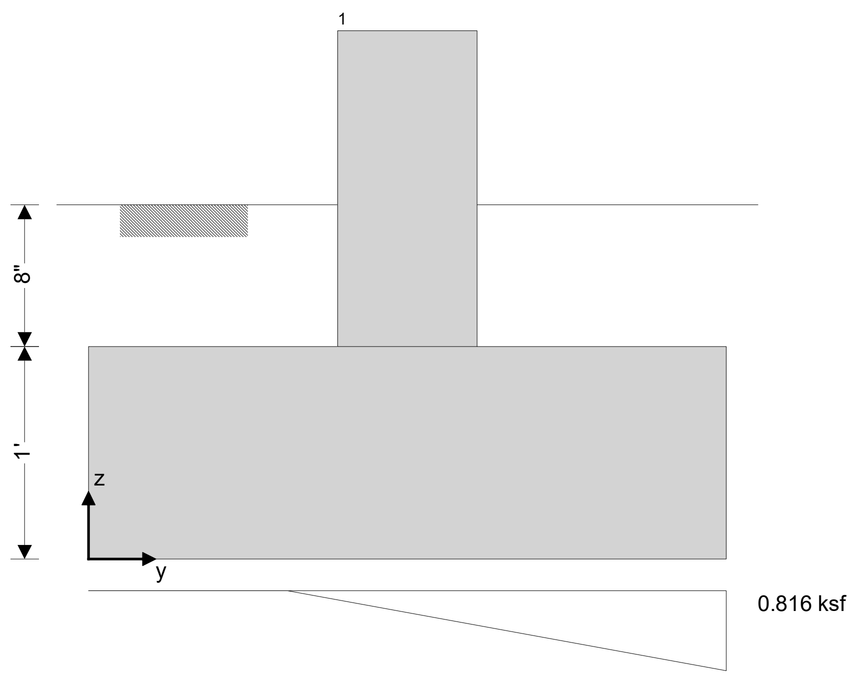
Width of foundation $L_y$ = **3** ft

Foundation area $A = L_x \times L_y$ = **3** $ft^2$

Depth of foundation $h$ = **12** in

Depth of soil over foundation $h_{soil}$ = **8** in

Density of concrete $\gamma_{conc}$ = **150.0** $lb/ft^3$




**Wall no.1 details**

Width of wall $l_{y1}$ = **7.875** in

position in y-axis $y_1$ = **18** in

**Soil properties**

Gross allowable bearing pressure $q_{allow\_Gross}$ = **2.5** ksf

Density of soil $\gamma_{soil}$ = **145.0** $lb/ft^3$

Angle of internal friction $\phi_b$ = **30.0** deg

Design base friction angle $\delta_{bb}$ = **30.0** deg

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Coefficient of base friction $\tan(\delta_{bb})$ = **0.577**

Dead surcharge load $F_{Dsur}$ = **116** psf

Self weight $F_{swt} = h \times \gamma_{conc}$ = **150** psf

Soil weight $F_{soil} = h_{soil} \times \gamma_{soil}$ = **96.7** psf

**Wall no.1 loads per linear foot**

Dead load in z $F_{Dz1}$ = **0.6** kips

Live load in z $F_{Lz1}$ = **0.2** kips

Seismic load moment in y $M_{Ey1}$ = **1.0** kip_ft

**Footing analysis for soil and stability**

**Load combinations per ASCE 7-10**

1.0D (0.225)
1.0D + 1.0L (0.252)
1.0D + 1.0Lr (0.225)
1.0D + 1.0S (0.225)
1.0D + 1.0R (0.225)
1.0D + 0.75L + 0.75Lr (0.245)
1.0D + 0.75L + 0.75S (0.245)
1.0D + 0.75L + 0.75R (0.245)
1.0D + 0.6W (0.225)
$(1.0 + 0.14 \times S_{DS})$D + 0.7E (0.436)
1.0D + 0.75L + 0.75Lr + 0.45W (0.245)
1.0D + 0.75L + 0.75S + 0.45W (0.245)
1.0D + 0.75L + 0.75R + 0.45W (0.245)
$(1.0 + 0.10 \times S_{DS})$D + 0.75L + 0.75S + 0.525E (0.402)
0.6D + 0.6W (0.135)
$(0.6 - 0.14 \times S_{DS})$D + 0.7E (0.577)

**Combination 16 results: $(0.6 - 0.14 \times S_{DS})$D + 0.7E**

**Forces on foundation per linear foot**

Force in z-axis $F_{dz} = \gamma_D \times A \times (F_{swt} + F_{soil} + F_{Dsur}) + \gamma_D \times F_{Dz1}$ = **0.8** kips

**Moments on foundation per linear foot**

Moment in y-axis, about y is 0 $M_{dy} = \gamma_D \times (A \times (F_{swt} + F_{soil} + F_{Dsur}) \times L_y / 2) + \gamma_D \times (F_{Dz1} \times y_1) + \gamma_E \times (M_{Ey1})$ = **1.8** kip_ft

**Uplift verification**

Vertical force $F_{dz}$ = **0.777** kips

***PASS - Foundation is not subject to uplift***

**Stability against overturning in y direction, moment about y is $L_y$**

Overturning moment $M_{OTyL} = \gamma_E \times (M_{Ey1})$ = **0.67** kip_ft

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|---|---|---|---|---|---|
| | Section<br>Masonry Cant. Footing | | | Sheet no./rev.<br>3 | |
| | Calc. by<br>SJV | Date<br>4/26/2018 | Chk'd by | Date | App'd by | Date |

Resisting moment $M_{RyL} = -1 \times (\gamma_D \times (A \times (F_{swt} + F_{soil} + F_{Dsur}) \times L_y / 2)) + \gamma_D \times (F_{Dz1} \times (y_1 - L_y)) =$ **-1.17** kip_ft

Factor of safety abs($M_{RyL}$ / $M_{OTyL}$) = **1.73**

***PASS - Overturning moment safety factor exceeds the minimum of 1.00***

**Stability against sliding**

Resistance due to base friction $F_{RFriction}$ = max($F_{dz}$, 0 kN) × tan($\delta_{bb}$) = **0.449** kips

**Bearing resistance**

**Eccentricity of base reaction**

Eccentricity of base reaction in y-axis $e_{dy} = M_{dy} / F_{dz} - L_y / 2$ = **10.379** in

Length of bearing in y-axis $L'_{yd}$ = min($L_y$,3 × ($L_y$ / 2 - abs($e_{dy}$))) = **22.863** in

**Strip base pressures**

$q_1$ = **0** ksf

$q_2 = 4 \times F_{dz} / (3 \times 1\text{ ft} \times (L_y - 2 \times e_{dy}))$ = **0.816** ksf

Minimum base pressure $q_{min}$ = min($q_1$,$q_2$) = **0** ksf

Maximum base pressure $q_{max}$ = max($q_1$,$q_2$) = **0.816** ksf

**Allowable bearing capacity**

Allowable bearing capacity $q_{allow} = q_{allow\_Gross}$ = **2.5** ksf

$q_{max} / q_{allow}$ = **0.326**

***PASS - Allowable bearing capacity exceeds design base pressure***

**FOOTING DESIGN (ACI318)**

**In accordance with ACI318-14**

**Material details**

Compressive strength of concrete $f'_c$ = **4500** psi

Yield strength of reinforcement $f_y$ = **60000** psi

Cover to reinforcement $c_{nom}$ = **3** in

Concrete type Normal weight

Concrete modification factor $\lambda$ = **1.00**

Wall type Masonry

**Analysis and design of concrete footing**

**Load combinations per ASCE 7-10**

1.4D (0.025)
1.2D + 1.6L + 0.5Lr (0.030)
1.2D + 1.6L + 0.5S (0.030)
1.2D + 1.6L + 0.5R (0.030)
1.2D + 1.0L + 1.6Lr (0.027)
1.2D + 1.0L + 1.6S (0.027)
1.2D + 1.0L + 1.6R (0.027)

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1954 W. Park Circle
Ogden, Utah 84404
(801) 782-6008

| Project | | | | Job Ref. | |
|---|---|---|---|---|---|
| Kimberly Clark Addition | | | | 18054 | |
| Section | | | | Sheet no./rev. | |
| Masonry Cant. Footing | | | | 4 | |
| Calc. by | Date | Chk'd by | Date | App'd by | Date |
| SJV | 4/26/2018 | | | | |

1.2D + 1.6Lr + 0.5W (0.021)
1.2D + 1.6S + 0.5W (0.021)
1.2D + 1.6R + 0.5W (0.021)
1.2D + 1.0L + 0.5Lr + 1.0W (0.027)
1.2D + 1.0L + 0.5S + 1.0W (0.027)
1.2D + 1.0L + 0.5R + 1.0W (0.027)
$(1.2 + 0.2 \times S_{DS})D + 1.0L + 0.2S + 1.0E$ (0.070)
0.9D + 1.0W (0.016)
$(0.9 - 0.2 \times S_{DS})D + 1.0E$ (0.056)

**Combination 14 results: $(1.2 + 0.2 \times S_{DS})D + 1.0L + 0.2S + 1.0E$**

**Forces on foundation per linear foot**

Ultimate force in z-axis $F_{uz} = \gamma_D \times A \times (F_{swt} + F_{soil} + F_{Dsur}) + \gamma_D \times F_{Dz1} + \gamma_L \times F_{Lz1} = \mathbf{2.6}$ kips

**Moments on foundation per linear foot**

Ultimate moment in y-axis, about y is 0 $M_{uy} = \gamma_D \times (A \times (F_{swt} + F_{soil} + F_{Dsur}) \times L_y / 2) + \gamma_D \times (F_{Dz1} \times y_1) + \gamma_L \times (F_{Lz1} \times y_1) + \gamma_E \times (M_{Ey1}) = \mathbf{4.8}$ kip_ft

**Eccentricity of base reaction**

Eccentricity of base reaction in y-axis $e_{uy} = M_{uy} / F_{uz} - L_y / 2 = \mathbf{4.496}$ in

**Strip base pressures**

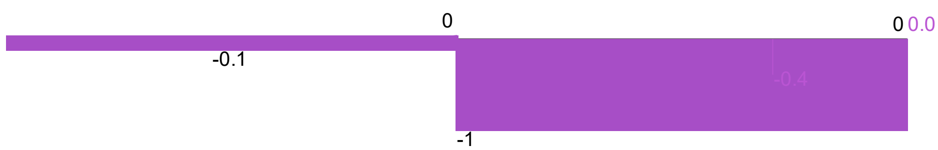
$q_{u1} = \mathbf{0.214}$ ksf

$q_{u2} = F_{uz} \times (1 + 6 \times e_{uy} / L_y) / (L_y \times 1\text{ ft}) = \mathbf{1.494}$ ksf

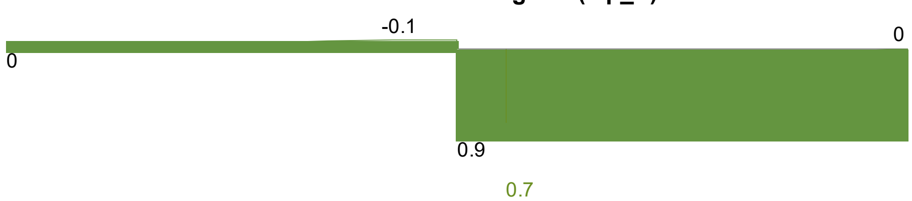
Minimum ultimate base pressure $q_{umin} = \min(q_{u1},q_{u2}) = \mathbf{0.214}$ ksf

Maximum ultimate base pressure $q_{umax} = \max(q_{u1},q_{u2}) = \mathbf{1.494}$ ksf

**Shear diagram (kips)**




**Moment diagram (kip_ft)**




**Moment design, y direction, positive moment**

Ultimate bending moment $M_{u.y.max} = \mathbf{0.711}$ kip_ft

Tension reinforcement provided No.5 bars at 14.0 in c/c bottom

Area of tension reinforcement provided $A_{sy.bot.prov} = \mathbf{0.266}$ in$^2$

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| | Calc. by<br>SJV | Date<br>4/26/2018 | Chk'd by | Date | App'd by | Date |

Minimum area of reinforcement (7.6.1.1) $A_{s.min} = 0.0018 \times L_x \times h =$ **0.259** $in^2$

***PASS - Area of reinforcement provided exceeds minimum***

Maximum spacing of reinforcement (7.7.2.3) $s_{max} = \min(3 \times h, 18\ in) =$ **18** in

***PASS - Maximum permissible reinforcement spacing exceeds actual spacing***

Depth to tension reinforcement $d = h - c_{nom} - \phi_{y.bot} / 2 =$ **8.688** in

Depth of compression block $a = A_{sy.bot.prov} \times f_y / (0.85 \times f'_c \times L_x) =$ **0.347** in

Neutral axis factor $\beta_1 =$ **0.83**

Depth to neutral axis $c = a / \beta_1 =$ **0.421** in

Strain in tensile reinforcement (7.3.3.1) $\varepsilon_t = 0.003 \times d / c - 0.003 =$ **0.05890**

***PASS - Tensile strain exceeds minimum required, 0.004***

Nominal moment capacity $M_n = A_{sy.bot.prov} \times f_y \times (d - a / 2) =$ **11.311** kip_ft

Flexural strength reduction factor $\phi_f = \min(\max(0.65 + (\varepsilon_t - 0.002) \times (250 / 3), 0.65), 0.9) =$ **0.900**

Design moment capacity $\phi M_n = \phi_f \times M_n =$ **10.18** kip_ft

$M_{u.y.max} / \phi M_n =$ **0.070**

***PASS - Design moment capacity exceeds ultimate moment load***

**Moment design, y direction, negative moment**

Ultimate bending moment $M_{u.y.min} =$ **-0.092** kip_ft

Tension reinforcement provided No.5 bars at 14.0 in c/c top

Area of tension reinforcement provided $A_{sy.top.prov} =$ **0.266** $in^2$

Minimum area of reinforcement (7.6.1.1) $A_{s.min} = 0.0018 \times L_x \times h =$ **0.259** $in^2$

***PASS - Area of reinforcement provided exceeds minimum***

Maximum spacing of reinforcement (7.7.2.3) $s_{max} = \min(3 \times h, 18\ in) =$ **18** in

***PASS - Maximum permissible reinforcement spacing exceeds actual spacing***

Depth to tension reinforcement $d = h - c_{nom} - \phi_{y.top} / 2 =$ **8.688** in

Depth of compression block $a = A_{sy.top.prov} \times f_y / (0.85 \times f'_c \times L_x) =$ **0.347** in

Neutral axis factor $\beta_1 =$ **0.83**

Depth to neutral axis $c = a / \beta_1 =$ **0.421** in

Strain in tensile reinforcement (7.3.3.1) $\varepsilon_t = 0.003 \times d / c - 0.003 =$ **0.05890**

***PASS - Tensile strain exceeds minimum required, 0.004***

Nominal moment capacity $M_n = A_{sy.top.prov} \times f_y \times (d - a / 2) =$ **11.311** kip_ft

Flexural strength reduction factor $\phi_f = \min(\max(0.65 + (\varepsilon_t - 0.002) \times (250 / 3), 0.65), 0.9) =$ **0.900**

Design moment capacity $\phi M_n = \phi_f \times M_n =$ **10.18** kip_ft

$\mathrm{abs}(M_{u.y.min}) / \phi M_n =$ **0.009**

***PASS - Design moment capacity exceeds ultimate moment load***

**One-way shear design, y direction**

Ultimate shear force $V_{u.y} =$ **0.399** kips

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|---|---|---|---|---|---|---|
| | Section<br>Masonry Cant. Footing | | | | Sheet no./rev.<br>6 | |
| | Calc. by<br>SJV | Date<br>4/26/2018 | Chk'd by | Date | App'd by | Date |

Depth to reinforcement $d_v = \min(h - c_{nom} - \phi_{y.bot} / 2, h - c_{nom} - \phi_{y.top} / 2) =$ **8.688** in

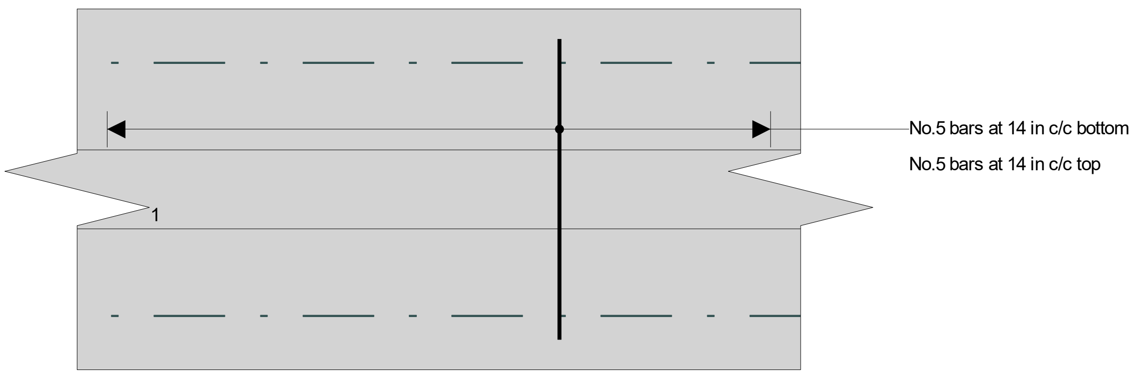
Shear strength reduction factor $\phi_v =$ **0.75**

Nominal shear capacity (Eq. 22.5.5.1) $V_n = 2 \times \lambda \times \sqrt{(f'_c \times 1 \text{ psi})} \times L_x \times d_v =$ **13.987** kips

Design shear capacity $\phi V_n = \phi_v \times V_n =$ **10.49** kips

$V_{u.y} / \phi V_n =$ **0.038**

***PASS - Design shear capacity exceeds ultimate shear load***



# Walls

07-May-18
4:14 PM

**Simply Supported Masonry Beam Allowable Stress Design (MSJC 2013)**

Version Date: July 11, 2016 Author: Troy M. Dye Author: Jeremy L. Achter

JOB TITLE: Kimberly Clark Addition JOB #: 18054

ENGINEERS

**DEFLECTION CRITERIA**

| | | |
|---|---|---|
| L / | 360 | Total Load |
| L / | 240 | Live Load |

**MASONRY PROPERTIES**

2000 psi

**STEEL PROPERTIES**

25600 psi

**SPECIAL INSPECTION**

Y

**MATERIAL PROPERTIES**

| | F'$_m$ | E$_m$ |
|---|---|---|
| **1500** | 1500 | 1125000 |
| **2000** | 2000 | 1500000 |
| **2500** | 2500 | 1875000 |
| **3000** | 3000 | 2250000 |

| F$_t$ | |
|---|---|
| 80 | psi |

See Table 2.2.3.2
Type S mortar fully grouted running bond

**SECTION PROPERTIES**

| | | | | | | | | | | | | 24 | | | LB-FT | LBS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | b | Grout depth | d | $I_{eff}$ | $M_{cr}$ | # Tension Bars | Area ea. Tension Bar | Shear Bars $A_v$ | Shear Bar Spacing | n | np | k | j | 2/kj | $M_{allow}$ | $V_s$ Reinf. Capacity |
| **8-16 A** | 7.625 | 16 | 10 | 912 | 1464 | 1 | 0.20 | 0.20 | 8 | 16.1 | 0.042 | 0.252 | 0.92 | 8.68 | 3909 | 5120 |
| **8-24 A** | 7.625 | 24 | 18 | 3699 | 4941 | 2 | 0.20 | 0.20 | 8 | 16.1 | 0.047 | 0.263 | 0.91 | 8.33 | 14013 | 7680 |
| **8-32 A** | 7.625 | 32 | 26 | 9622 | 10590 | 2 | 0.31 | 0.20 | 8 | 16.1 | 0.050 | 0.271 | 0.91 | 8.11 | 31282 | 10240 |
| **8-40 A** | 7.625 | 40 | 34 | 17254 | 13679 | 2 | 0.20 | 0.20 | 8 | 16.1 | 0.025 | 0.199 | 0.93 | 10.74 | 27084 | 12800 |
| **8-40 B** | 7.625 | 40 | 28 | 20450 | 15365 | 4 | 0.31 | 0.20 | 8 | 16.1 | 0.094 | 0.349 | 0.88 | 6.48 | 50704 | 12800 |
| **8-48 A** | 7.625 | 48 | 34 | 26909 | 16325 | 2 | 0.31 | 0.20 | 8 | 16.1 | 0.039 | 0.242 | 0.92 | 9.00 | 41347 | 15360 |
| **8-48 B** | 7.625 | 48 | 36 | 34299 | 23257 | 4 | 0.31 | 0.20 | 8 | 16.1 | 0.073 | 0.316 | 0.89 | 7.08 | 76748 | 15360 |
| **8-48 C** | 7.625 | 48 | 34 | 38628 | 24318 | 6 | 0.31 | 0.20 | 8 | 16.1 | 0.116 | 0.379 | 0.87 | 6.04 | 80249 | 15360 |
| **12-16 A** | 11.625 | 16 | 10 | 1738 | 2901 | 2 | 0.31 | 0.40 | 8 | 16.1 | 0.086 | 0.337 | 0.89 | 6.68 | 9574 | 10240 |
| **12-24 A** | 11.625 | 24 | 18 | 5665 | 7581 | 2 | 0.31 | 0.40 | 8 | 16.1 | 0.048 | 0.265 | 0.91 | 8.28 | 21706 | 15360 |
| **12-32 A** | 11.625 | 32 | 26 | 13270 | 13694 | 2 | 0.31 | 0.40 | 24 | 16.1 | 0.033 | 0.226 | 0.92 | 9.56 | 31797 | 6827 |
| **12-40 A** | 11.625 | 40 | 34 | 26298 | 20998 | 2 | 0.31 | 0.40 | 24 | 16.1 | 0.025 | 0.201 | 0.93 | 10.67 | 41958 | 8533 |
| **12-40 B** | 11.625 | 40 | 28 | 26561 | 20160 | 4 | 0.31 | 0.40 | 24 | 16.1 | 0.061 | 0.294 | 0.90 | 7.53 | 66530 | 8533 |
| **12-48 A** | 11.625 | 48 | 42 | 47248 | 29343 | 2 | 0.31 | 0.40 | 24 | 16.1 | 0.020 | 0.183 | 0.94 | 11.65 | 52166 | 10240 |
| **12-48 B** | 11.625 | 48 | 38 | 46875 | 33092 | 4 | 0.31 | 0.40 | 24 | 16.1 | 0.045 | 0.259 | 0.91 | 8.45 | 91847 | 10240 |

INDICATES THE CONTROLLING ALLOWABLE UNIFORM LOAD

**2000** ***ALLOWABLE TOTAL UNIFORM LOAD (PLF) Based on bending stress*** $\omega = 10*M_{allow}/L^2$

| SPAN (FT) | 8-16 A | 8-24 A | 8-32 A | 8-40 A | 8-40 B | 8-48 A | 8-48 B | 8-48 C | 12-16 A | 12-24 A | 12-32 A | 12-40 A | 12-40 B | 12-48 A | 12-48 B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **6** | 1086 | 3893 | 8690 | 7523 | 14084 | 11485 | 21319 | 22291 | 2659 | 6029 | 8832 | 11655 | 18480 | 14491 | 25513 |
| **7** | 798 | 2860 | 6384 | 5527 | 10348 | 8438 | 15663 | 16377 | 1954 | 4430 | 6489 | 8563 | 13577 | 10646 | 18744 |
| **8** | 611 | 2190 | 4888 | 4232 | 7922 | 6460 | 11992 | 12539 | 1496 | 3392 | 4968 | 6556 | 10395 | 8151 | 14351 |
| **9** | 483 | 1730 | 3862 | 3344 | 6260 | 5105 | 9475 | 9907 | 1182 | 2680 | 3926 | 5180 | 8214 | 6440 | 11339 |
| **10** | 391 | 1401 | 3128 | 2708 | 5070 | 4135 | 7675 | 8025 | 957 | 2171 | 3180 | 4196 | 6653 | 5217 | 9185 |
| **11** | 323 | 1158 | 2585 | 2238 | 4190 | 3417 | 6343 | 6632 | 791 | 1794 | 2628 | 3468 | 5498 | 4311 | 7591 |
| **12** | 271 | 973 | 2172 | 1881 | 3521 | 2871 | 5330 | 5573 | 665 | 1507 | 2208 | 2914 | 4620 | 3623 | 6378 |
| **13** | 231 | 829 | 1851 | 1603 | 3000 | 2447 | 4541 | 4748 | 567 | 1284 | 1881 | 2483 | 3937 | 3087 | 5435 |
| **14** | 199 | 715 | 1596 | 1382 | 2587 | 2110 | 3916 | 4094 | 488 | 1107 | 1622 | 2141 | 3394 | 2662 | 4686 |
| **15** | 174 | 623 | 1390 | 1204 | 2253 | 1838 | 3411 | 3567 | 426 | 965 | 1413 | 1865 | 2957 | 2318 | 4082 |
| **16** | 153 | 547 | 1222 | 1058 | 1981 | 1615 | 2998 | 3135 | 374 | 848 | 1242 | 1639 | 2599 | 2038 | 3588 |
| **18** | 121 | 433 | 966 | 836 | 1565 | 1276 | 2369 | 2477 | 295 | 670 | 981 | 1295 | 2053 | 1610 | 2835 |
| **20** | 98 | 350 | 782 | 677 | 1268 | 1034 | 1919 | 2006 | 239 | 543 | 795 | 1049 | 1663 | 1304 | 2296 |

**2000** ***ALLOWABLE TOTAL UNIFORM LOAD (PLF) Based on shear stress*** $\omega = 2*V_{allow}/L$

| SPAN (FT) | 8-16 A | 8-24 A | 8-32 A | 8-40 A | 8-40 B | 8-48 A | 8-48 B | 8-48 C | 12-16 A | 12-24 A | 12-32 A | 12-40 A | 12-40 B | 12-48 A | 12-48 B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **6** | 3880 | 6584 | 9256 | 11928 | 11928 | 14600 | 14600 | 14600 | 5915 | 10536 | 11183 | 14525 | 14525 | 17866 | 17866 |
| **7** | 3118 | 5439 | 7729 | 10019 | 10019 | 12310 | 12310 | 12310 | 4753 | 8556 | 9273 | 12138 | 12138 | 15002 | 15002 |
| **8** | 2728 | 4580 | 6584 | 8588 | 8588 | 10592 | 10592 | 10592 | 4159 | 7070 | 7841 | 10348 | 10348 | 12854 | 12854 |
| **9** | 2425 | 3880 | 5693 | 7474 | 7474 | 9256 | 9256 | 9256 | 3697 | 5915 | 6727 | 8955 | 8955 | 11183 | 11183 |
| **10** | 2182 | 3274 | 4981 | 6584 | 6584 | 8187 | 8187 | 8187 | 3327 | 4991 | 5836 | 7841 | 7841 | 9846 | 9846 |
| **11** | 1984 | 2976 | 4398 | 5855 | 5855 | 7313 | 7313 | 7313 | 3025 | 4537 | 5107 | 6930 | 6930 | 8753 | 8753 |
| **12** | 1819 | 2728 | 3880 | 5248 | 5248 | 6584 | 6584 | 6584 | 2773 | 4159 | 4500 | 6171 | 6171 | 7841 | 7841 |
| **13** | 1679 | 2518 | 3414 | 4734 | 4734 | 5967 | 5967 | 5967 | 2559 | 3839 | 3986 | 5528 | 5528 | 7070 | 7070 |
| **14** | 1559 | 2338 | 3118 | 4294 | 4294 | 5439 | 5439 | 5439 | 2377 | 3565 | 3649 | 4977 | 4977 | 6409 | 6409 |
| **15** | 1455 | 2182 | 2910 | 3880 | 3880 | 4981 | 4981 | 4981 | 2218 | 3327 | 3406 | 4500 | 4500 | 5836 | 5836 |
| **16** | 1364 | 2046 | 2728 | 3501 | 3501 | 4580 | 4580 | 4580 | 2080 | 3119 | 3193 | 4082 | 4082 | 5335 | 5335 |
| **18** | 1212 | 1819 | 2425 | 3031 | 3031 | 3880 | 3880 | 3880 | 1848 | 2773 | 2838 | 3548 | 3548 | 4500 | 4500 |
| **20** | 1091 | 1637 | 2182 | 2728 | 2728 | 3274 | 3274 | 3274 | 1664 | 2495 | 2554 | 3193 | 3193 | 3831 | 3831 |

**2000** ***ALLOWABLE TOTAL UNIFORM LOAD (PLF) Based on deflection*** $\omega = 384*E*I_{eff}*12/(DEFLECTION\ CRITERIA*5*(L*12)^3)$

| SPAN (FT) | 8-16 A | 8-24 A | 8-32 A | 8-40 A | 8-40 B | 8-48 A | 8-48 B | 8-48 C | 12-16 A | 12-24 A | 12-32 A | 12-40 A | 12-40 B | 12-48 A | 12-48 B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **6** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| **7** | 5909 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 11257 | N/A | N/A | N/A | N/A | N/A | N/A |
| **8** | 3959 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 7541 | N/A | N/A | N/A | N/A | N/A | N/A |
| **9** | 2780 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 5297 | N/A | N/A | N/A | N/A | N/A | N/A |
| **10** | 2027 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 3861 | N/A | N/A | N/A | N/A | N/A | N/A |
| **11** | 1523 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 2901 | N/A | N/A | N/A | N/A | N/A | N/A |
| **12** | 1173 | 4757 | N/A | N/A | N/A | N/A | N/A | N/A | 2234 | 7286 | N/A | N/A | N/A | N/A | N/A |
| **13** | 923 | 3742 | N/A | N/A | N/A | N/A | N/A | N/A | 1757 | 5730 | N/A | N/A | N/A | N/A | N/A |
| **14** | 739 | 2996 | N/A | N/A | N/A | N/A | N/A | N/A | 1407 | 4588 | N/A | N/A | N/A | N/A | N/A |
| **15** | 601 | 2436 | N/A | N/A | N/A | N/A | N/A | N/A | 1144 | 3730 | N/A | N/A | N/A | N/A | N/A |
| **16** | 495 | 2007 | N/A | N/A | N/A | N/A | N/A | N/A | 943 | 3074 | N/A | N/A | N/A | N/A | N/A |
| **18** | 348 | 1410 | 3666 | N/A | N/A | N/A | N/A | N/A | 662 | 2159 | 5056 | N/A | N/A | N/A | N/A |
| **20** | 253 | 1028 | 2673 | N/A | 5681 | N/A | N/A | N/A | 483 | 1574 | 3686 | N/A | 7378 | N/A | N/A |

*N/A indicates span length exceeds 8 times effective beam depth and therefore deflection need not be checked (1.13.3.3)*

**2000** ***ALLOWABLE LIVE UNIFORM LOAD (PLF) Based on deflection*** $\omega = 384*E*I_{eff}*12/(DEFLECTION\ CRITERIA*5*(L*12)^3)$

| SPAN (FT) | 8-16 A | 8-24 A | 8-32 A | 8-40 A | 8-40 B | 8-48 A | 8-48 B | 8-48 C | 12-16 A | 12-24 A | 12-32 A | 12-40 A | 12-40 B | 12-48 A | 12-48 B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **6** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| **7** | 5909 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 11257 | N/A | N/A | N/A | N/A | N/A | N/A |
| **8** | 3959 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 7541 | N/A | N/A | N/A | N/A | N/A | N/A |
| **9** | 2780 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 5297 | N/A | N/A | N/A | N/A | N/A | N/A |
| **10** | 2027 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 3861 | N/A | N/A | N/A | N/A | N/A | N/A |
| **11** | 1523 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 2901 | N/A | N/A | N/A | N/A | N/A | N/A |
| **12** | 1173 | 4757 | N/A | N/A | N/A | N/A | N/A | N/A | 2234 | 7286 | N/A | N/A | N/A | N/A | N/A |
| **13** | 923 | 3742 | N/A | N/A | N/A | N/A | N/A | N/A | 1757 | 5730 | N/A | N/A | N/A | N/A | N/A |
| **14** | 739 | 2996 | N/A | N/A | N/A | N/A | N/A | N/A | 1407 | 4588 | N/A | N/A | N/A | N/A | N/A |
| **15** | 601 | 2436 | N/A | N/A | N/A | N/A | N/A | N/A | 1144 | 3730 | N/A | N/A | N/A | N/A | N/A |
| **16** | 495 | 2007 | N/A | N/A | N/A | N/A | N/A | N/A | 943 | 3074 | N/A | N/A | N/A | N/A | N/A |
| **18** | 348 | 1410 | 3666 | N/A | N/A | N/A | N/A | N/A | 662 | 2159 | 5056 | N/A | N/A | N/A | N/A |
| **20** | 253 | 1028 | 2673 | N/A | 5681 | N/A | N/A | N/A | 483 | 1574 | 3686 | N/A | 7378 | N/A | N/A |

*N/A indicates span length exceeds 8 times effective beam depth and therefore deflection need not be checked (1.13.3.3)*

ARW ENGINEERS structural consultants

## IBC2015 SLENDER MASONRY WALL ANALYSIS

7-May-18

Version Date: November 3, 2017 | Author: Zach Hansen | Reviewed By: Troy Dye | 4:20 PM

| | | | |
|---|---|---|---|
| JOB TITLE: | Kimberly Clark Addition | JOB #: | 18054 |
| WALL LOCATION: | Electrical Room | DESIGNED BY: | SJV |
| | Wall Design | | |

**USING TMS 402-13 / ACI 530-13 / ASCE 5-13**

| | | | | | |
|---|---|---|---|---|---|
| TOTAL WALL HEIGHT : (w/o parapet included) | 16.833 | feet | **APPLIED VERTICAL LOADS:** | | |
| UNSUPPORTED HEIGHT : (effective height) | 15 | feet | DEAD : | 280 | plf |
| PARAPET HEIGHT : | 1.833 | feet | ROOF LIVE : | 280 | plf |
| WALL THICKNESS (Actual) : | 7.625 | inches | SNOW : | 2380 | plf (wost case drift) |
| WALL WEIGHT : | 48 | psf | LIVE : | 0 | plf |
| {6000 max} $f'_m$ : (Special Inspection Required) | 2000 | psi | ECCENTRICITY : | 6 | inches |
| REBAR $F_y$ : | 60 | ksi | $f_1$ : | 0.5 | |
| TWO WYTHE WALL : | N | (Y/N) | $f_2$ : | 0.2 | |
| DIMENSION d : {comp. face to rebar cent.} | 3.8125 | inches | **APPLIED LATERAL LOADS:** | | |
| WALL SPAN DIRECTION: (Vert. or Horiz.) | V | (V/H) | WIND W: | 40.0 | psf |
| MORTAR TYPE : | S | (M, S, or N) | SEISMIC E: | 20.0 | psf |
| SOLID GROUTED? | N | (Y/N) | (Two Wythe Walls Must Be Solid Grouted) | | |

| | | | |
|---|---|---|---|
| $A_s$ Minimum : | 0.064 | $in^2/ft$ | (TMS 402-13/ACI 530-13/ASCE 5-13 7.3.2.6(c)) |
| Steel Strain, $\varepsilon_t$ : | 0.0100 | | (TMS 402-13/ACI 530-13/ASCE 5-13 9.3.3.5) |
| Max Reinf. Area : | 0.42 | $in^2/ft$ | (TMS 402-13/ACI 530-13/ASCE 5-13 9.3.3.5.1) |
| Factored Axial Load Stress : | 103.82 | psi | **h'/t<30 - Fa < 0.2f'm - O.K.** |
| $\varphi$ : | 0.9 | | (TMS 402-13/AC 530-13/ASCE 5-13 9.1.4.4) |
| $E_m$ : | 900 | f'm | |
| Masonry Modulus of Elasticity $E_m$ : | 1800 | ksi | Modular Ratio n: 16.1 |
| ACI 530-08 Allowable D (0.007 h) | 1.26 | in | |
| User Allowable D L/ 140 | 1.29 | in | |
| Allowable D : | **1.26** | in | |

**SUMMARY**

| | | | | | | |
|---|---|---|---|---|---|---|
| Vertical Bars Try # | **5** | bars | One Layer | | | |
| Bar Spacing @ | **32** | " o.c. | | | | |
| Trial $A_s$ : | **0.12** | sq in/ft | **OK** | | | |
| vert ratio As = | 0.0013 | | no. | (#) | spa. | ratio |
| horiz. ratio req'd = | 0.0007 | => | 2 | 4 | 48 | 0.0011 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **STRENGTH LOAD CASE (16-2) => 1.2D+1.6L+0.5(Lr or S)** | | | | **SERVICE LOAD CASES (16-9), (16-10), & (16-11) =>** | | | |
| $M_u$ = | 4.63 | k-in/ft | | **D L & D+(Lr or S) & D+0.75L+0.75(Lr or S)** | | | |
| $\varphi M_n$ = | 29.96 | k-in/ft | **...OK** | $\Delta_s$ : | 0.04 | in | **...OK** |
| **STRENGTH LOAD CASE (16-3) => 1.2D+1.6(Lr or S)+ 0.5W** | | | | **SERVICE LOAD CASE (16-12) =>** | | | |
| $M_u$ = | 22.65 | k-in/ft | | **D+(0.6W or 0.7E)** | | | |
| $\varphi M_n$ = | 38.47 | k-in/ft | **...OK** | $\Delta_s$ : | 0.05 | in | **...OK** |
| **STRENGTH LOAD CASE (16-4) => 1.2D+1.0W+f1L+0.5(Lr or S)** | | | | **SERVICE LOAD CASE (16-13) =>** | | | |
| $M_u$ = | 19.40 | k-in/ft | | **D+0.45W+0.75L+0.75(Lr or S)** | | | |
| $\varphi M_n$ = | 29.96 | k-in/ft | **...OK** | $\Delta_s$ : | 0.14 | in | **...OK** |
| **STRENGTH LOAD CASES (16-6) & (16-7) => 0.9D+(W or E)** | | | | **SERVICE LOAD CASE (16-14) =>** | | | |
| $M_u$ = | 9.26 | k-in/ft | | **D+0.525E+0.75L+0.75S** | | | |
| $\varphi M_n$ = | 27.57 | k-in/ft | **...OK** | $\Delta_s$ : | 0.05 | in | **...OK** |
| **STRENGTH LOAD CASES (16-6) & (16-7) => 0.9D+(W or E)** | | | | **SERVICE LOAD CASES (16-15) & (16-16) =>** | | | |
| $M_u$ = | 14.46 | k-in/ft | | **0.6D+0.6W & 0.6D+0.7E** | | | |
| $\varphi M_n$ = | 25.18 | k-in/ft | **...OK** | $\Delta_s$ : | 0.05 | in | **...OK** |

## DETAILED ANALYSIS

| STRENGTH LOAD CASE (16-2) => 1.2D+1.6L+0.5(Lr or S) | | | SERVICE LOAD CASES (16-9), (16-10), & (16-11) => D + L, D + (Lr or S), D + 0.75L + 0.75(Lr or S) | | |
|---|---|---|---|---|---|
| $P_{uf}$ = | 1.53 | k/ft | $P_{sf}$ = | 2.660 | k/ft |
| $P_{uw}$ = | 0.59 | k/ft | $P_{sw}$ = | 0.49 | k/ft |
| $P_u$ = | 2.12 | k/ft | $P_s$ = | 3.15 | k/ft |
| $F_a$ = | 46.41 | psi | $\omega_s$ = | 0 | psf |
| $\omega_u$ = | 0 | psf | $M_s$ = | 8.12 | k-in/ft |
| $M_u$ = | 4.63 | k-in/ft | $\Delta_s$ : | 0.04 | inches |
| $\varphi M_n$ = | 29.96 | k-in/ft | | | |
| $\Delta_u$ : | 0.03 | inches | | | |
| **STRENGTH LOAD CASE (16-3) => 1.2D+1.6(Lr or S)+ 0.5W** | | | **SERVICE LOAD CASE (16-12) => D + (0.6W or 0.7E)** | | |
| $P_{uf}$ = | 4.14 | k/ft | $P_{sf}$ = | 0.280 | k/ft |
| $P_{uw}$ = | 0.59 | k/ft | $P_{sw}$ = | 0.49 | k/ft |
| $P_u$ = | 4.73 | k/ft | $P_s$ = | 0.77 | k/ft |
| $F_a$ = | 103.82 | psi | $\omega_s$ = | 24 | psf |
| $\omega_u$ = | 20.00 | psf | $M_s$ = | 8.98 | k-in/ft |
| $M_u$ = | 22.65 | k-in/ft | $\Delta_s$ : | 0.05 | inches |
| $\varphi M_n$ = | 38.47 | k-in/ft | | | |
| $\Delta_u$ : | 0.73 | inches | | | |
| **STRENGTH LOAD CASE (16-4) => 1.2D+1.0W+$f_1$L+0.5(Lr or S)** | | | **SERVICE LOAD CASE (16-13) => D + 0.45W + 0.75L + 0.75(Lr or S)** | | |
| $P_{uf}$ = | 1.53 | k/ft | $P_{sf}$ = | 2.065 | k/ft |
| $P_{uw}$ = | 0.59 | k/ft | $P_{sw}$ = | 0.49 | k/ft |
| $P_u$ = | 2.12 | k/ft | $P_s$ = | 2.56 | k/ft |
| $F_a$ = | 46.41 | psi | $\omega_s$ = | 18 | psf |
| $\omega_u$ = | 40.00 | psf | $M_s$ = | 12.62 | k-in/ft |
| $M_u$ = | 19.40 | k-in/ft | $\Delta_s$ : | 0.14 | inches |
| $\varphi M_n$ = | 29.96 | k-in/ft | | | |
| $\Delta_u$ : | 0.62 | inches | | | |
| **STRENGTH LOAD CASE (16-5) => 1.2D+1.0E+$f_1$L+$f_2$S** | | | **SERVICE LOAD CASE (16-14) => D + 0.525E + 0.75L + 0.75S** | | |
| $P_{uf}$ = | 0.81 | k/ft | $P_{sf}$ = | 2.065 | k/ft |
| $P_{uw}$ = | 0.59 | k/ft | $P_{sw}$ = | 0.49 | k/ft |
| $P_u$ = | 1.40 | k/ft | $P_s$ = | 2.56 | k/ft |
| $F_a$ = | 30.75 | psi | $\omega_s$ = | 10.5 | psf |
| $\omega_u$ = | 20.00 | psf | $M_s$ = | 9.88 | k-in/ft |
| $M_u$ = | 9.26 | k-in/ft | $\Delta_s$ : | 0.05 | inches |
| $\varphi M_n$ = | 27.57 | k-in/ft | | | |
| $\Delta_u$ : | 0.05 | inches | | | |
| **STRENGTH LOAD CASES (16-6) & (16-7) => 0.9D+(W or E)** | | | **SERVICE LOAD CASES (16-15) & (16-16) => 0.6D + 0.6W, 0.6D + 0.7E** | | |
| $P_{uf}$ = | 0.25 | k/ft | $P_{sf}$ = | 0.168 | k/ft |
| $P_{uw}$ = | 0.44 | k/ft | $P_{sw}$ = | 0.49 | k/ft |
| $P_u$ = | 0.69 | k/ft | $P_s$ = | 0.66 | k/ft |
| $F_a$ = | 15.24 | psi | $\omega_s$ = | 24 | psf |
| $\omega_u$ = | 40.00 | psf | $M_s$ = | 8.64 | k-in/ft |
| $M_u$ = | 14.46 | k-in/ft | $\Delta_s$ : | 0.05 | inches |
| $\varphi M_n$ = | 25.18 | k-in/ft | | | |
| $\Delta_u$ : | 0.30 | inches | | | |

24' Opening Attachment

Panel weight = 9.25" x 16' x 24' x 150pcf = 44.4 K

(4) Attachment Points

t.s = 10'

Dead = 13psf (10') = 130plf x 24' = 3.12k

Snow = 30 psf (10') x 24' = 7.2 k

1.4D = 66.64k

1.2D+1.6S = 68.6k ← Controls

68.6k / 4 Attachment points = 17.2 k / Attachment.

Steel

$17.2k = 0.9(0.6)(36)(3/4" \times w) \Rightarrow w = 1.2$ in

Weld

$17.2k = 1.392(5)(l) \Rightarrow l = 2.5"$

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**IBC 2015 Cast-in-place Anchor Bolt Design referencing ACI 318-14 Chapter 17**

Version Date: December 5, 2017 Author: Troy M. Dye Reviewed By: Scott Porter

JOB TITLE: Kimberly Clark Addition JOB #: 18054
DESCRIPTION: Worst Case End Anchors DESIGNER: SJV

## Pier and Anchor Bolt Geometry

| | Min Edge or Spacing | | Bolt Quantities |
|---|---|---|---|
| Top Pier Edge | 12 | | |
| AB-f5 | 0 | | |
| AB-f4 | 0 | | |
| AB-f3 | 0 | | |
| AB-f2 | 8 | | 2 |
| AB-f1 | 10 | | 2 |
| Column centerline | 0 | << | |
| AB-b1 | 10 | | 2 |
| AB-b2 | 8 | | 2 |
| AB-b3 | 8 | | 2 |
| AB-b4 | 0 | | |
| AB-b5 | 0 | | |
| Bottom Pier Edge | 12 | | 10 # Bolts in Group |

Pier Dimensions
36.0 " wide
68.0 " long

| | | |
|---|---|---|
| Left Pier Edge | 12 | |
| AB-l1 | 6 | |
| Column centerline | 0 | << |
| AB-r1 | 6 | |
| Right Pier Edge | 12 | |

Bolt Group Dimensions
12.0 " wide
44.0 " long

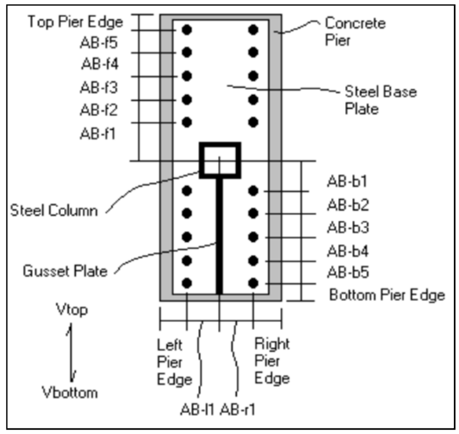


*Figure 1. Generic Anchor Bolt Locations*

## Design Loads

**Shear $V_u$ :** **420** kips *Use ACI 318 Section 5.3 load combinations*

**Tension $P_u$:** **222** kips

**Increase Shear Vu and Tension Pu above by Omega**

| | |
|---|---|
| Is the seismic tension component more than 20% of the total factored tension force? | YES |
| Pier confined for tension force? | YES |
| Pier confined for shear force? | YES |

| | | |
|---|---|---|
| Anchors Torqued: | NO | |
| Bolt Grade: | F1554 Gr. 55 | |
| Bolt Diameter: | 2 | inches |
| Embedment Length: | 24 | inches |
| Concrete $f'_c$: | 4500 | psi |
| Rebar $f_y$: | 60000 | psi |
| Anchor $F_u$ : | 75 | ksi |
| Bolt Area $A_{bolt}$ : | 2.50 | $in^2$ |
| Seismic Design Category Factor: | 0.75 | *Section 17.2.3.4.4* |
| Pier Ht / Ftg Thick: | 32 | inches **OK** |
| Bolt type: | H | |

Omega Level Force 17.2.3.4.3d & 17.2.3.5.3c

| | | |
|---|---|---|
| Bearing Area: | 5.86 | $in^2$ |
| Steel $\phi_t$: | 0.75 | *Section 17.3.3* |
| Steel $\phi_s$: | 0.65 | *Section 17.3.3* |
| Concrete $\phi$: | 0.75 | *Section 17.3.3* |
| $\lambda$ : | 1 | *Section 19.2.4* |
| $\lambda_a$ : | 1 | *Section 17.2.6* |

Eccentricity for Tension
4 in
Eccentricity for Shear
0

| *Bolt Diameter ($in^2$)* | *Threads per (inch)* | *Tensile Stress Area ($in^2$)* |
|---|---|---|
| 0.5 | 13 | 0.14 |
| 0.625 | 11 | 0.23 |
| 0.75 | 10 | 0.33 |
| 0.875 | 9 | 0.46 |
| 1 | 8 | 0.61 |
| 1.125 | 7 | 0.76 |
| 1.25 | 7 | 0.97 |
| 1.375 | 6 | 1.15 |
| 1.5 | 6 | 1.41 |
| 1.75 | 5 | 1.90 |
| 2 | 4.5 | 2.50 |
| 2.25 | 4.5 | 3.25 |
| 2.5 | 4 | 4.00 |
| 2.75 | 4 | 4.93 |
| 3 | 4 | 5.97 |

## Tension Calculations

| | | | | $c_{a2}$ | | | $c_{a1}$ | |
|---|---|---|---|---|---|---|---|---|
| $A_N$ : | 2448 | $in^2$ | Left Edge Dist. : | 12 | inches | Top Edge Dist. : | 12 | inches |
| $A_{NO}$ : | 576 | $in^2$ | Right Edge Dist. : | 12 | inches | Bottom Edge Dist. : | 12 | inches |

**Concrete Tension Capacity (Section 17.4.2) - Breakout Strength**

$\psi_{ec,N}$: 0.90 $\psi_{ed,N}$: 0.80 $\psi_{c,N}$: 1

$N_b$ = 34.3 kips $N_{cb}$ = 105.1 kips

**Concrete Tension Capacity (Section 17.4.3) - Pullout Strength**

$\psi_{c,P}$: 1 $N_{pn}$ = 210.9 kips

$N_p$ = 210.9 kips Capacity of Group: 2109.0 kips

**Concrete Tension Capacity (Section 17.4.4) - Side-Face Blowout Strength**

Use $A_N$ : 2448 $in^2$

$N_{sb}$ = N/A kips $N_{sbg}$ = N/A kips

**$\phi P_c$ :** 1186.3 kips **$P_c$ :** **2109.0** kips Ultimate Concrete Strength Based on Pullout Only

**Steel Tension Capacity (Section 17.4.1)**

**$P_{ss}'$ :** 187.4 kips / AB **$P_{ss}$ :** **1873.7** kips Ultimate Steel Tension Capacity

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## IBC 2015 Cast-in-place Anchor Bolt Design referencing ACI 318-14 Chapter 17

Version Date: December 5, 2017

JOB TITLE: Kimberly Clark Addition — JOB #: 18054

DESCRIPTION: Worst Case End Anchors — DESIGNER: SJV

### Shear Calculations

B — Specify which system resists shear

**Bolts Resisting Shear** — Bolts resist tension and shear

**Steel Shear Capacity (Section 17.5.1)**

$V_{sa}$ : 89.94 kips / AB — $\mathbf{V_{sa}}$ : $\boxed{899.4}$ kips — Ultimate Steel Shear Capacity based on Assumed Breakout Surface

n : 10 — Number of anchors resisting shear based on assumed concrete breakout surface

Grout height below base plate, $h_2$ : 1.5 inches

**Concrete Shear Breakout Capacity (Section 17.5.2)**

$\psi_{ec,V}$: 1.00 — $\psi_{ed,V}$: 0.90 — $\psi_{c,V}$: 1.2 — $\psi_{h,V}$: 1.00

| Top Edge Bolts | | | Bottom Edge Bolts | | |
|---|---|---|---|---|---|
| Edge Distance: | 12.0 | inches | Edge Distance : | 12.0 | inches |
| $A_{Vc}$ = | 648.0 | $in^2$ | $A_{Vc}$ = | 648.0 | $in^2$ |
| $A_{Vco}$ = | 648.0 | $in^2$ | $A_{Vco}$ = | 648.0 | $in^2$ |
| $V_b$ = | 41.8 | kips | $V_b$ = | 41.8 | kips |
| $V_{cb}$ = | 45.2 | kips | $V_{cb}$ = | 45.2 | kips |

**Concrete Shear Pryout Capacity (Section 17.5.3)**

| | | | | | |
|---|---|---|---|---|---|
| $V_{cp}$ = | 1457.4 | kips | $N_b$ = | 214.3 | kips |
| Group Capacity $\mathbf{V_n}$: | $\boxed{1457.4}$ | kips | Group Capacity $\mathbf{V_n}$: | $\boxed{1457.4}$ | kips |

Ultimate Concrete Capacity Based on Pryout Strength Only

### Combined Tension and Shear

**Shear Force Acting Towards Top Pier Edge, $V_{top}$**

| | | |
|---|---|---|
| 0.512 | < 1 - OK | Concrete Shear ($V_u/\phi V_n$) |
| 0.718 | < 1 - OK | Steel Shear ($V_u/\phi V_{ss}$) |

**Anchor Bolts O.K.**
**Concrete O.K.**
Checks Shear Only

**Shear Force Acting Towards Bottom Pier Edge, $V_{bottom}$**

| | | |
|---|---|---|
| 0.187 | < 1 - OK | Concrete Tension ($P_u/\phi P_n$) |
| 0.512 | < 1 - OK | Concrete Shear ($V_u/\phi V_n$) |
| 0.512 | < 1 - OK | Concrete Combined (Section D.7) |
| 0.158 | < 1 - OK | Steel Tension ($P_u/\phi P_{ss}$) |
| 0.718 | < 1 - OK | Steel Shear ($V_u/\phi V_{ss}$) |
| 0.718 | < 1 - OK | Steel Combined (Section D.7) |

**Anchor Bolts O.K.**
**Concrete O.K.**
Checks Shear and Tension

**FORCES INCLUDE OMEGA PER 17.2.3.4.3d and 17.2.3.5.3c**

### DESIGN SUMMARY

**Anchor Bolts** — **(10) 2" diameter headed anchor bolts w/ 24"minimum embedment**

*Designed for combined tension and shear*

**Tension Confined Pier** — **36" wide x 68" long w/ min (16) #5 vertical bars**

*Designed to transfer anchor bolt tension into reinforcement*

**Shear Confined Pier** — **36" wide x 68" long w/ min (24) #4 hairpin**

*Designed to transfer anchor bolt shear into reinforcement*

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**IBC 2015 Cast-in-place Anchor Bolt Design referencing ACI 318-14 Chapter 17**

Version Date: December 5, 2017

JOB TITLE: Kimberly Clark Addition

DESCRIPTION: Worst Case End Anchors

JOB #: 18054

DESIGNER: SJV

## Anchor Reinforcing

***Reinforcing Data***

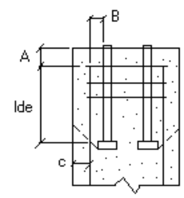
| | |
|---|---|
| $\Psi$t : | 1 |
| $\Psi$e : | 1 |
| $\Psi$s : | 1 |
| $\gamma$ : | 0.8 |

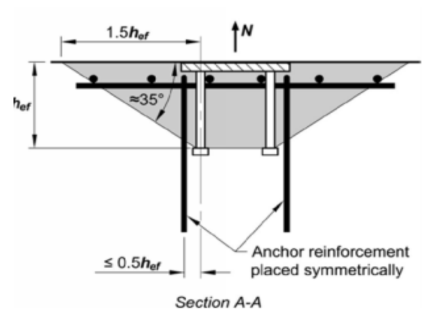
Assumes that vertical reinforcement layout is symmetrical around anchor bolt pattern

NOTE: The calculation for the concrete anchor capacities are based on 1) Tension pullout, 2) Shear pryout. The breakout strength in tension and shear and side face blowout are omitted because the vertical reinforcement is used to confine this failure cone.

***Pier Reinforcement to Resist Tension Breakout (17.4.2.9)***

| | | |
|---|---|---|
| Vert. Pier Reinforcing Size : | 5 | bar |
| Distance from A.B. to Rebar (B) : | 4 | in |
| Cover above vert. reinf (A) : | 2 | in |
| c : | 3 | in |
| Rebar Area : | 0.31 | $in^2$ |
| Rebar Diameter : | 0.625 | in |
| $l_{db}$ : | 17.44 | in |
| $l_{de}$ : | 18.00 | in |
| $0.75*F_y$ of Rebar @ $l_{de}$ - $f_s$ : | 45.00 | ksi |
| $A_{st}$ : | 4.93 | $in^2$ |
| Total # of vertical bars required : | 16 | Quantity of reinforcement placed symmetrically around anchor bolts |
| Embedment of standard hook : | 6.71 | in |




***Pier Reinforcement to Resist Shear Breakout (17.5.2.9)***

| | | |
|---|---|---|
| Hairpin/stirrup reinforcing size : | 4 | bar |
| Rebar area : | 0.4 | $in^2$ |
| $A_{st}$ : | 9.33 | $in^2$ |
| Total # of hairpins/stirrups required : | 24 | Quantity of hairpins or stirrups wrappe around anchor bolts |

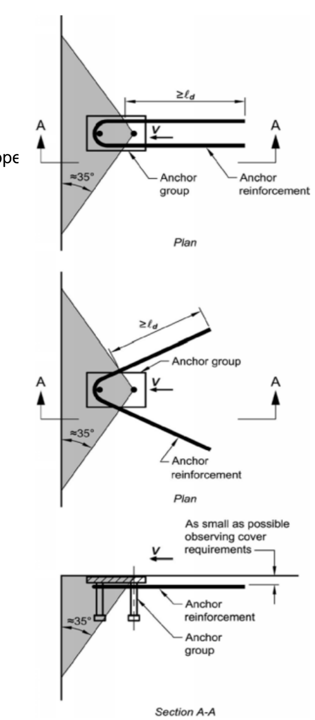



Fig. RD.6.2.9(a)—Hairpin anchor reinforcement for shear.

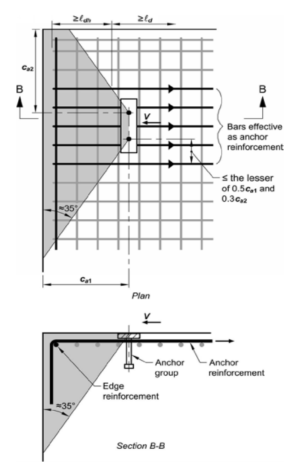



Fig. RD.6.2.9(b)—Edge reinforcement and anchor reinforcement for shear.

| | | | |
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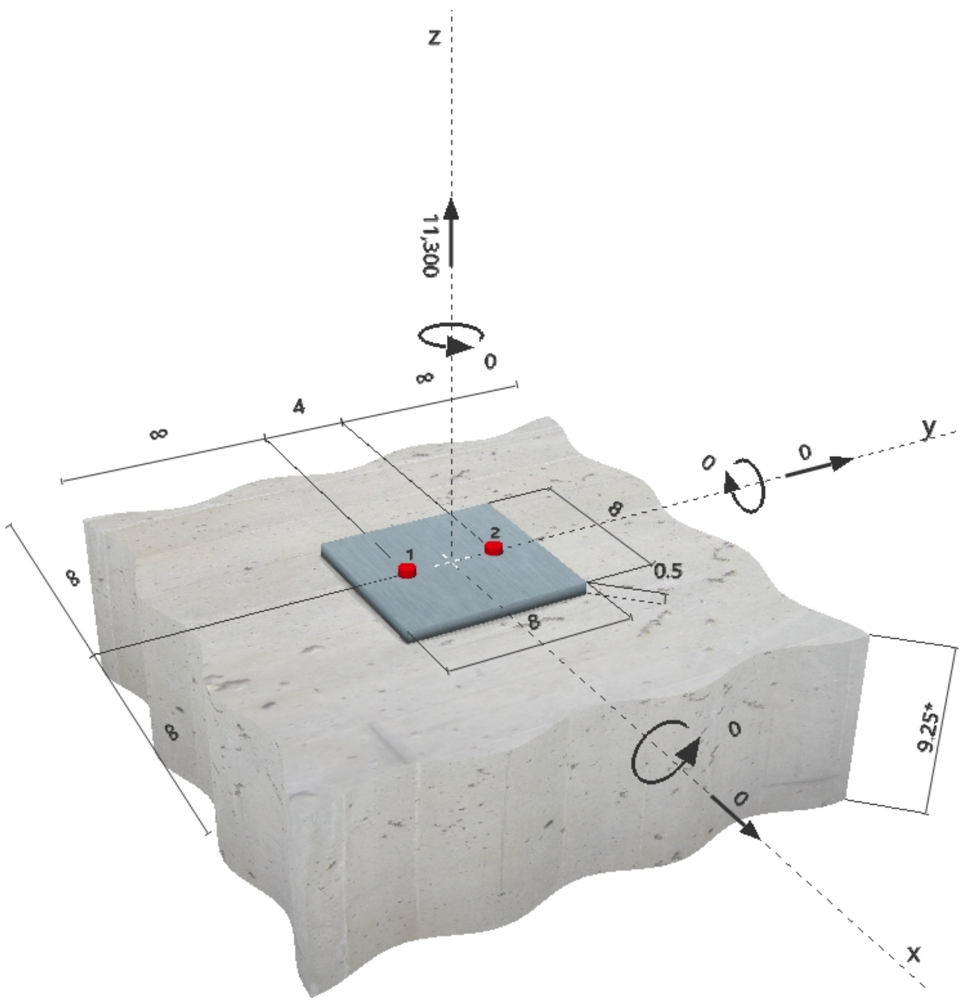
**Specifier's comments:** OOP Embed

## 1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **Hex Head ASTM F 1554 GR. 55 3/4** |
| Effective embedment depth: | $h_{ef}$ = 5.000 in. |
| Material: | ASTM F 1554 |
| Proof: | Design method ACI 318-14 / CIP |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 0.500 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 8.000 in. x 8.000 in. x 0.500 in.; (Recommended plate thickness: not calculated |
| Profile: | no profile |
| Base material: | cracked concrete, , $f_c'$ = 4,500 psi; h = 9.250 in. |
| Reinforcement: | tension: condition B, shear: condition B; |
| | edge reinforcement: none or < No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | Tension load: yes (17.2.3.4.3 (d)) |
| | Shear load: yes (17.2.3.5.3 (c)) |

**Geometry [in.] & Loading [lb, in.lb]**



| | | | |
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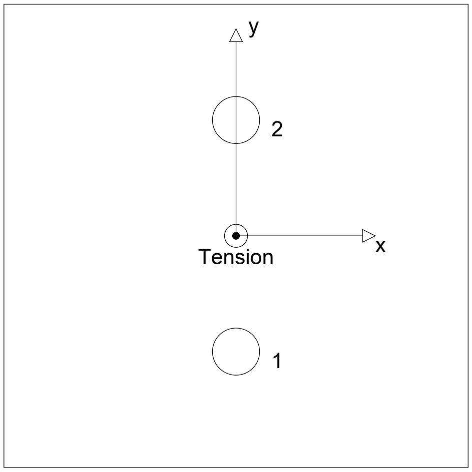
## 2 Load case/Resulting anchor forces




Load case: Design loads

**Anchor reactions [lb]**

Tension force: (+Tension, -Compression)

| Anchor | Tension force | Shear force | Shear force x | Shear force y |
|---|---|---|---|---|
| 1 | 5,650 | 0 | 0 | 0 |
| 2 | 5,650 | 0 | 0 | 0 |

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 11,300 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

## 3 Tension load

| | **Load $N_{ua}$ [lb]** | **Capacity $\phi$ $N_n$ [lb]** | **Utilization $\beta_N = N_{ua}/\phi N_n$** | **Status** |
|---|---|---|---|---|
| Steel Strength* | 5,650 | 18,787 | 31 | OK |
| Pullout Strength* | 5,650 | 12,361 | 46 | OK |
| Concrete Breakout Strength** | 11,300 | 11,970 | 95 | OK |
| Concrete Side-Face Blowout, direction ** | N/A | N/A | N/A | N/A |

* anchor having the highest loading **anchor group (anchors in tension)

### 3.1 Steel Strength

$N_{sa} = A_{se,N}\, f_{uta}$ ACI 318-14 Eq. (17.4.1.2)

$\phi\ N_{sa} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1

**Variables**

| $A_{se,N}$ [in.$^2$] | $f_{uta}$ [psi] |
|---|---|
| 0.33 | 75,000 |

**Calculations**

| $N_{sa}$ [lb] |
|---|
| 25,050 |

**Results**

| $N_{sa}$ [lb] | $\phi_{steel}$ | $\phi$ $N_{sa}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|
| 25,050 | 0.750 | 18,787 | 5,650 |

| | | | |
|---|---|---|---|
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### 3.2 Pullout Strength

$N_{pN} = \psi_{c,p} N_p$ ACI 318-14 Eq. (17.4.3.1)

$N_p = 8 A_{brg} f'_c$ ACI 318-14 Eq. (17.4.3.4)

$\phi N_{pN} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1

**Variables**

| $\psi_{c,p}$ | $A_{brg}$ [in.$^2$] | $\lambda_a$ | $f'_c$ [psi] |
|---|---|---|---|
| 1.000 | 0.65 | 1.000 | 4,500 |

**Calculations**

| $N_p$ [lb] |
|---|
| 23,544 |

**Results**

| $N_{pn}$ [lb] | $\phi_{concrete}$ | $\phi_{seismic}$ | $\phi_{nonductile}$ | $\phi N_{pn}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|---|---|
| 23,544 | 0.700 | 0.750 | 1.000 | 12,361 | 5,650 |

### 3.3 Concrete Breakout Strength

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$ ACI 318-14 Eq. (17.4.2.1b)

$\phi N_{cbg} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1

$A_{Nc}$ see ACI 318-14, Section 17.4.2.1, Fig. R 17.4.2.1(b)

$A_{Nc0} = 9 h_{ef}^2$ ACI 318-14 Eq. (17.4.2.1c)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e'_N}{3 h_{ef}}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.4)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.5b)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.7b)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ ACI 318-14 Eq. (17.4.2.2a)

**Variables**

| $h_{ef}$ [in.] | $e_{c1,N}$ [in.] | $e_{c2,N}$ [in.] | $c_{a,min}$ [in.] | $\psi_{c,N}$ |
|---|---|---|---|---|
| 5.000 | 0.000 | 0.000 | $\infty$ | 1.000 |

| $c_{ac}$ [in.] | $k_c$ | $\lambda_a$ | $f'_c$ [psi] |
|---|---|---|---|
| - | 24 | 1.000 | 4,500 |

**Calculations**

| $A_{Nc}$ [in.$^2$] | $A_{Nc0}$ [in.$^2$] | $\psi_{ec1,N}$ | $\psi_{ec2,N}$ | $\psi_{ed,N}$ | $\psi_{cp,N}$ | $N_b$ [lb] |
|---|---|---|---|---|---|---|
| 285.00 | 225.00 | 1.000 | 1.000 | 1.000 | 1.000 | 18,000 |

**Results**

| $N_{cbg}$ [lb] | $\phi_{concrete}$ | $\phi_{seismic}$ | $\phi_{nonductile}$ | $\phi N_{cbg}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|---|---|
| 22,800 | 0.700 | 0.750 | 1.000 | 11,970 | 11,300 |

| | | | |
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## 4 Shear load

| | Load $V_{ua}$ [lb] | Capacity $\phi$ $V_n$ [lb] | Utilization $\beta_V = V_{ua}/\phi V_n$ | Status |
|---|---|---|---|---|
| Steel Strength* | N/A | N/A | N/A | N/A |
| Steel failure (with lever arm)* | N/A | N/A | N/A | N/A |
| Pryout Strength* | N/A | N/A | N/A | N/A |
| Concrete edge failure in direction ** | N/A | N/A | N/A | N/A |

* anchor having the highest loading **anchor group (relevant anchors)

## 5 Warnings

- The anchor design methods in PROFIS Anchor require rigid anchor plates per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Anchor calculates the minimum required anchor plate thickness with FEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid base plate assumption is valid is not carried out by PROFIS Anchor. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies when supplementary reinforcement is used. The Φ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!
- An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-14, Chapter 17, Section 17.2.3.4.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.2.3.4.3 (b), Section 17.2.3.4.3 (c), or Section 17.2.3.4.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.2.3.5.3 (a), Section 17.2.3.5.3 (b), or Section 17.2.3.5.3 (c).
- Section 17.2.3.4.3 (b) / Section 17.2.3.5.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.2.3.4.3 (c) / Section 17.2.3.5.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.2.3.4.3 (d) / Section 17.2.3.5.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by $\omega_0$.

# Fastening meets the design criteria!

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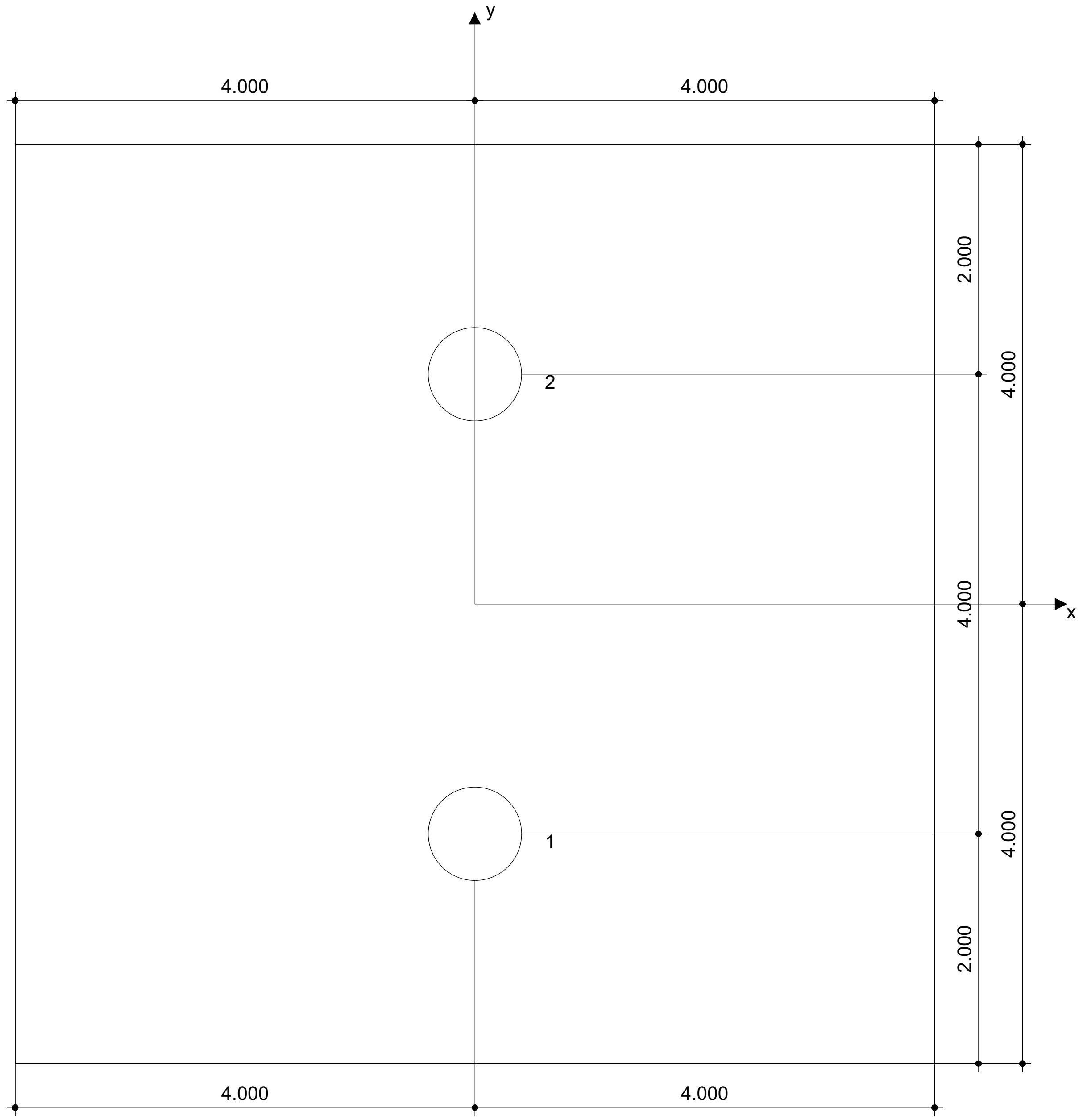
## 6 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: $d_f$ = 0.813 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Drilling method: -
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 55 3/4
Installation torque: -
Hole diameter in the base material: - in.
Hole depth in the base material: 5.000 in.
Minimum thickness of the base material: 6.000 in.




**Coordinates Anchor in.**

| Anchor | x | y | $c_{-x}$ | $c_{+x}$ | $c_{-y}$ | $c_{+y}$ |
|---|---|---|---|---|---|---|
| 1 | 0.000 | -2.000 | - | - | - | - |
| 2 | 0.000 | 2.000 | - | - | - | - |

| | | | |
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## 7 Remarks; Your Cooperation Duties

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Profis Anchor 2.7.6

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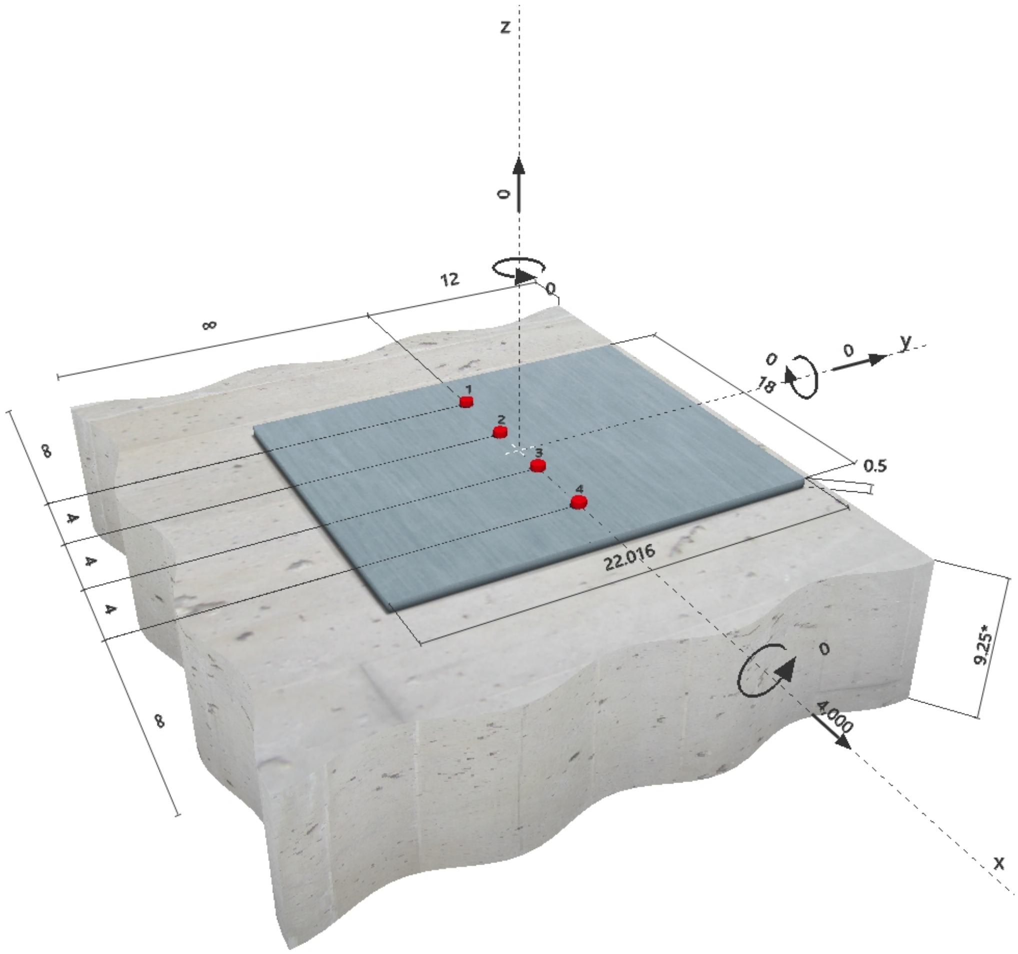
**Specifier's comments:**

## 1 Input data


| | |
|---|---|
| **Anchor type and diameter:** | **HIT-HY 200 + HAS-E 3/4** |
| Effective embedment depth: | $h_{ef,opti}$ = 3.500 in. ($h_{ef,limit}$ = 7.500 in.) |
| Material: | 5.8 |
| Evaluation Service Report: | ESR-3187 |
| Issued I Valid: | 11/1/2016 \| 3/1/2018 |
| Proof: | Design method ACI 318-14 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 0.500 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 18.000 in. x 22.016 in. x 0.500 in.; (Recommended plate thickness: not calculated |
| Profile: | no profile |
| Base material: | cracked concrete, , $f_c$' = 4,500 psi; h = 9.250 in., Temp. short/long: 32/32 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Dry** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present |
| | edge reinforcement: none or < No. 4 bar |

**Geometry [in.] & Loading [lb, in.lb]**



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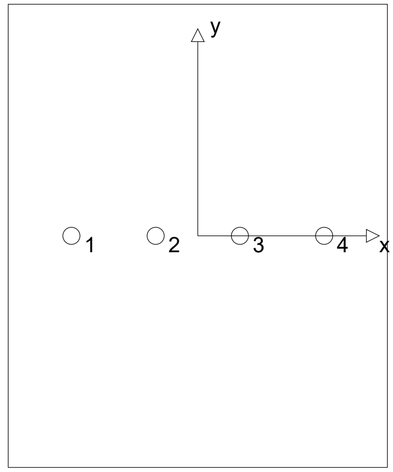
## 2 Load case/Resulting anchor forces

Load case: Design loads

**Anchor reactions [lb]**
Tension force: (+Tension, -Compression)

| Anchor | Tension force | Shear force | Shear force x | Shear force y |
|---|---|---|---|---|
| 1 | 0 | 1,000 | 1,000 | 0 |
| 2 | 0 | 1,000 | 1,000 | 0 |
| 3 | 0 | 1,000 | 1,000 | 0 |
| 4 | 0 | 1,000 | 1,000 | 0 |




max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

## 3 Tension load

| | Load $N_{ua}$ [lb] | Capacity $\phi$ $N_n$ [lb] | Utilization $\beta_N = N_{ua}/\phi N_n$ | Status |
|---|---|---|---|---|
| Steel Strength* | N/A | N/A | N/A | N/A |
| Bond Strength** | N/A | N/A | N/A | N/A |
| Sustained Tension Load Bond Strength* | N/A | N/A | N/A | N/A |
| Concrete Breakout Strength** | N/A | N/A | N/A | N/A |

* anchor having the highest loading **anchor group (anchors in tension)

| | | | |
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## 4 Shear load

| | Load $V_{ua}$ [lb] | Capacity $\phi V_n$ [lb] | Utilization $\beta_V = V_{ua}/\phi V_n$ | Status |
|---|---|---|---|---|
| Steel Strength* | 1,000 | 8,730 | 12 | OK |
| Steel failure (with lever arm)* | N/A | N/A | N/A | N/A |
| Pryout Strength (Concrete Breakout Strength controls)** | 4,000 | 22,402 | 18 | OK |
| Concrete edge failure in direction y+** | 4,000 | 30,783 | 13 | OK |

* anchor having the highest loading **anchor group (relevant anchors)

### 4.1 Steel Strength

$V_{sa} = (0.6\ A_{se,V}\ f_{uta})$ refer to ICC-ES ESR-3187
$\phi\ V_{steel} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

**Variables**

| $A_{se,V}$ [in.$^2$] | $f_{uta}$ [psi] | $(0.6\ A_{se,V}\ f_{uta})$ [lb] |
|---|---|---|
| 0.33 | 72,500 | 14,550 |

**Calculations**

| $V_{sa}$ [lb] |
|---|
| 14,550 |

**Results**

| $V_{sa}$ [lb] | $\phi_{steel}$ | $\phi\ V_{sa}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|
| 14,550 | 0.600 | 8,730 | 1,000 |

### 4.2 Pryout Strength (Concrete Breakout Strength controls)

$V_{cpg} = k_{cp}\left[\left(\frac{A_{Nc}}{A_{Nc0}}\right)\psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b\right]$ ACI 318-14 Eq. (17.5.3.1b)
$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1
$A_{Nc}$ see ACI 318-14, Section 17.4.2.1, Fig. R 17.4.2.1(b)
$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-14 Eq. (17.4.2.1c)
$\psi_{ec,N} = \left(\frac{1}{1+\frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.4)
$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.5b)
$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.7b)
$N_b = k_c\ \lambda_a \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-14 Eq. (17.4.2.2a)

**Variables**

| $k_{cp}$ | $h_{ef}$ [in.] | $e_{c1,N}$ [in.] | $e_{c2,N}$ [in.] | $c_{a,min}$ [in.] |
|---|---|---|---|---|
| 2 | 3.500 | 0.000 | 0.000 | 12.000 |

| $\psi_{c,N}$ | $c_{ac}$ [in.] | $k_c$ | $\lambda_a$ | $f_c'$ [psi] |
|---|---|---|---|---|
| 1.000 | 5.094 | 17 | 1.000 | 4,500 |

**Calculations**

| $A_{Nc}$ [in.$^2$] | $A_{Nc0}$ [in.$^2$] | $\psi_{ec1,N}$ | $\psi_{ec2,N}$ | $\psi_{ed,N}$ | $\psi_{cp,N}$ | $N_b$ [lb] |
|---|---|---|---|---|---|---|
| 236.25 | 110.25 | 1.000 | 1.000 | 1.000 | 1.000 | 7,467 |

**Results**

| $V_{cpg}$ [lb] | $\phi_{concrete}$ | $\phi\ V_{cpg}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|
| 32,002 | 0.700 | 22,402 | 4,000 |

### 4.3 Concrete edge failure in direction y+

$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ec,V}\ \psi_{ed,V}\ \psi_{c,V}\ \psi_{h,V}\ \psi_{parallel,V}\ V_b$ ACI 318-14 Eq. (17.5.2.1b)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

$A_{Vc}$ see ACI 318-14, Section 17.5.2.1, Fig. R 17.5.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-14 Eq. (17.5.2.1c)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-14 Eq. (17.5.2.5)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-14 Eq. (17.5.2.6b)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-14 Eq. (17.5.2.8)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-14 Eq. (17.5.2.2a)

**Variables**

| $c_{a1}$ [in.] | $c_{a2}$ [in.] | $e_{cV}$ [in.] | $\psi_{c,V}$ | $h_a$ [in.] |
|---|---|---|---|---|
| 12.000 | - | 0.000 | 1.000 | 9.250 |

| $l_e$ [in.] | $\lambda_a$ | $d_a$ [in.] | $f_c'$ [psi] | $\psi_{parallel,V}$ |
|---|---|---|---|---|
| 3.500 | 1.000 | 0.750 | 4,500 | 2.000 |

**Calculations**

| $A_{Vc}$ [in.$^2$] | $A_{Vc0}$ [in.$^2$] | $\psi_{ec,V}$ | $\psi_{ed,V}$ | $\psi_{h,V}$ | $V_b$ [lb] |
|---|---|---|---|---|---|
| 444.00 | 648.00 | 1.000 | 1.000 | 1.395 | 23,004 |

**Results**

| $V_{cbg}$ [lb] | $\phi_{concrete}$ | $\phi\ V_{cbg}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|
| 43,976 | 0.700 | 30,783 | 4,000 |

## 5 Warnings

- The anchor design methods in PROFIS Anchor require rigid anchor plates per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Anchor calculates the minimum required anchor plate thickness with FEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid base plate assumption is valid is not carried out by PROFIS Anchor. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies when supplementary reinforcement is used. The Φ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-14, Section 17.8.1.

## Fastening meets the design criteria!

| | | | |
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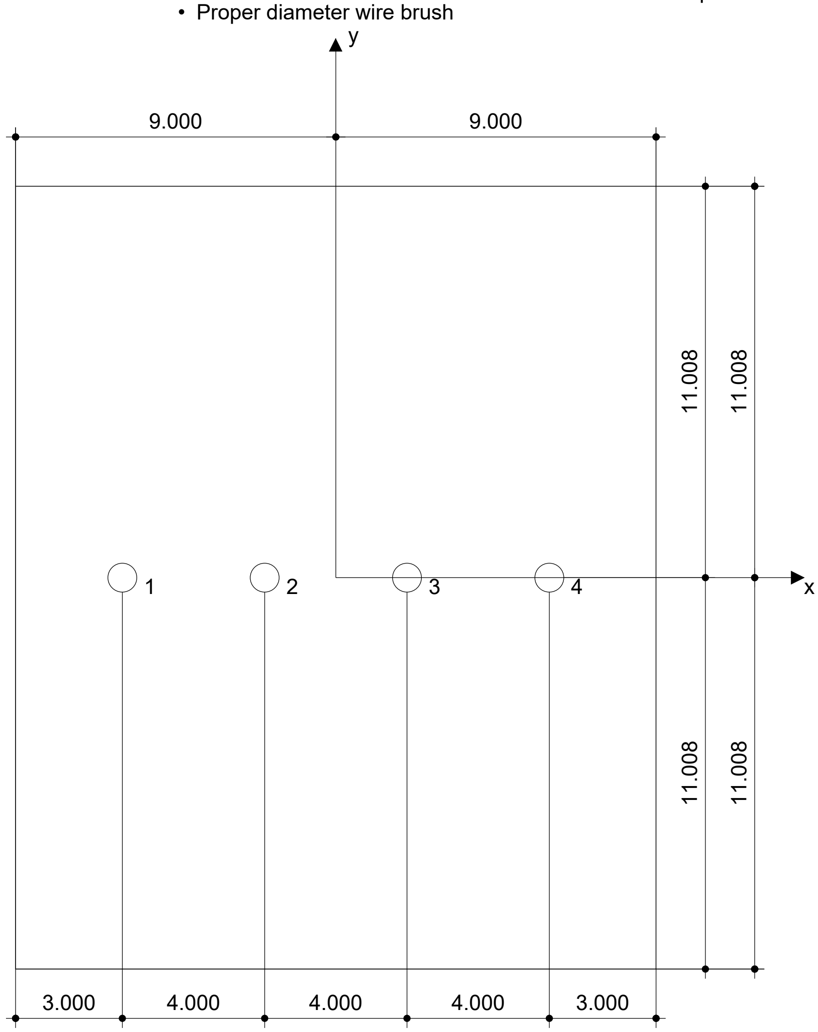
## 6 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: $d_f$ = 0.813 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Drilling method: Hammer drilled
Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and diameter: HIT-HY 200 + HAS-E 3/4
Installation torque: 1,200.002 in.lb
Hole diameter in the base material: 0.875 in.
Hole depth in the base material: 3.500 in.
Minimum thickness of the base material: 5.250 in.

### 6.1 Recommended accessories

| Drilling | Cleaning | Setting |
|---|---|---|
| • Suitable Rotary Hammer<br>• Properly sized drill bit | • Compressed air with required accessories to blow from the bottom of the hole<br>• Proper diameter wire brush | • Dispenser including cassette and mixer<br>• Torque wrench |




**Coordinates Anchor in.**

| Anchor | x | y | $c_{-x}$ | $c_{+x}$ | $c_{-y}$ | $c_{+y}$ |
|---|---|---|---|---|---|---|
| 1 | -6.000 | 0.000 | - | - | - | 12.000 |
| 2 | -2.000 | 0.000 | - | - | - | 12.000 |
| 3 | 2.000 | 0.000 | - | - | - | 12.000 |
| 4 | 6.000 | 0.000 | - | - | - | 12.000 |

| | | | |
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Profis Anchor 2.7.6

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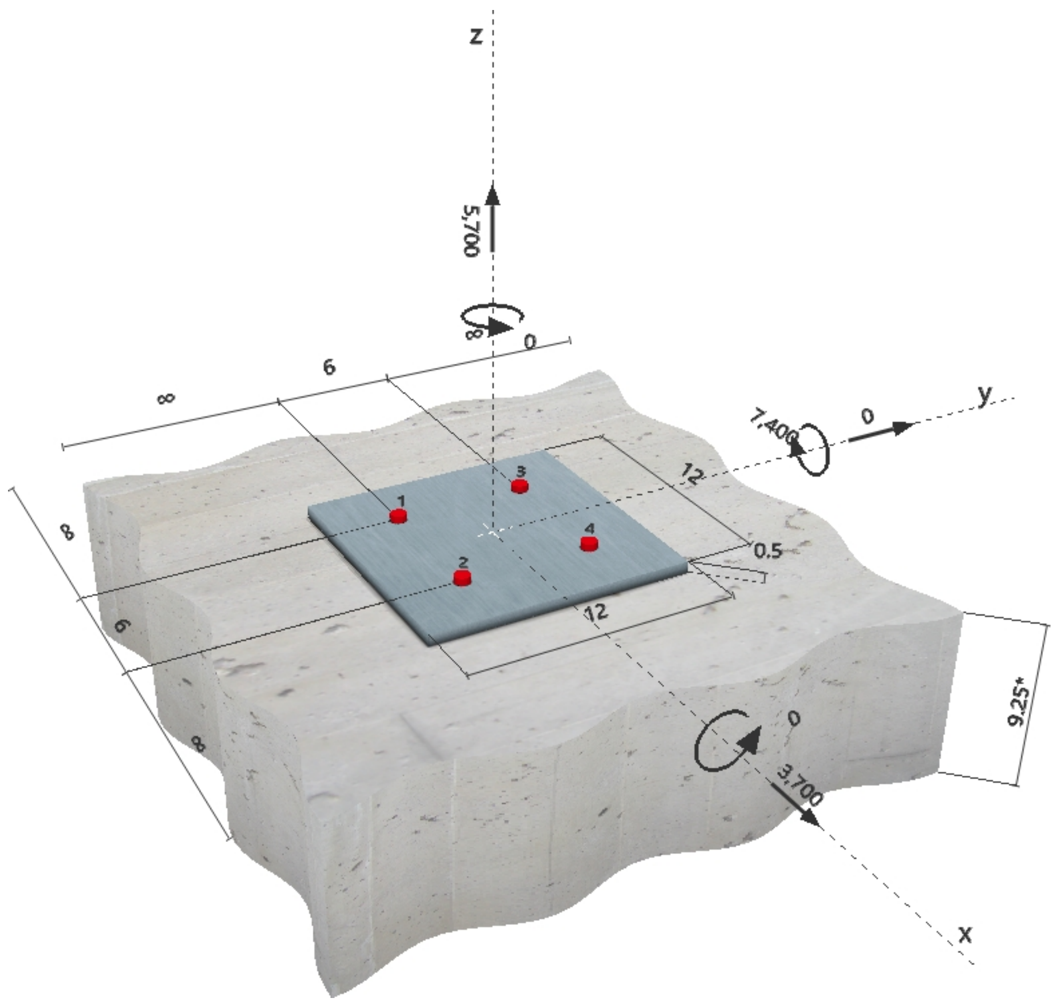
**Specifier's comments:** Joist Sear

## 1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **Hex Head ASTM F 1554 GR. 55 3/4** |
| Effective embedment depth: | $h_{ef}$ = 5.000 in. |
| Material: | ASTM F 1554 |
| Proof: | Design method ACI 318-14 / CIP |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 0.500 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 12.000 in. x 12.000 in. x 0.500 in.; (Recommended plate thickness: not calculated |
| Profile: | no profile |
| Base material: | cracked concrete, , $f_c$' = 4,500 psi; h = 9.250 in. |
| Reinforcement: | tension: condition B, shear: condition B; |
| | edge reinforcement: none or < No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | Tension load: yes (17.2.3.4.3 (d)) |
| | Shear load: yes (17.2.3.5.3 (c)) |

**Geometry [in.] & Loading [lb, in.lb]**



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Profis Anchor 2.7.6

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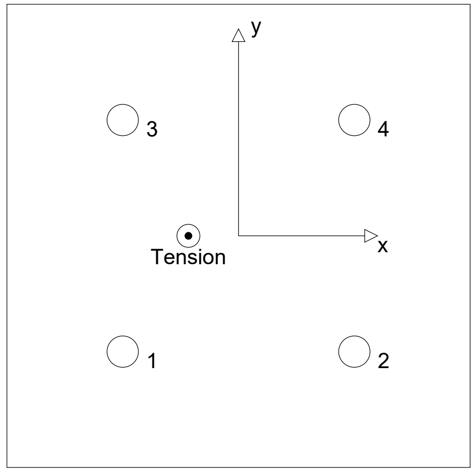
## 2 Load case/Resulting anchor forces

Load case: Design loads

**Anchor reactions [lb]**
Tension force: (+Tension, -Compression)

| Anchor | Tension force | Shear force | Shear force x | Shear force y |
|---|---|---|---|---|
| 1 | 2,042 | 925 | 925 | 0 |
| 2 | 808 | 925 | 925 | 0 |
| 3 | 2,042 | 925 | 925 | 0 |
| 4 | 808 | 925 | 925 | 0 |




max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-1.298/0.000): 5,700 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

## 3 Tension load

| | Load $N_{ua}$ [lb] | Capacity $\phi$ $N_n$ [lb] | Utilization $\beta_N = N_{ua}/\phi N_n$ | Status |
|---|---|---|---|---|
| Steel Strength* | 2,042 | 18,787 | 11 | OK |
| Pullout Strength* | 2,042 | 12,361 | 17 | OK |
| Concrete Breakout Strength** | 5,700 | 15,789 | 37 | OK |
| Concrete Side-Face Blowout, direction ** | N/A | N/A | N/A | N/A |

* anchor having the highest loading **anchor group (anchors in tension)

### 3.1 Steel Strength

$N_{sa} = A_{se,N}\, f_{uta}$ ACI 318-14 Eq. (17.4.1.2)
$\phi\ N_{sa} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1

**Variables**

| $A_{se,N}$ [in.$^2$] | $f_{uta}$ [psi] |
|---|---|
| 0.33 | 75,000 |

**Calculations**

| $N_{sa}$ [lb] |
|---|
| 25,050 |

**Results**

| $N_{sa}$ [lb] | $\phi_{steel}$ | $\phi\ N_{sa}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|
| 25,050 | 0.750 | 18,787 | 2,042 |

| | | | |
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### 3.2 Pullout Strength

$N_{pN} = \psi_{c,p} N_p$ ACI 318-14 Eq. (17.4.3.1)

$N_p = 8 A_{brg} f'_c$ ACI 318-14 Eq. (17.4.3.4)

$\phi\ N_{pN} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1

**Variables**

| $\psi_{c,p}$ | $A_{brg}$ [in.$^2$] | $\lambda_a$ | $f'_c$ [psi] |
|---|---|---|---|
| 1.000 | 0.65 | 1.000 | 4,500 |

**Calculations**

| $N_p$ [lb] |
|---|
| 23,544 |

**Results**

| $N_{pn}$ [lb] | $\phi_{concrete}$ | $\phi_{seismic}$ | $\phi_{nonductile}$ | $\phi\ N_{pn}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|---|---|
| 23,544 | 0.700 | 0.750 | 1.000 | 12,361 | 2,042 |

### 3.3 Concrete Breakout Strength

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ ACI 318-14 Eq. (17.4.2.1b)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1

$A_{Nc}$ see ACI 318-14, Section 17.4.2.1, Fig. R 17.4.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-14 Eq. (17.4.2.1c)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e'_N}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.4)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.5b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.7b)

$N_b = k_c\ \lambda_a \sqrt{f'_c}\ h_{ef}^{1.5}$ ACI 318-14 Eq. (17.4.2.2a)

**Variables**

| $h_{ef}$ [in.] | $e_{c1,N}$ [in.] | $e_{c2,N}$ [in.] | $c_{a,min}$ [in.] | $\psi_{c,N}$ |
|---|---|---|---|---|
| 5.000 | 1.298 | 0.000 | ∞ | 1.000 |

| $c_{ac}$ [in.] | $k_c$ | $\lambda_a$ | $f'_c$ [psi] |
|---|---|---|---|
| - | 24 | 1.000 | 4,500 |

**Calculations**

| $A_{Nc}$ [in.$^2$] | $A_{Nc0}$ [in.$^2$] | $\psi_{ec1,N}$ | $\psi_{ec2,N}$ | $\psi_{ed,N}$ | $\psi_{cp,N}$ | $N_b$ [lb] |
|---|---|---|---|---|---|---|
| 441.00 | 225.00 | 0.852 | 1.000 | 1.000 | 1.000 | 18,000 |

**Results**

| $N_{cbg}$ [lb] | $\phi_{concrete}$ | $\phi_{seismic}$ | $\phi_{nonductile}$ | $\phi\ N_{cbg}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|---|---|
| 30,074 | 0.700 | 0.750 | 1.000 | 15,789 | 5,700 |

| | | | |
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## 4 Shear load

| | Load $V_{ua}$ [lb] | Capacity $\phi V_n$ [lb] | Utilization $\beta_V = V_{ua}/\phi V_n$ | Status |
|---|---|---|---|---|
| Steel Strength* | 925 | 9,769 | 10 | OK |
| Steel failure (with lever arm)* | N/A | N/A | N/A | N/A |
| Pryout Strength** | 3,700 | 49,392 | 8 | OK |
| Concrete edge failure in direction ** | N/A | N/A | N/A | N/A |

* anchor having the highest loading **anchor group (relevant anchors)

### 4.1 Steel Strength

$V_{sa} = 0.6\, A_{se,V}\, f_{uta}$ ACI 318-14 Eq. (17.5.1.2b)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

**Variables**

| $A_{se,V}$ [in.$^2$] | $f_{uta}$ [psi] |
|---|---|
| 0.33 | 75,000 |

**Calculations**

| $V_{sa}$ [lb] |
|---|
| 15,030 |

**Results**

| $V_{sa}$ [lb] | $\phi_{steel}$ | $\phi\ V_{sa}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|
| 15,030 | 0.650 | 9,769 | 925 |

### 4.2 Pryout Strength

$V_{cpg} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\, \psi_{ed,N}\, \psi_{c,N}\, \psi_{cp,N}\, N_b\right]$ ACI 318-14 Eq. (17.5.3.1b)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

$A_{Nc}$ see ACI 318-14, Section 17.4.2.1, Fig. R 17.4.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-14 Eq. (17.4.2.1c)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e_N'}{3\, h_{ef}}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.4)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.5b)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.7b)

$N_b = k_c\, \lambda_a \sqrt{f_c'}\, h_{ef}^{1.5}$ ACI 318-14 Eq. (17.4.2.2a)

**Variables**

| $k_{cp}$ | $h_{ef}$ [in.] | $e_{c1,N}$ [in.] | $e_{c2,N}$ [in.] | $c_{a,min}$ [in.] |
|---|---|---|---|---|
| 2 | 5.000 | 0.000 | 0.000 | ∞ |

| $\psi_{c,N}$ | $c_{ac}$ [in.] | $k_c$ | $\lambda_a$ | $f_c'$ [psi] |
|---|---|---|---|---|
| 1.000 | - | 24 | 1.000 | 4,500 |

**Calculations**

| $A_{Nc}$ [in.$^2$] | $A_{Nc0}$ [in.$^2$] | $\psi_{ec1,N}$ | $\psi_{ec2,N}$ | $\psi_{ed,N}$ | $\psi_{cp,N}$ | $N_b$ [lb] |
|---|---|---|---|---|---|---|
| 441.00 | 225.00 | 1.000 | 1.000 | 1.000 | 1.000 | 18,000 |

**Results**

| $V_{cpg}$ [lb] | $\phi_{concrete}$ | $\phi_{seismic}$ | $\phi_{nonductile}$ | $\phi\ V_{cpg}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|---|---|
| 70,560 | 0.700 | 1.000 | 1.000 | 49,392 | 3,700 |

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## 5 Combined tension and shear loads

| $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|
| 0.361 | 0.095 | 5/3 | 21 | OK |

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

## 6 Warnings

- The anchor design methods in PROFIS Anchor require rigid anchor plates per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Anchor calculates the minimum required anchor plate thickness with FEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid base plate assumption is valid is not carried out by PROFIS Anchor. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies when supplementary reinforcement is used. The Φ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!
- An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-14, Chapter 17, Section 17.2.3.4.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.2.3.4.3 (b), Section 17.2.3.4.3 (c), or Section 17.2.3.4.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.2.3.5.3 (a), Section 17.2.3.5.3 (b), or Section 17.2.3.5.3 (c).
- Section 17.2.3.4.3 (b) / Section 17.2.3.5.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.2.3.4.3 (c) / Section 17.2.3.5.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.2.3.4.3 (d) / Section 17.2.3.5.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by $\omega_0$.

## Fastening meets the design criteria!

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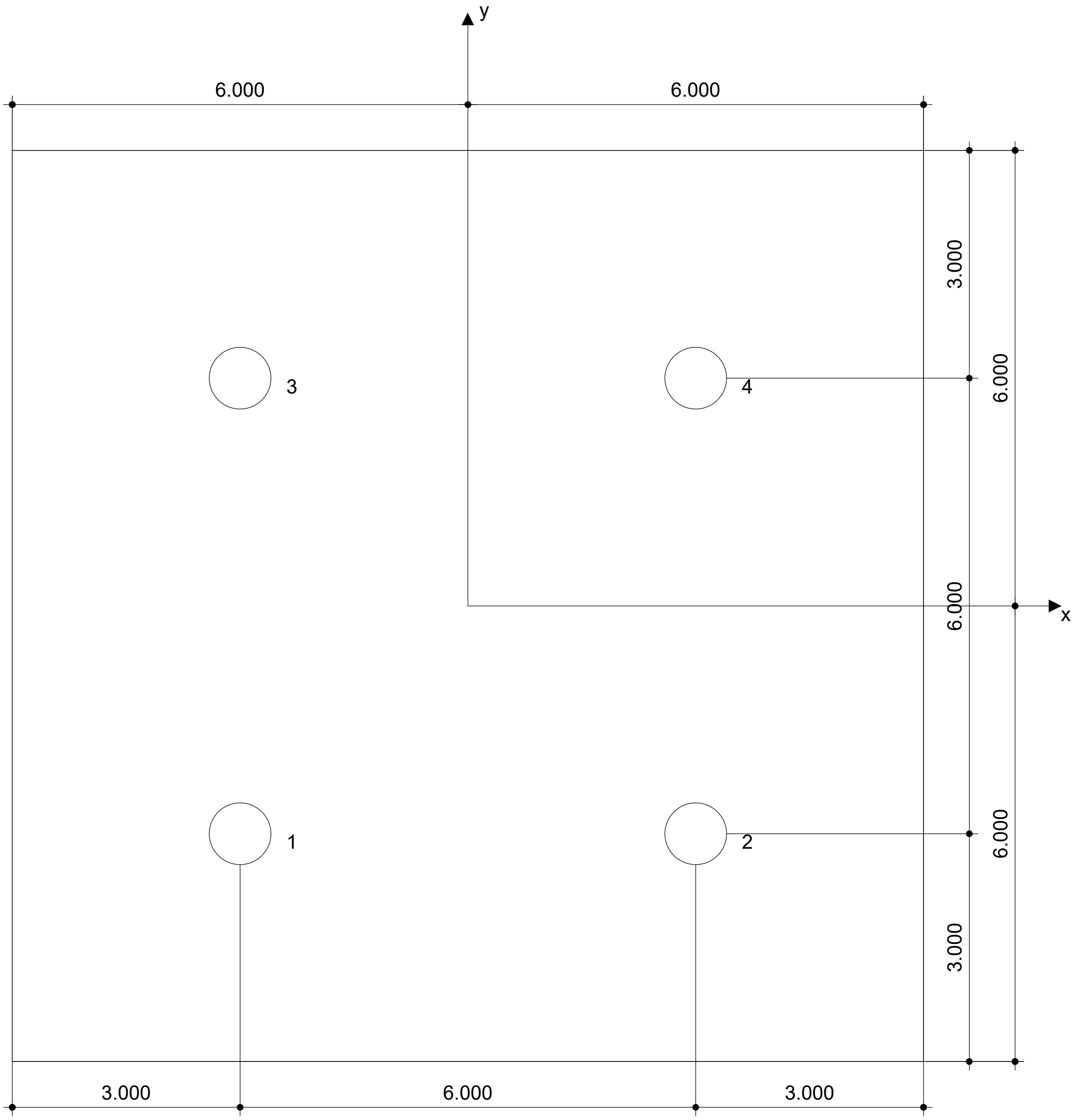
| E-Mail: | | | |

## 7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: $d_f$ = 0.813 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Drilling method: -
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 55 3/4
Installation torque: -
Hole diameter in the base material: - in.
Hole depth in the base material: 5.000 in.
Minimum thickness of the base material: 6.000 in.




**Coordinates Anchor in.**

| Anchor | x | y | $c_{-x}$ | $c_{+x}$ | $c_{-y}$ | $c_{+y}$ |
|---|---|---|---|---|---|---|
| 1 | -3.000 | -3.000 | - | - | - | - |
| 2 | 3.000 | -3.000 | - | - | - | - |
| 3 | -3.000 | 3.000 | - | - | - | - |
| 4 | 3.000 | 3.000 | - | - | - | - |

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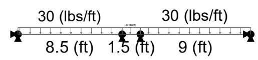
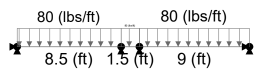
| Country: | United States | | |
| State: | Utah | | |
| Zip Code: | 84404 | | |

Joist 1

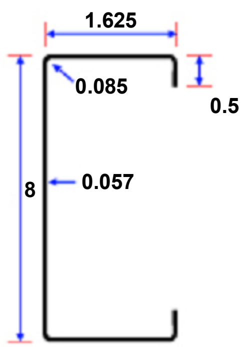
## User-Defined Joist




### Dead Load




### Live Load




**800S162-54, 33 ksi**

**Gross Section Properties**

| | |
|---|---|
| Ix (major) (in4) | 5.737 |
| Sx (major) (in3) | 1.434 |
| rx (major) (in) | 2.927 |
| Iy (minor) (in4) | 0.194 |
| Sy (minor) (in3) | 0.152 |
| ry (minor) (in) | 0.539 |
| Area (in²) | 0.67 |
| Xo (in) | -0.914 |
| J x 1000 (in4) | 0.715 |
| Cw (in6) | 2.539 |
| Ro (in) | 3.114 |
| Weight (lbs/ft) | 2.278 |

**Floor Information:**

| | |
|---|---|
| Design Code | 2015 IBC/AISI S100-12/ASCE 7-10 |
| Design Method | ASD |
| Joist Length (ft) | 19 |
| Number of Spans | 3 |
| LL Allowable Deflection, L / | 360 |
| TL Allowable Deflection, L / | 240 |
| Absolute Deflection (in) | 1 |
| Deflection calculation method at parapet free end | Relative value considered |

**Material Properties:**

| | |
|---|---|
| Fy (ksi) | 33 |
| Fu (ksi) | 45 |
| E (ksi) | 29500 |
| G (ksi) | 11300 |

**Bracing Data:**

| | |
|---|---|
| Top Flange Lateral Bracing (in) | Full |
| Top Flange Torsional Bracing (in) | Full |
| Bottom Flange Lateral Bracing (in) | 54 |
| Bottom Flange Torsional Bracing (in) | 54 |
| $K_{\varphi}$ Distortional Buckling Rotational Stiffness (lbf-in./in.) | 50 |

**Design Options**

| | |
|---|---|
| ° Section Layout | Single |
| ° Fastener Spacing (in) | N/A |
| ° Standard Punchout | Considered |
| ° Strength Increase from Cold Work of Forming (AISI, Sec. A7.2) | Considered |
| ° CMx | 1 |
| ° Cb | 1 |

| | | | | |
|---|---|---|---|---|
| Company: | ARW Engineers | | Date: | Mon, May 07 18 |
| Address: | 1594 W Park Circle | Joist 1 | | |
| Country: | United States | | | |
| State: | Utah | | | |
| Zip Code: | 84404 | **User-Defined Joist** | | |

| | |
|---|---|
| ° Shear Coeff. Kv | 5.34 |
| ° X (in) | 4 |

**Joint Supports and Reactions:**

| # | Support Type | Rx (kips) | Ry (kips) | Rm (kips.in) |
|---|---|---|---|---|
| 1 | Hinged | 0.000 | 0.376 | 0.000 |
| 2 | Roller | 0.000 | 0.561 | 0.000 |
| 3 | Roller | 0.000 | 0.759 | 0.000 |
| 4 | Hinged | 0.000 | 0.395 | 0.000 |

**Joint Loads:**

| Joint | Load Case | Vertical (lbs) | M (lbs.ft) |
|---|---|---|---|
| | | | |

**Unfactored Reactions:**

| Load Case | Joint | Rx (kips) | Ry (kips) | Rm (kips.in) |
|---|---|---|---|---|
| Dead Load | 1 | 0.000 | 0.102 | 0.000 |
| Dead Load | 2 | 0.000 | 0.153 | 0.000 |
| Dead Load | 3 | 0.000 | 0.207 | 0.000 |
| Dead Load | 4 | 0.000 | 0.108 | 0.000 |
| Live Load | 1 | 0.000 | 0.273 | 0.000 |
| Live Load | 2 | 0.000 | 0.408 | 0.000 |
| Live Load | 3 | 0.000 | 0.552 | 0.000 |
| Live Load | 4 | 0.000 | 0.287 | 0.000 |

**Span Uniform Loads:**

| # | Dead Load (lbs/ft) | Live Load (lbs/ft) |
|---|---|---|
| 1 | 30 | 80 |
| 2 | 30 | 80 |
| 3 | 30 | 80 |

**Span Non-Uniform Loads:**

| # | Load Case | Start pt. | Load (lbs/ft) | End pt. | Load (lbs/ft) |
|---|---|---|---|---|---|
| | | | | | |

**Span Concentrated Loads:**

| # | Load Case | Vertical (lbs) | Moment (lbs.ft) | X/L |
|---|---|---|---|---|
| | | | | |

**Load Combination Factors:**

| # | Dead | Live | Used For |
|---|---|---|---|
| 1 | 1 | 0 | Strength |
| 2 | 1 | 1 | Strength |
| 3 | 0 | 1 | Deflection |
| 4 | 1 | 1 | Deflection |

**Capacity Check:**

| Member | | Moment (kips.in) | Shear (kips) | LL Deflection (in) | TL Deflection (in) | Crippling (kips) |
|---|---|---|---|---|---|---|
| 1 | Actual | 9.376 | 0.559 | 0.03 | 0.041 | 0.376 |
| | Allowable | 26.355 | 2.091 | 0.283 | 0.425 | 0.51 |
| | Act./All. | 0.356 | 0.268 | 0.105 | 0.096 | 0.736 |
| | X/L | 1.000 | 1.000 | N/A | N/A | 0.000 |
| 2 | Actual | 10.839 | 0.164 | 0.002 | 0.002 | 0.759 |
| | Allowable | 26.355 | 2.091 | 0.05 | 0.075 | 1.02 |
| | Act./All. | 0.411 | 0.078 | 0.034 | 0.031 | 0.744 |
| | X/L | 1.000 | 1.000 | N/A | N/A | 1.000 |
| 3 | Actual | 10.839 | 0.595 | 0.036 | 0.05 | 0.395 |
| | Allowable | 26.355 | 2.091 | 0.3 | 0.45 | 0.51 |
| | Act./All. | 0.411 | 0.285 | 0.121 | 0.111 | 0.773 |
| | X/L | 0.000 | 0.000 | N/A | N/A | 1.000 |

**Web Crippling Design is enabled Excluding locations of stiffening clips, Min. Bearing Length = 2.5 (in)**

| | | | |
|---|---|---|---|
| Company: | ARW Engineers | | Date: Mon, May 07 18 |
| Address: | 1594 W Park Circle | Joist 1 | |
| Country: | United States | | |
| State: | Utah | | |
| Zip Code: | 84404 | **User-Defined Joist** | |

**Interaction Check:**

| Member | Combined (M,V) (kips.in, kips) | | Combined (M,Pcr) (kips.in, kips) | |
|---|---|---|---|---|
| 1 | Moment(Mx) | -9.376 | Moment(Mx) | -9.376 |
| | Shear(Vy) | 0.559 | P (Crippling) | 0.561 |
| | Act./All. | 0.445 | Act./All. | 0.660 |
| | X/L | 1.000 | X/L | 1.000 |
| 2 | Moment(Mx) | -10.839 | Moment(Mx) | -10.839 |
| | Shear(Vy) | 0.164 | P (Crippling) | 0.759 |
| | Act./All. | 0.419 | Act./All. | 0.839 |
| | X/L | 1.000 | X/L | 1.000 |
| 3 | Moment(Mx) | -10.839 | Moment(Mx) | -10.839 |
| | Shear(Vy) | -0.595 | P (Crippling) | 0.759 |
| | Act./All. | 0.500 | Act./All. | 0.839 |
| | X/L | 0.000 | X/L | 0.000 |

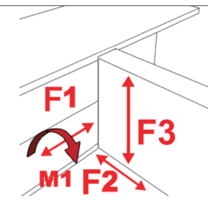
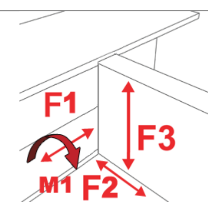
| | |
|---|---|
| Company: | ARW Engineers |
| Address: | 1594 W Park Circle |
| Country: | United States |
| State: | Utah |
| Zip Code: | 84404 |

Joist 1

Date: Mon, May 07 18

## User-Defined Joist

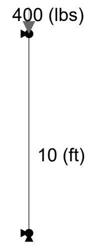
**Connection Data:**

| | | | | |
|---|---|---|---|---|
| 1 | Clip Data | Clip Position | Clip @ joint 1 |  |
| | | Clip Type | None | |
| | | Screws | N/A | |
| | Clip Allowable Loads | F1 (kips) | N/A | |
| | | F2 (kips) | N/A | |
| | | F3 (kips) | N/A | |
| | | M1 (kips.in) | N/A | |
| | Clip Actual Loads | F1 (kips) | 0.000 | |
| | | F2 (kips) | 0.000 | |
| | | F3 (kips) | 0.376 | |
| | | M1 (kips.in) | 0.000 | |
| | Clip Interaction | Linear Interaction ratio | N/A | |
| | Screws Allowable Loads | Screw All Shear (kips) | N/A | |
| | | Screw All Tension (kips) | N/A | |
| | Screws Actual Loads | Screw Act Shear (kips) | N/A | |
| | | Screw Act Tension (kips) | N/A | |
| | Screws Interaction | Linear Interaction ratio | N/A | |
| 2 | Clip Data | Clip Position | Clip @ joint 4 |  |
| | | Clip Type | None | |
| | | Screws | N/A | |
| | Clip Allowable Loads | F1 (kips) | N/A | |
| | | F2 (kips) | N/A | |
| | | F3 (kips) | N/A | |
| | | M1 (kips.in) | N/A | |
| | Clip Actual Loads | F1 (kips) | 0.000 | |
| | | F2 (kips) | 0.000 | |
| | | F3 (kips) | 0.395 | |
| | | M1 (kips.in) | 0.000 | |
| | Clip Interaction | Linear Interaction ratio | N/A | |
| | Screws Allowable Loads | Screw All Shear (kips) | N/A | |
| | | Screw All Tension (kips) | N/A | |
| | Screws Actual Loads | Screw Act Shear (kips) | N/A | |
| | | Screw Act Tension (kips) | N/A | |
| | Screws Interaction | Linear Interaction ratio | N/A | |

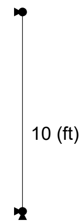
- When more than one load affect a connection, simple linear relationship is used to check the interaction of multiple loads acting on the connection.

| | | | | |
|---|---|---|---|---|
| Company: | ARW Engineers | | Date: | Mon, May 07 18 |
| Address: | 1594 W Park Circle | Wall 1 | | |
| Country: | United States | | | |
| State: | Utah | | | |
| Zip Code: | 84404 | | | |

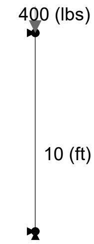
## Simple Stud Interior Span



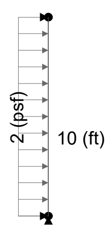

**Dead Load**



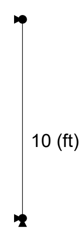

**Wind Load**




**Live Load**



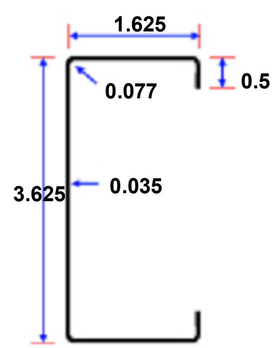

**Transverse Load**




**Snow/Roof Live Load**

### Gross Section Properties:

| | |
|---|---|
| Ix (major) (in4) | 0.551 |
| Sx (major) (in3) | 0.304 |
| rx (major) (in) | 1.45 |
| Iy (minor) (in4) | 0.099 |
| Sy (minor) (in3) | 0.091 |
| ry (minor) (in) | 0.616 |
| Area (in²) | 0.262 |
| Xo (in) | -1.308 |
| J x 1000 (in4) | 0.105 |
| Cw (in6) | 0.297 |
| Ro (in) | 2.048 |
| Weight (lbs/ft) | 0.892 |




**362S162-33, 33 ksi**

### Wall Information:

| | |
|---|---|
| Design Code | 2015 IBC/AISI S100-12/ASCE 7-10 |
| Design Method | ASD |

### Material Properties:

| | |
|---|---|
| Fy (ksi) | 33 |
| Fu (ksi) | 45 |
| E (ksi) | 29500 |
| G (Ksi) | 11300 |

| | | | |
|---|---|---|---|
| Company: | ARW Engineers | Date: | Mon, May 07 18 |
| Address: | 1594 W Park Circle | | |
| Country: | United States | | |
| State: | Utah | | |
| Zip Code: | 84404 | | |

Wall 1

## Simple Stud Interior Span

| | |
|---|---|
| Wall Height (ft) | 10 |
| Stud Spacing (in) | 16 |
| Allowable H. Deflection L / | 360 |
| Absolute Deflection (in) | 1 |
| Dead Loads (lbs) | 400 |
| Live Load (lbs) | 400 |
| Max. Bridging Spacing (ft) | 4 |
| Snow/Roof Live Load (lbs) | 0 |

**Span Loads:**

| Span | Ultimate Wind Load (psf) | Transverse Load (psf) |
|---|---|---|
| 1 | 0 | 2 |

**Bracing Data:**

| | |
|---|---|
| Lateral Bracing (in) | @ Bridging Spacing |
| Torsional Bracing (in) | Full |
| Kφ Distortional Buckling Rotational Stiffness (lbf-in./in.) | 50 |

**Reactions:**

| Joint | Rx (kips) | Ry (kips) | Rm (kips.in) |
|---|---|---|---|
| 1 | -0.013 | 0.8 | 0 |
| 2 | -0.013 | 0 | 0 |

**Unfactored Reactions:**

| Load Case | Joint | Rx (kips) | Ry (kips) | Rm (kips.in) |
|---|---|---|---|---|
| Dead Load | 1 | 0 | 0.4 | 0 |
| Dead Load | 2 | 0 | 0 | 0 |
| Live Load | 1 | 0 | 0.4 | 0 |
| Live Load | 2 | 0 | 0 | 0 |
| Wind Load | 1 | 0 | 0 | 0 |
| Wind Load | 2 | 0 | 0 | 0 |
| Transverse Load | 1 | -0.013 | 0 | 0 |
| Transverse Load | 2 | -0.013 | 0 | 0 |
| Snow/Roof Live Load | 1 | 0 | 0 | 0 |
| Snow/Roof Live Load | 2 | 0 | 0 | 0 |

**Load Combination Factors:**

| # | Dead | Live | Wind | Transverse | Snow/Roof Live Load | Used For |
|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 0 | 0 | 0 | Strength |
| 2 | 1 | 1 | 0 | 1 | 0 | Strength |
| 3 | 1 | 0 | 0 | 0 | 1 | Strength |
| 4 | 1 | 0.75 | 0 | 0.75 | 0.75 | Strength |
| 5 | 1 | 0 | 0.6 | 0 | 0 | Strength |
| 6 | 1 | 0.75 | 0.45 | 0.75 | 0.75 | Strength |
| 7 | 0 | 0 | 0.6 | 0 | 0 | Deflection |
| 8 | 0 | 0 | 0 | 1 | 0 | Deflection |

**Design Options:**

| | |
|---|---|
| ° Section Layout | Single |
| ° Fastener Spacing (in) | N/A |
| ° Standard Punchout | Considered |
| ° Strength Increase from Cold Work of Forming (AISI, Sec. A7.2) | Considered |
| ° CMx | 1 |
| ° Cb | 1 |
| ° Shear Coeff. Kv | 5.34 |
| ° X (in) | 4 |

**Capacity Check:**

| Member | Moment (kips.in) | Shear (kips) | Tension (kips) | Compression (kips) | Hz. Deflection (in) | Crippling (kips) |
|---|---|---|---|---|---|---|
| Actual | 0.4 | 0.011 | N/A | 0.8 | 0.037 | N/A |

**Effective Section Properties:**

| Member | | Value |
|---|---|---|
| 1 | Ae(Comp.) (in²) | 0.188 |
| | Sxe (in3) | 0.268 |
| | Ixe (in4) | 0.551 |

| Company: | ARW Engineers | | Date: | Mon, May 07 18 |
|---|---|---|---|---|
| Address: | 1594 W Park Circle | Wall 1 | | |
| Country: | United States | | | |
| State: | Utah | | | |
| Zip Code: | 84404 | | | |

## Simple Stud Interior Span

| Member | | Moment (kips.in) | Shear (kips) | Tension (kips) | Compression (kips) | Hz. Deflection (in) | Crippling (kips) |
|---|---|---|---|---|---|---|---|
| 1 | Allowable | 5.29 | 0.521 | 4.73 | 2.486 | 0.333 | N/A |
| | Act./All. | 0.076 * | 0.021 * | N/A | 0.322 * | 0.111 | N/A |
| | X/L | 0.500 | 0.083 | N/A | 0.100 | N/A | N/A |

| Member | | Value |
|---|---|---|
| | Fy Design (ksi) | 33.000 |

**Design for Web Crippling is Disabled**

*** Forces are calculated for punched-out section**

**Interaction Check (kips.in, kips):**

| Member | Combined (M,V) | | Combined (M,Pcr) | | Combined (M,T) | | Combined (M,P) | |
|---|---|---|---|---|---|---|---|---|
| 1 | Moment(Mx) | -0.384 | Moment(Mx) | N/A | Moment(Mx) | N/A | Moment(Mx) | -0.400 |
| | Shear(Vy) | 0.003 | Pcr (Crippling) | N/A | Tension (T) | N/A | Comp. (P) | -0.800 |
| | Act./All. | 0.073 | Act./All. | N/A | Act./All. | N/A | Act./All. | 0.409 |
| | X/L | 0.400 | X/L | N/A | X/L | N/A | X/L | 0.500 |

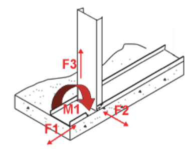
| | | | |
|---|---|---|---|
| Company: | ARW Engineers | Date: | Mon, May 07 18 |
| Address: | 1594 W Park Circle | | |
| Country: | United States | | |
| State: | Utah | | |
| Zip Code: | 84404 | | |

Wall 1

## Simple Stud Interior Span

### Connection Data:

| | | | |
|---|---|---|---|
| 1 | Clip Data | Clip Position | Base Connection @ Wall |
| | | Clip Type | None |
| | | Screws | N/A |
| | Allowable Loads | F1 (kips) | N/A |
| | | F2 (kips) | N/A |
| | | F3 (kips) | N/A |
| | | M1 (kips.in) | N/A |
| | | Screw Shear (kips) | N/A |
| | | Screw Tension (kips) | N/A |
| | Actual Loads | F1 (kips) | 0.000 |
| | | F2 (kips) | -0.013 |
| | | F3 (kips) | 0.8 |
| | | M1 (kips.in) | 0.000 |
| | | Screw Shear (kips) | N/A |
| | | Screw Tension (kips) | N/A |
| | Interaction | Clip Linear Interaction ratio | N/A |
| | | Screws Linear Interaction ratio | N/A |
| | Base Material | Material | N/A |
| | | Concrete Compressive Strength (psi) | N/A |
| | Attachment to Structure | Fastener Designation | N/A |
| | | Quantity | N/A |
| | | Min. Penetration (in) | N/A |
| | | Min. Edge Distance for Shear (in) | N/A |
| | | Min. Edge Distance for Tension (in) | N/A |
| | | Min. Fastener Spacing for Shear (in) | N/A |
| | | Min. Fastener Spacing for Tension (in) | N/A |
| | | Allowable Shear (kips) | N/A |
| | | Allowable Tension (kips) | N/A |
| | Fastener Design Load | Actual Shear (kips) | N/A |
| | | Actual Tension (kips) | N/A |
| | | Interaction Ratio | N/A |
| | | Tensile Strength Reduction Factor | N/A |
| | | Shear Strength Reduction Factor | N/A |

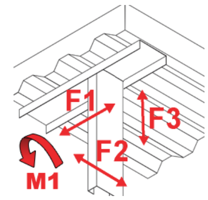


| | | | |
|---|---|---|---|
| Company: | ARW Engineers | Date: | Mon, May 07 18 |
| Address: | 1594 W Park Circle | | |
| Country: | United States | | |
| State: | Utah | | |
| Zip Code: | 84404 | | |

Wall 1

## Simple Stud Interior Span

| | | | |
|---|---|---|---|
| 2 | Clip Data | Clip Position | Head connection @ Wall |
| | | Clip Type | None |
| | | Screws | N/A |
| | Allowable Loads | F1 (kips) | N/A |
| | | F2 (kips) | N/A |
| | | F3 (kips) | N/A |
| | | M1 (kips.in) | N/A |
| | | Screw Shear (kips) | N/A |
| | | Screw Tension (kips) | N/A |
| | Actual Loads | F1 (kips) | 0.000 |
| | | F2 (kips) | -0.013 |
| | | F3 (kips) | 0.000 |
| | | M1 (kips.in) | 0.000 |
| | | Screw Shear (kips) | N/A |
| | | Screw Tension (kips) | N/A |
| | Interaction | Clip Linear Interaction ratio | N/A |
| | | Screws Linear Interaction ratio | N/A |
| | Base Material | Material | N/A |
| | | Concrete Compressive Strength (psi) | N/A |
| | Attachment to Structure | Fastener Designation | N/A |
| | | Quantity | N/A |
| | | Min. Penetration (in) | N/A |
| | | Min. Edge Distance for Shear (in) | N/A |
| | | Min. Edge Distance for Tension (in) | N/A |
| | | Min. Fastener Spacing for Shear (in) | N/A |
| | | Min. Fastener Spacing for Tension (in) | N/A |
| | | Allowable Shear (kips) | N/A |
| | | Allowable Tension (kips) | N/A |
| | Fastener Design Load | Actual Shear (kips) | N/A |
| | | Actual Tension (kips) | N/A |
| | | Interaction Ratio | N/A |
| | | Tensile Strength Reduction Factor | N/A |
| | | Shear Strength Reduction Factor | N/A |




- When more than one load affect a connection, simple linear relationship is used to check the interaction of multiple loads acting on the connection.
- Fastener attachment of connectors to the primary structure should be reviewed by a design professional.
- Displayed actual & allowable are for one fastener.

| | | | |
|---|---|---|---|
| Company: | ARW Engineers | | Date: Mon, May 07 18 |
| Address: | 1594 W Park Circle | Wall 1 | |
| Country: | United States | | |
| State: | Utah | | |
| Zip Code: | 84404 | **Simple Stud Interior Span** | |

**Bridging Data:**

| | | | |
|---|---|---|---|
| 1 | Bridging Member | Type of Bridging Member | Cold-Rolled Channel |
| | | Bridge Spacing (ft) | 4 |
| | | Bridging Row Anchored @ (ft) | 16 |
| | | Allowable Bending Moment (M1)(kips.in) | 1.23 |
| | | Actual Bending Moment (M1) (kips.in) | 0.013 |
| | | Allowable Axial Load (F1) (kips) | 1.332 |
| | | Actual Axial Load (F1) (kips) | 0.096 |
| | | Interaction Ratio | 0.082 |
| | Clip Data | Type of Bridging Clip | BridgeClip (1 Screw) |
| | | Bridging Clip Allowable Bending Moment (kips.in) | 0.18 |
| | | Bridging Clip Actual Bending Moment (kips.in) | 0.013 |
| | | Allowable Tension on Clip (kips) | 0.075 |
| | | Actual Tension on Clip (kips) | 0.016 |
| | | Clip Interaction Ratio | 0.283 |
| | | | |
| | Connection of Clip to Wall Stud | Allowable tension of #10 screws (kips) | N/A |
| | | Actual tension on #10 screws (kips) | N/A |
| | | Act./All. | N/A |
| | | Required quantity of #10 screws | N/A |
| | Connection of Clip to Bridging Member | Allowable shear of #10 screws (kips) | 0.376 |
| | | Actual shear on #10 screws (kips) | 0.016 |
| | | Act./All. | 0.043 |
| | | Required quantity of #10 screws | 1 |