



CITY OF TALENT • COMMUNITY DEVELOPMENT

PO Box 445, Talent, Oregon 97540
Phone: (541) 535-7401 Fax: (541) 535-7423 www.cityoftalent.org

GENERAL LAND USE APPLICATION

Project Description: changing ownership foot print for barner cover, also adding in bike parking station
Property Owner: DAN GREGORY
Mailing Address: P.O. Box 1505 TALENT 97540
Phone: 541-601-3887
Street Address: 102 Talent Ave
Email Address: clangreg4@gmail.com
Applicant/Consultant: Garth Evey
Mailing Address: 399 N. Laurel St. Ashland 02, 97520
Phone: 541-282-3417

Table with 4 columns: Assessor's Map Number, Tax Lot Number, Acres, Zone. Row 1: 38-1W-23CD, 5500, .14, CSD. Row 2: 38-1W-

Subzone (if applicable)

Pre-Application Meeting Completed? [ ] Yes [x] No [ ] N/A Date Completed:

Type of Application (check all boxes that apply)

Grid of checkboxes for application types: Site Development Plan Review (checked), Variance, Conditions Modification, Annexation, Accessory Dwelling Unit, Appeal, Conditional Use Permit, Home Occupation, Code Interpretation, Comprehensive Plan Amendment, Comprehensive Plan Map/Zoning Map Change, Development Code Amendment.

APPLICATION DEPOSITS (Application fees are calculated by ACTUAL PROCESSING COSTS)

I hereby certify that the statements and information contained in this application, including the enclosed drawings and the required findings of fact, are in all respects, true and correct.

Applicant's Signature: [Signature]
Property Owner's Signature (required): [Signature]

Date: 9/20/2016
Date: 9/22/2016

**APPLICATION FEES & DEPOSITS**

Fees and deposits are intended to cover the full cost for processing applications. Applicants seeking development which requires more than one type of review (such as site plans and conditional use permits) must pay all applicable fees and deposits.

**Application Deposits:** Certain application fees are represented by a deposit amount. Applicants shall be charged for actual processing costs incurred by the City. The actual costs charged to the City for technical review of land use applications, including but not limited to City's planning, public works, engineering, administration, legal, wetland specialists, geologists, biologists, arborist, and any other services provided in processing applications, shall be charged to Applicant, at the rate(s) charged to the City. In addition, the actual costs of preparing and mailing notices to abutting property owners or others required to be notified, the costs of publishing notices in newspapers, and any other mandated costs shall be charged to applicant. Any additional costs incurred beyond the deposit amount shall be charged to and paid by the applicant on a monthly basis. The applicant agrees that any deficiencies shall be collected from applicant, and that applicant's failure to pay these amounts triggers the City's option to pursue any or all remedies, as listed below.

**Fixed Fee Applications:** Fees are non-refundable and are based on average application processing costs rounded to the nearest dollar.

Applicant acknowledges and agrees that Applicant's failure to pay City costs over the deposit fee amounts, as charged monthly by the City, may result in the City pursuing any or all legal remedies available, including but not limited to liening property in the amount owed; prosecution for violation of the City's current fee resolution and City land development or division ordinances; issuance of a stop work order, non-issuance of building permits for property, or cessation of related proceedings; set-off against any reimbursement owed; and turning amounts owed over to a collection agency.

  
 \_\_\_\_\_  
 Applicant's Signature

9/20/2016  
 \_\_\_\_\_  
 Date

  
 \_\_\_\_\_  
 Property Owner's Signature (required)

9/22/2016  
 \_\_\_\_\_  
 Date

I hereby acknowledge that my applications may be consolidated. When an applicant applies for more than one type of land use or development permit (e.g., Type-II and III) for the same one or more parcels of land, the proceedings shall be consolidated for review and decision. If more than one approval authority would be required to decide on the applications if submitted separately, then the decision shall be made by the approval authority having original jurisdiction over one of the applications in the following order of preference: (1) City Planner, (2) the Planning Commission, and (3) the City Council. Joint meetings between governing bodies may be held to streamline the decision process.

  
 \_\_\_\_\_  
 Applicant's Signature

9/20/2016  
 \_\_\_\_\_  
 Date

  
 \_\_\_\_\_  
 Property Owner's Signature (required)

9/22/2016  
 \_\_\_\_\_  
 Date

| FOR OFFICE USE ONLY                |                  |                            |                             |
|------------------------------------|------------------|----------------------------|-----------------------------|
| Deposit Paid (Amount):<br>\$296.00 | Date:<br>9-22-16 | Received By:<br>C. Bradley | File Number:<br>SPR #16-007 |

In compliance with the Americans with Disabilities Act, if you need special assistance, please contact TTY phone number 1-800-735-2900 for English and for Spanish please contact TTY phone number 1-800-735-3896.

*The City of Talent is an Equal Opportunity Provider*



# DEI

*engineers*

## STRUCTURAL CALCULATIONS

For

The Pump House Patio Roof  
102 Talent Avenue  
Talent, Oregon



9/19/16

For:

Nautilus Design Studio

Job # B16670

September 2016

Prepared by:

**DUNAGAN ENGINEERING INC.**

4790 Caughlin Parkway #766

Reno, NV 89519

775.329.2733

## Design Criteria

### BUILDING CODES AND DESIGN REFERENCES

- 2014 Oregon Structural Specialty Code
- Minimum Design Loads for Buildings and Other Structures (ASCE 7-10)
- Manual of Steel Construction, Fourteenth Edition,  
by the American Institute of Steel Construction.
- Seismic Provisions for Structural Steel Buildings (AISC 341-10)  
by the American Institute of Steel Construction.
- Building Code Requirements for Reinforced Concrete (ACI 318-11)  
by the American Concrete Institute.

### DESIGN STRESSES

- Concrete, ASTM C-150, Type II.
  - Slabs-on-Grade -  $f_c = 4000$  psi
  - Footings -  $f_c = 2500$  psi
- Masonry, ASTM C90-75
  - 8" CMU -  $f_m = 1500$  psi
- Reinforcing Steel, ASTM A-615
  - $f_y = 60$  ksi Grade 60, UNO
- Structural Steel Plate (Threaded Rod) ASTM A-36
  - $F_y = 36$  ksi
- Structural Steel Beams (WF Sections) ASTM A-992, Grade 50
  - $F_y = 50$  ksi
- Structural Steel Tubes (HSS Sections) ASTM A-500, Grade B
  - Rectangular/Square Section -  $F_y = 46$  ksi
  - Round Section -  $F_y = 42$  ksi
- Bolts (Steel Connections) ASTM A-325N (UNO)
- Machine Bolts & Anchor Bolts: ASTM A-307 (UNO)

## Design Criteria

### DESIGN LOADS

- Risk Category (ASCE 7-10): II, Standard Table 1.5-1
  
- Dead Load: As Noted in Calculations
  
- Live Loads (ASCE 7-10):
  - Roof 20 psf (Roof Live Load - Reducible)
  
- Snow Loads (ASCE 7-10):
  - Risk Category: II, Standard Table 1.5-1
  - Site Elevation: 4300 ft
  - Exposure Category: C Section 26.7.3
  - Corresponding Importance Factor,  $I_p$ : 1.00 Table 1.5-2
  - Ground Snow Load: 30 psf
  - Flat Roof Snow Load: 25.2 psf
  
- Wind Design Criteria (ASCE 7-10):
  - Risk Category: II, Standard Table 1.5-1
  - Basic Wind Speed: 110 mph (City of Talent, Jackson Co.)
  - Exposure Category: C Section 26.7.3
  - Corresponding Importance Factor,  $I_w$ : 1.00 Table 1.5-2
  
- Seismic Design Criteria (ASCE 7-10):
  - Risk Category: II, Standard Table 1.5-1
  - Corresponding Importance Factor,  $I_p$ : 1.00 Table 1.5-2
  - Seismic Design Category: D Section 11.6
  - Latitude: 42.2
  - Longitude: -122.79
  
- Max. Considered Earthquake Spectral Response Acceleration (Undamped)
  - 0.2 sec. period for Soil Site Class B  $S_s$ : 0.617 g Figure 22-1
  - 1.0 sec. period for Soil Site Class B  $S_1$ : 0.323 g Figure 22-2
  
- Soil Site Coefficients Table 20.3-1
  - Soil Site Class: D  $F_a$ : 1.306 Table 11.4-1
  - $F_v$ : 1.755 Table 11.4-2
  
- Max. Considered Earthquake Spectral Response Acceleration (5% Damped)
  - 0.2 sec. period for Soil Site Class D  $S_{DS}$ : 0.537 g Eq. 11.4-3
  - 1.0 sec. period for Soil Site Class D  $S_{D1}$ : 0.378 g Eq. 11.4-4
  
- Basic Seismic Force Resisting System:
  - = Ordinary Steel Moment Frames,  $R = 3.5$

## Design Criteria

### SOIL PARAMETERS

- Allowable Soil Bearing
  - All Foundations (Gravity Loads) 1500 psf
  - All Foundations (Short Term Loads) 2000 psf
- Minimum Depth of Footing Embedment 24 inches
- Active Soil Pressure (Unrestrained Condition) 35 psf/ft
- Active Soil Pressure (Restrained Condition) 55 psf/ft
- Passive Soil Pressure 150 psf/ft
- Coefficient of Friction 0.15

### ASSUMPTIONS

- Assumed soil parameters per IBC Chapter 18, Table 1806.2 & Chapter 16, Table 1610.1.
- Building sites are assumed to be drained and free of clay or expansive soil. Any other conditions should be brought to the attention of Dunagan Engineering, Inc.
- These calculations assume stable, undisturbed soils and level of stepped footings. Any other conditions should be reported to Dunagan Engineering, Inc.
- All footings shall bear on undisturbed soil with a footing depth below frost line, 24" as per local code requirements.
- All finish grade shall slope away from foundation for a minimum of 10'-0".
- An assumed soil bearing pressure is determined and will be increased in accordance with IBC Table 1806.2.

## Snow Loads

### Site/Structure Information

|                            |                             |                       |
|----------------------------|-----------------------------|-----------------------|
| County:                    | Talent, Jackson Co., Oregon |                       |
| Site Elevation:            | 1630 ft                     |                       |
| Ground Snow Load, $p_g$ :  | 30 psf                      |                       |
| Snow Density, $\gamma$ :   | 17.9 pcf                    | ASCE 7-10 Eqn. 7.7-1  |
| Exposure Category:         | C                           | ASCE 7-10 26.7.3      |
| Exposure Factor, $C_e$ :   | 1.0                         | ASCE 7-10 Table 7-2   |
| Importance Factor, $I_s$ : | 1.00                        | ASCE 7-10 Table 1.5-2 |
| Thermal Factor, $C_t$ :    | 1.2                         | ASCE 7-10 Table 7-3   |

### Roof Snow Loads

|                                |        |        |        |                      |
|--------------------------------|--------|--------|--------|----------------------|
| Flat Roof Snow Load, $p_f$ :   | 25 psf |        |        | ASCE 7-10 Eqn. 7.3-1 |
| Roof Pitch:                    | 1 /12  | 0 /12  | 0 /12  |                      |
| Roof Slope:                    | 4.8 °  | 0.0 °  | 0.0 °  |                      |
| Slope Factor, $C_s$ :          | 1.00   | 1.00   | 1.00   | ASCE 7-10 Figure 7-2 |
| Sloped Roof Snow Load, $p_s$ : | 25 psf | 25 psf | 25 psf | ASCE 7-10 Eqn. 7.4-1 |

# DEI

engineers

Project: ROOF FRAMING

Prepared By: BOB Date: 9/16

VERTICAL DESIGN

Sheet #: \_\_\_\_\_ of \_\_\_\_\_

ROOF FRAMING

Job #: B16070

ROOFING: LOCKSEAM METAL ROOFING - 16" PANELS

DL = 1.5 PSF → 2 PSF

SUPPORT @ 24" O.C.

LOAD FOR 144.8 PSF @ 2.5' SPAN

USE 24-GAUGE

\* FASTEN PER MFG'S SPECIFICATIONS

PANEL SUPPORTS @ 24" O.C.:

|                    |              |        |
|--------------------|--------------|--------|
| DL = 1.5 PSF (2) = | 3 PLF        | PANELS |
|                    | 3 PLF        | TUBE   |
|                    | 1 PLF        | MISC   |
|                    | <u>7 PLF</u> |        |

SPAN = 10'

V = 285 # ; M = 713 # ; EI<sub>2</sub> = 26.65 × 10<sup>6</sup>

S<sub>r</sub> = 12(713) / .6(46,000) = 0.31 in<sup>3</sup>

I<sub>r</sub> = 0.919 in<sup>4</sup>

HSS 2x3x3/16 @ 24" O.C.

R- BEAM #1:

DL<sub>1</sub> = 3.5 PSF

LL<sub>1</sub> = 25 PSF

28.5 PSF

W = 28.5(10) = 285 # ; l = 10'

R = 2280 # ; M = 9120 # ; EI = 525.3 × 10<sup>6</sup>

AREAS' D = 15(2280) / .5(46,000) = 0.15 in<sup>2</sup>

S' AREAS' D = 12(9120) / .6(46,000) = 3.96 in<sup>3</sup>

I' AREAS' D = 525 × 10<sup>6</sup> / 29 × 10<sup>6</sup> = 18.1 in<sup>4</sup>

COLUMN: P = 2.3K ; H = 12'

KH = 2(12) = 24'

HSS 8x4x3/16

HSS 6x4x1/4

# DEI

engineers

Project: ROOF FRAMING

Prepared By: EDZ Date: 9/16

VERTICAL DESIGN

Sheet #:      of     

ROOF FRAMING

Job #: 216670

R-Beam #2:  $W = 285(12) = 342 \frac{1}{2} \text{ ft.}$

$l = 23'$

$R = 3933 \# ; M = 22,615 \# \text{ ft.} ; EI = 1872 \times 10^6$

$\text{Area}'_b = 15(3933) / .5(46,000) = 0.24 \text{ in}^2$

$\text{S}'_{\text{req'd}} = 12(22,615) / .6(46,000) = 9.8 \text{ in}^3$

$I_r = 1872 / 29 = 64.6 \text{ in}^4$

COLUMN:  $H = 12$

$KH = 1.2(12) = 14.4'$

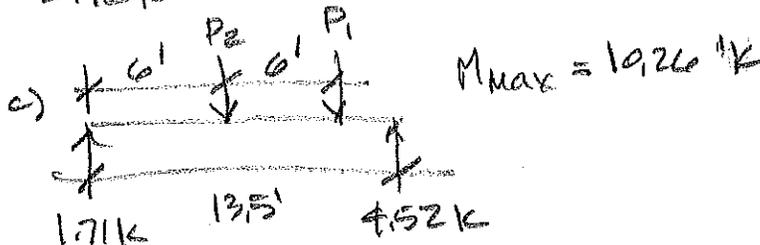
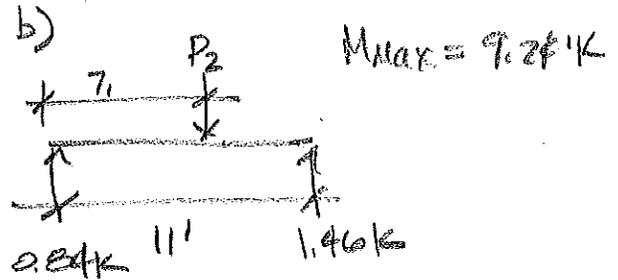
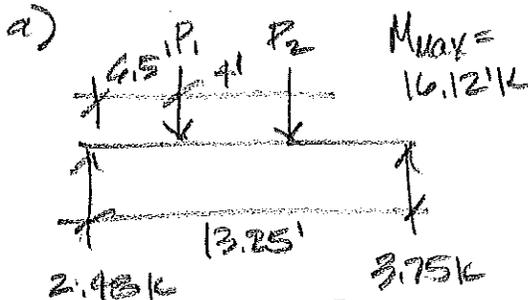
$P = 3.9 \text{ k}$

HSS 10 x 6 x 3/16

HSS 6 x 4 x 1/4

R-Beam #3:  $P_1 = 3.9 \text{ k}$

(R-Beam #4 & #5 SIMILAR)  $P_2 = 2.3 \text{ k}$



$S_r = 12(16.12) / .6(46) = 7.0 \text{ in}^3$

HSS 10 x 4 x 1/4 or W 10 x 15

COLUMN:  $P = 4.6 \text{ k}$

$KH = 1.2(13) = 15.6 \text{ k}$

HSS 4 x 6 x 1/4

## Foundations

Soil Bearing Capacity: 1500 psf

### Isolated Pad

| Pier  | Load  | $A_{reqd}$ | Min. Width | Width | Allow. Load |
|-------|-------|------------|------------|-------|-------------|
| (---) | (lbs) | (ft)       | (in)       | (in)  | (lbs)       |
| P1    | 1800  | 1.2        | 13         | 18    | 3375        |
| P2    | 1000  | 0.7        | 9.797959   | 18    | 3375        |

# DEI

*engineering*

| Seismic Design Criteria     |              |
|-----------------------------|--------------|
| Building Occupancy Category | II, Standard |
| Importance Factor, $I_p$    | = 1.00       |
| $S_s$                       | = 0.617      |
| $S_1$                       | = 0.323      |
| $F_a$                       | = 1.306      |
| $F_v$                       | = 1.755      |
| Roof Mass H (ft)            | = 13.0 ft    |
| North/South R               | = 3.5        |
| East/West R                 | = 3.5        |

| Wind Design Criteria     |                  |
|--------------------------|------------------|
| Wind Speed (3 sec gust)  | = 110.0 mph LRFD |
| Exposure Category        | = C              |
| Roof Pitch (x/12)        | = 1              |
| Top of Roof              | = 14.0 ft        |
| Plate Height             | = 12.0 ft        |
| Mean Roof Height, $h_n$  | = 13.0 ft        |
| Importance Factor, $I_w$ | = 1.00           |
| North/South Width (ft)   | = 42.0 ft        |
| East/West Width (ft)     | = 62.0 ft        |

| Equivalent Lateral Force Procedure          |                              |                 |  |
|---|------------------------------|-----------------|--|
| Structure Type =                            | All Other Structural Systems |                 |  |
| $S_{Ds} = 2/3 * F_a * S_s$                  | = 0.537 g                    |                 |  |
| $S_{D1} = 2/3 * F_v * S_1$                  | = 0.378 g                    |                 |  |
|   | North/South $C_s$            | East/West $C_s$ |  |
| (12.8-2) $S_{Ds} / (R/I_p)$                 | = 0.1535                     | 0.1535          |  |
| (12.8-3) $S_{D1} / (T * R/I_p)$             | = 0.7886                     | 0.7886          |  |
| (12.8-4) $(S_{D1} * T_L) / (T^2 * (R/I_p))$ | = 3.4554                     | 3.4554          |  |
| $C_{smax}$                                  | = 0.7886                     | 0.7886          |  |
| (12.8-5) $0.044 * S_{Ds} * I_p$             | = 0.0236                     | 0.0236          |  |
| (12.8-5) $0.5 * S_1 / (R/I_p)$              | = 0.0461                     | 0.0461          |  |
| $C_{smin}$                                  | = 0.0236                     | 0.0236          |  |

| Seismic Area Loading |   |            |
|----------------------|---|------------|
| 1-Roof               | = | 12.0 psf * |
| 2-Floor              | = | 0.0 psf    |
| 3-Decks              | = | 0.0 psf *  |
| 4-Walls              | = | 0.0 psf    |
| 5-Load               | = | 0.0 psf    |
| 6-Load               | = | 0.0 psf    |
| 7-Load               | = | 0.0 psf    |
| 8-Load               | = | 0.0 psf    |
| 9-Load               | = | 0.0 psf    |

\*Per ASCE 7-10 Section 12.7.2, 20% of the uniform flat roof snow load is included due to the flat roof snow load,  $P_f$ , exceeding 30 psf.

North/South V = 0.1074 W (ASD) (12.8-1)  
 East/West V = 0.1074 W (ASD) (12.8-1)

Long-Period Transition Period,  $T_L$  = 0.60 seconds (Figure 22-12)  
 Building Period,  $T_a$  = 0.14 seconds (12.8-7)  
 Seismic Design Category = D


**Design Maps Detailed Report**

ASCE 7-10 Standard (42.2°N, 122.79°W)

Site Class D – “Stiff Soil”, Risk Category I/II/III

**Section 11.4.1 — Mapped Acceleration Parameters**

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain  $S_s$ ) and 1.3 (to obtain  $S_1$ ). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

**From Figure 22-1** [1]

$$S_s = 0.617 \text{ g}$$

**From Figure 22-2** [2]

$$S_1 = 0.323 \text{ g}$$

**Section 11.4.2 — Site Class**

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

| Site Class                       | $\bar{V}_s$         | $\bar{N}$ or $\bar{N}_{ch}$ | $\bar{s}_u$        |
|----------------------------------|---------------------|-----------------------------|--------------------|
| A. Hard Rock                     | >5,000 ft/s         | N/A                         | N/A                |
| B. Rock                          | 2,500 to 5,000 ft/s | N/A                         | N/A                |
| C. Very dense soil and soft rock | 1,200 to 2,500 ft/s | >50                         | >2,000 psf         |
| D. Stiff Soil                    | 600 to 1,200 ft/s   | 15 to 50                    | 1,000 to 2,000 psf |
| E. Soft clay soil                | <600 ft/s           | <15                         | <1,000 psf         |

Any profile with more than 10 ft of soil having the characteristics:

- Plasticity index  $PI > 20$ ,
- Moisture content  $w \geq 40\%$ , and
- Undrained shear strength  $\bar{s}_u < 500$  psf

F. Soils requiring site response analysis in accordance with Section

See Section 20.3.1

21.1

For SI: 1ft/s = 0.3048 m/s 1lb/ft<sup>2</sup> = 0.0479 kN/m<sup>2</sup>

### Section 11.4.3 — Site Coefficients and Risk-Targeted Maximum Considered Earthquake ( $MCE_R$ ) Spectral Response Acceleration Parameters

Table 11.4-1: Site Coefficient  $F_a$ 

| Site Class | Mapped $MCE_R$ Spectral Response Acceleration Parameter at Short Period |              |              |              |                 |
|------------|---|--------------|--------------|--------------|-----------------|
|            | $S_s \leq 0.25$   | $S_s = 0.50$ | $S_s = 0.75$ | $S_s = 1.00$ | $S_s \geq 1.25$ |
| A          | 0.8   | 0.8          | 0.8          | 0.8          | 0.8             |
| B          | 1.0   | 1.0          | 1.0          | 1.0          | 1.0             |
| C          | 1.2   | 1.2          | 1.1          | 1.0          | 1.0             |
| D          | 1.6   | 1.4          | 1.2          | 1.1          | 1.0             |
| E          | 2.5   | 1.7          | 1.2          | 0.9          | 0.9             |
| F          | See Section 11.4.7 of ASCE 7  |              |              |              |                 |

Note: Use straight-line interpolation for intermediate values of  $S_s$

**For Site Class = D and  $S_s = 0.617$  g,  $F_a = 1.306$**

Table 11.4-2: Site Coefficient  $F_v$ 

| Site Class | Mapped $MCE_R$ Spectral Response Acceleration Parameter at 1-s Period |              |              |              |                 |
|------------|---|--------------|--------------|--------------|-----------------|
|            | $S_1 \leq 0.10$   | $S_1 = 0.20$ | $S_1 = 0.30$ | $S_1 = 0.40$ | $S_1 \geq 0.50$ |
| A          | 0.8   | 0.8          | 0.8          | 0.8          | 0.8             |
| B          | 1.0   | 1.0          | 1.0          | 1.0          | 1.0             |
| C          | 1.7   | 1.6          | 1.5          | 1.4          | 1.3             |
| D          | 2.4   | 2.0          | 1.8          | 1.6          | 1.5             |
| E          | 3.5   | 3.2          | 2.8          | 2.4          | 2.4             |
| F          | See Section 11.4.7 of ASCE 7  |              |              |              |                 |

Note: Use straight-line interpolation for intermediate values of  $S_1$

**For Site Class = D and  $S_1 = 0.323$  g,  $F_v = 1.755$**

**Equation (11.4-1):**

$$S_{MS} = F_g S_s = 1.306 \times 0.617 = 0.806 \text{ g}$$

**Equation (11.4-2):**

$$S_{M1} = F_v S_1 = 1.755 \times 0.323 = 0.566 \text{ g}$$

Section 11.4.4 — Design Spectral Acceleration Parameters

**Equation (11.4-3):**

$$S_{DS} = \frac{2}{3} S_{MS} = \frac{2}{3} \times 0.806 = 0.537 \text{ g}$$

**Equation (11.4-4):**

$$S_{D1} = \frac{2}{3} S_{M1} = \frac{2}{3} \times 0.566 = 0.377 \text{ g}$$

Section 11.4.5 — Design Response Spectrum

From **Figure 22-12** [3]

$$T_L = 16 \text{ seconds}$$

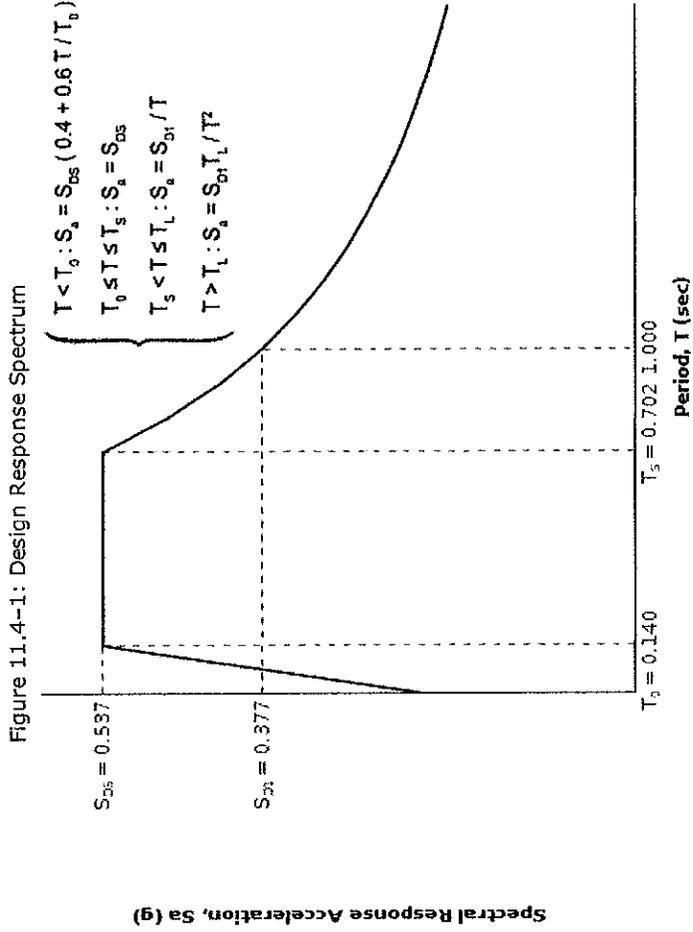
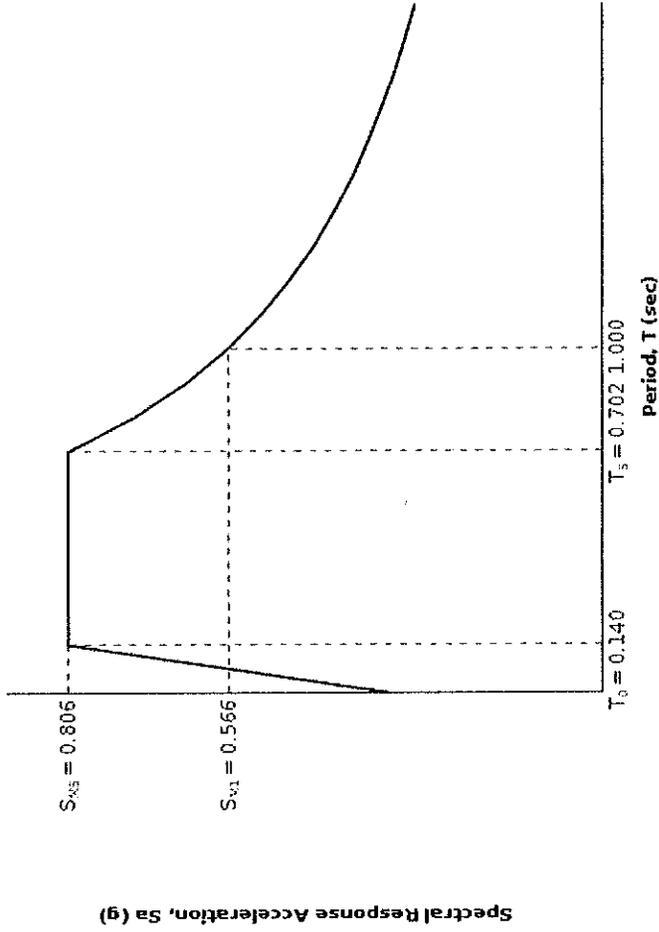


Figure 11.4-1: Design Response Spectrum

### Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE<sub>R</sub>) Response Spectrum

The MCE<sub>R</sub> Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From **Figure 22-7** <sup>[4]</sup>

PGA = 0.284

**Equation (11.8-1):**

$$PGA_M = F_{PGA} PGA = 1.233 \times 0.284 = 0.35 \text{ g}$$

Table 11.8-1: Site Coefficient  $F_{PGA}$

| Site Class | Mapped MCE Geometric Mean Peak Ground Acceleration, PGA |            |            |                              |
|------------|---|------------|------------|------------------------------|
|            | PGA ≤ 0.10  | PGA = 0.20 | PGA = 0.30 | PGA ≥ 0.50                   |
| A          | 0.8   | 0.8        | 0.8        | 0.8                          |
| B          | 1.0   | 1.0        | 1.0        | 1.0                          |
| C          | 1.2   | 1.2        | 1.0        | 1.0                          |
| D          | 1.6   | 1.4        | 1.2        | 1.0                          |
| E          | 2.5   | 1.7        | 1.2        | 0.9                          |
| F          |   |            |            | See Section 11.4.7 of ASCE 7 |

Note: Use straight-line interpolation for intermediate values of PGA

For Site Class = D and PGA = 0.284 g,  $F_{PGA} = 1.233$

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From **Figure 22-17** <sup>[5]</sup>

$C_{RS} = 0.867$

From **Figure 22-18** <sup>[6]</sup>

$C_{R1} = 0.841$

## Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

| VALUE OF $S_{DS}$            | RISK CATEGORY |     |    |   |
|------------------------------|---------------|-----|----|---|
|                              | I or II       | III | IV |   |
| $S_{DS} < 0.167g$            | A             | A   | A  | A |
| $0.167g \leq S_{DS} < 0.33g$ | B             | B   | B  | C |
| $0.33g \leq S_{DS} < 0.50g$  | C             | C   | C  | D |
| $0.50g \leq S_{DS}$          | D             | D   | D  | D |

For Risk Category = I and  $S_{DS} = 0.537g$ , Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

| VALUE OF $S_{D1}$             | RISK CATEGORY |     |    |   |
|-------------------------------|---------------|-----|----|---|
|                               | I or II       | III | IV |   |
| $S_{D1} < 0.067g$             | A             | A   | A  | A |
| $0.067g \leq S_{D1} < 0.133g$ | B             | B   | B  | C |
| $0.133g \leq S_{D1} < 0.20g$  | C             | C   | C  | D |
| $0.20g \leq S_{D1}$           | D             | D   | D  | D |

For Risk Category = I and  $S_{D1} = 0.377g$ , Seismic Design Category = D

Note: When  $S_1$  is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category = "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = D

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

## References

- Figure 22-1: [http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010\\_ASCE-7\\_Figure\\_22-1.pdf](http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf)
- Figure 22-2: [http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010\\_ASCE-7\\_Figure\\_22-2.pdf](http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf)
- Figure 22-12: [http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010\\_ASCE-7\\_Figure\\_22-12.pdf](http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf)
- Figure 22-7: [http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010\\_ASCE-7\\_Figure\\_22-7.pdf](http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf)

5. *Figure 22-17*: [http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010\\_ASCE-7\\_Figure\\_22-17.pdf](http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf)
6. *Figure 22-18*: [http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010\\_ASCE-7\\_Figure\\_22-18.pdf](http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf)

# DEI

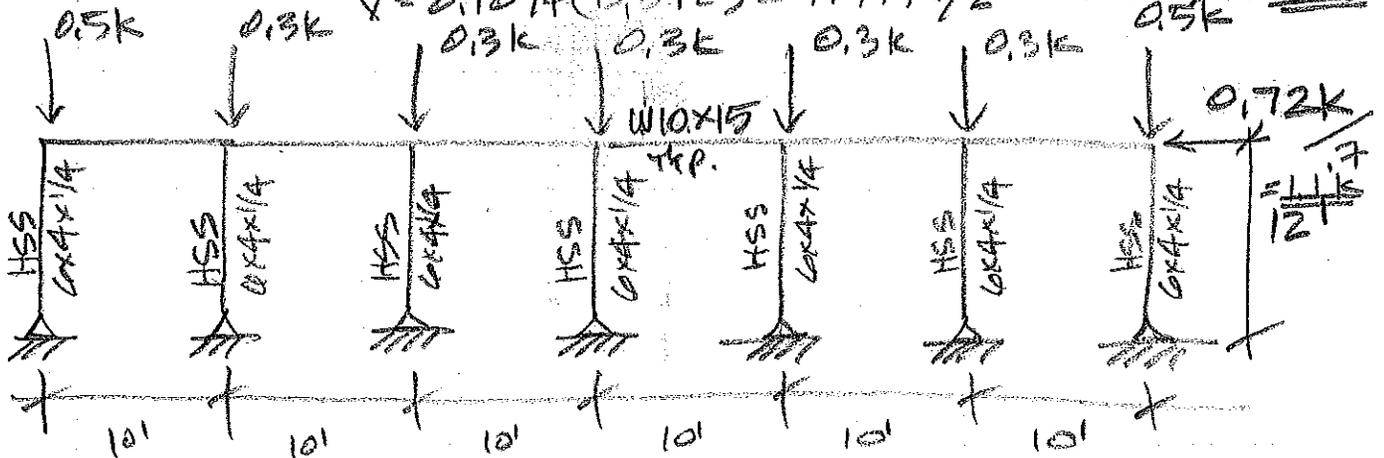
engineers

Project: ROOF FRAMING  
LATERAL DESIGN  
FRAMES

Prepared By: ED Date: 7/16  
 Sheet #: \_\_\_\_\_ of \_\_\_\_\_  
 Job #: P16670

FRAME #1:  $W = 18(62)(12) = 13,392 \#$

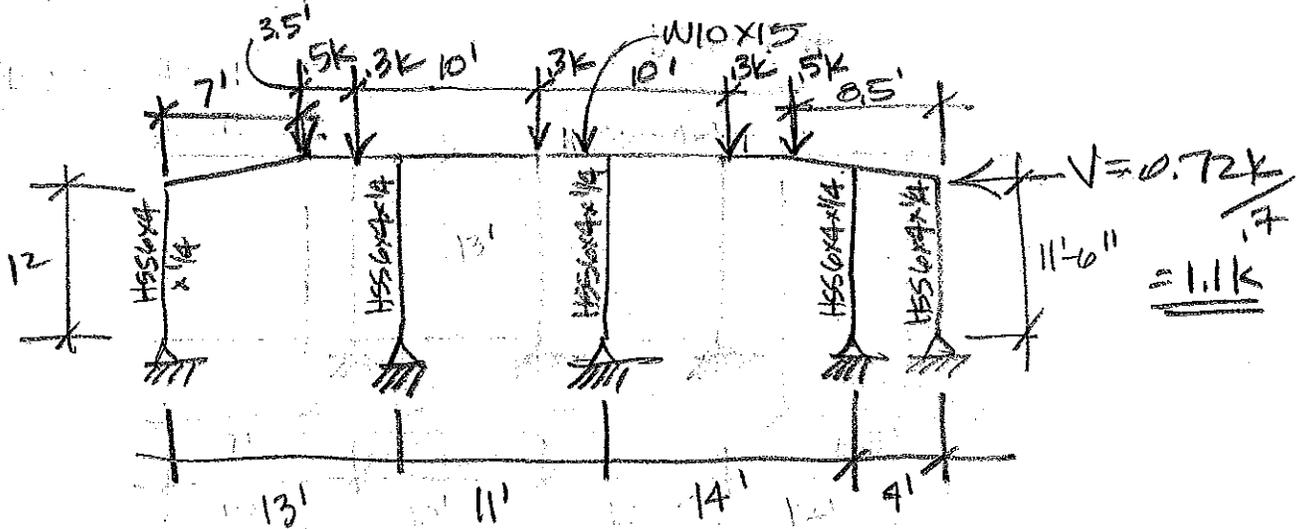
$V = 0.1074(13,392) = 1.44K / 2 = 0.72K / 1.7 = 1.1K$



VERTICAL LOADS = DEAD  
 LATERAL = SEISMIC

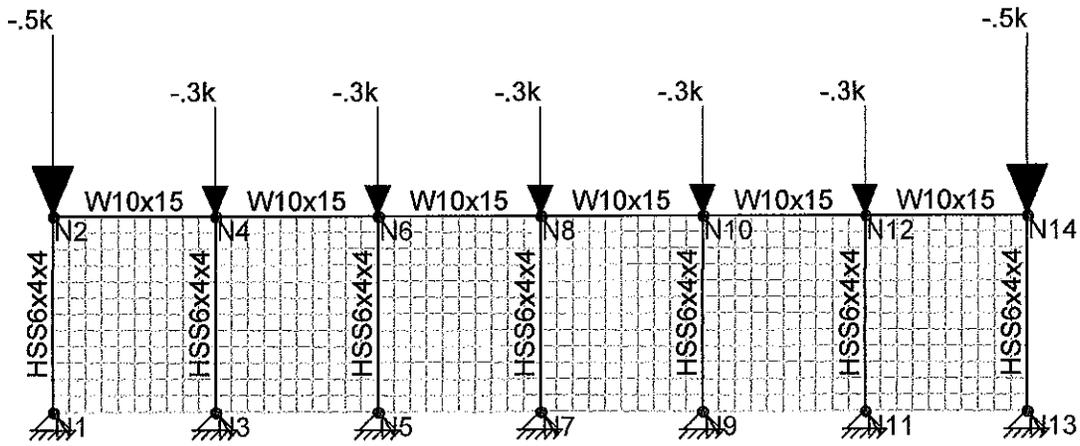
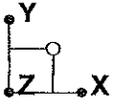
COLUMN - 4" DIMENSION LEFT TO RIGHT  
 6" DIMENSION INTO PAGE

GIRDER - STRONG DIRECTION



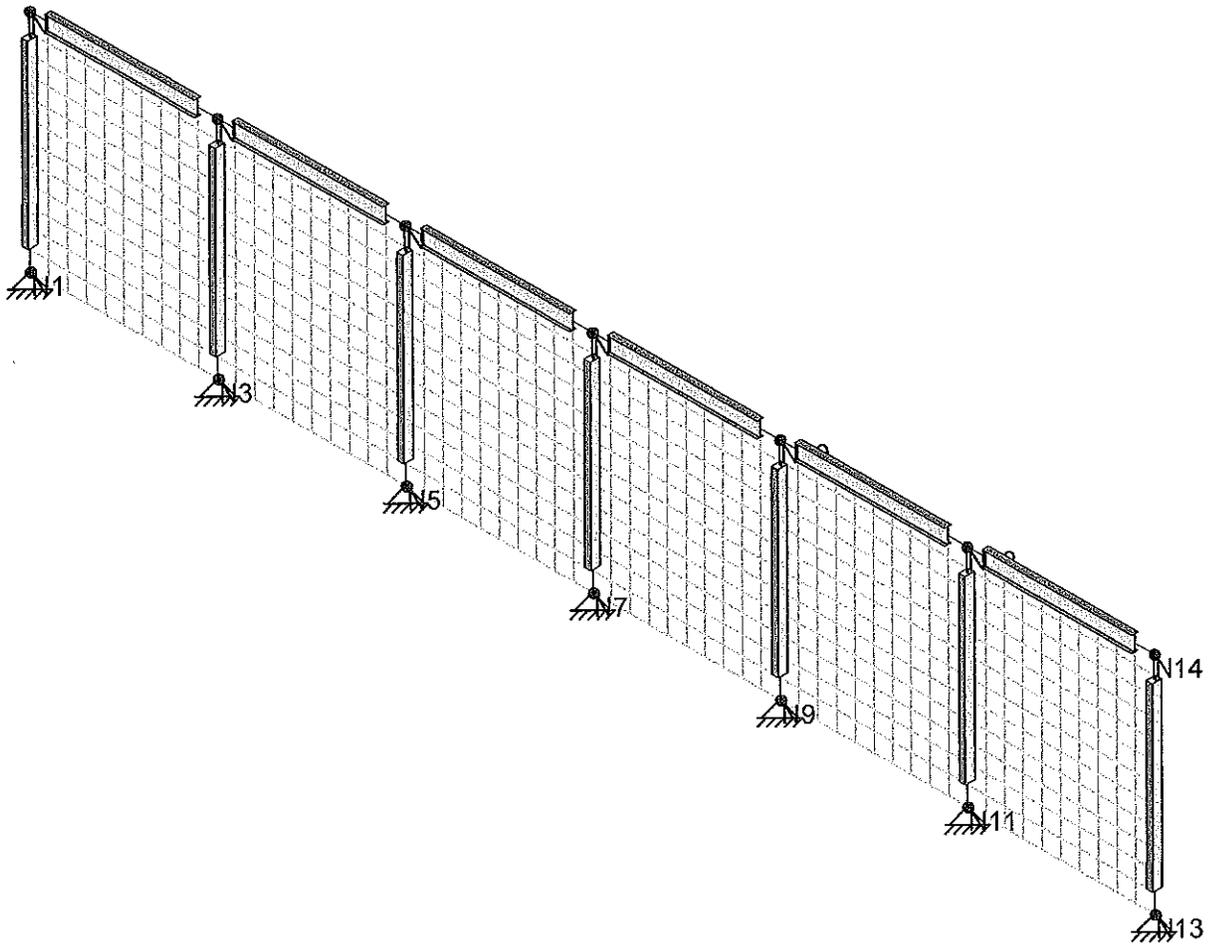
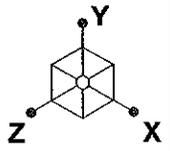
COLUMNS - 6" DIMENSION LEFT TO RIGHT  
 4" DIMENSION INTO PAGE

GIRDER - STRONG DIRECTION



Loads: BLC 1, Dead  
Envelope Only Solution

|                       |          |                          |
|-----------------------|----------|--------------------------|
| DEI                   | Frame #1 | SK - 7                   |
| EHS                   |          | Sept 19, 2016 at 1:31 PM |
| B16670 The Pump House |          | Frame #1.r2d             |



Envelope Only Solution

|                       |          |                          |
|-----------------------|----------|--------------------------|
| DEI                   | Frame #1 | SK - 5                   |
| EHS                   |          | Sept 19, 2016 at 1:30 PM |
| B16670 The Pump House |          | Frame #1.r2d             |



Company : DEI  
 Designer : EHS  
 Job Number : B16670 The Pump House  
 Model Name : Frame #1

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### Hot Rolled Steel Properties

|   | Label          | E [ksi] | G [ksi] | Nu | Therm (1E5 F) | Density[k/ft^3] | Yield[ksi] |
|---|----------------|---------|---------|----|---------------|-----------------|------------|
| 1 | A36 Gr.36      | 29000   | 11154   | .3 | .65           | .49             | 36         |
| 2 | A572 Gr.50     | 29000   | 11154   | .3 | .65           | .49             | 50         |
| 3 | A992           | 29000   | 11154   | .3 | .65           | .49             | 50         |
| 4 | A500 Gr.B RND  | 29000   | 11154   | .3 | .65           | .49             | 42         |
| 5 | A500 Gr.B Rect | 29000   | 11154   | .3 | .65           | .49             | 46         |
| 6 | A53 Gr.B       | 29000   | 11154   | .3 | .65           | .49             | 35         |

### Hot Rolled Steel Section Sets

|   | Label    | Shape    | Type   | Design List      | Material       | Design Rul... | A [in2] | I (90,270)... | I (0,180) [...] |
|---|----------|----------|--------|------------------|----------------|---------------|---------|---------------|-----------------|
| 1 | Column   | HSS6x4x4 | Column | SquareTube A1085 | A500 Gr.B Rect | Typical       | 4.3     | 11.1          | 20.9            |
| 2 | Column 2 | W12x65   | Column | Wide Flange      | A992           | Typical       | 19.1    | 174           | 533             |
| 3 | Beam     | HSS6x4x4 | Beam   | SquareTube A1085 | A500 Gr.B Rect | Typical       | 4.3     | 11.1          | 20.9            |
| 4 | Beam 2   | W10x15   | Beam   | Wide Flange      | A992           | Typical       | 4.41    | 2.89          | 68.9            |

### Joint Coordinates and Temperatures

|    | Label | X [ft] | Y [ft] | Temp [F] |
|----|-------|--------|--------|----------|
| 1  | N1    | 0      | 0      | 0        |
| 2  | N2    | 0      | 12     | 0        |
| 3  | N3    | 10     | 0      | 0        |
| 4  | N4    | 10     | 12     | 0        |
| 5  | N6    | 20     | 12     | 0        |
| 6  | N8    | 30     | 12     | 0        |
| 7  | N5    | 20     | 0      | 0        |
| 8  | N7    | 30     | 0      | 0        |
| 9  | N9    | 40     | 0      | 0        |
| 10 | N10   | 40     | 12     | 0        |
| 11 | N11   | 50     | 0      | 0        |
| 12 | N12   | 50     | 12     | 0        |
| 13 | N13   | 60     | 0      | 0        |
| 14 | N14   | 60     | 12     | 0        |

### Joint Boundary Conditions

|   | Joint Label | X [k/in] | Y [k/in] | Rotation[k-ft/rad] | Footing |
|---|-------------|----------|----------|--------------------|---------|
| 1 | N1          | Reaction | Reaction |                    |         |
| 2 | N3          | Reaction | Reaction |                    |         |
| 3 | N5          | Reaction | Reaction |                    |         |
| 4 | N7          | Reaction | Reaction |                    |         |
| 5 | N9          | Reaction | Reaction |                    |         |
| 6 | N11         | Reaction | Reaction |                    |         |
| 7 | N13         | Reaction | Reaction |                    |         |

### Hot Rolled Steel Design Parameters

|   | Label | Shape  | Length[ft] | Lb-out[ft] | Lb-in[ft] | Lcomp top[ft] | Lcomp bot[ft] | L-torq... | K-out | K-in | Cb | Function |
|---|-------|--------|------------|------------|-----------|---------------|---------------|-----------|-------|------|----|----------|
| 1 | M1    | Column | 12         |            |           | Lb out        |               |           |       |      |    | Lateral  |
| 2 | M2    | Column | 12         |            |           | Lb out        |               |           |       |      |    | Lateral  |
| 3 | M8    | Beam 2 | 10         | 2          |           | 2             |               |           |       |      |    | Lateral  |
| 4 | M9    | Beam 2 | 10         |            |           | Lb out        |               |           |       |      |    | Lateral  |
| 5 | M10   | Beam 2 | 10         |            |           | Lb out        |               |           |       |      |    | Lateral  |
| 6 | M11   | Beam 2 | 10         |            |           | Lb out        |               |           |       |      |    | Lateral  |
| 7 | M12   | Beam 2 | 10         |            |           | Lb out        |               |           |       |      |    | Lateral  |



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 Designer : EHS  
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 Model Name : Frame #1

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**Hot Rolled Steel Design Parameters (Continued)**

|    | Label | Shape  | Length[ft] | Lb-out[ft] | Lb-in[ft] | Lcomp top[ft] | Lcomp bot[ft] | L-torq... | K-out | K-in | Cb | Function |
|----|-------|--------|------------|------------|-----------|---------------|---------------|-----------|-------|------|----|----------|
| 8  | M13   | Beam 2 | 10         |            |           |               | Lb out        |           |       |      |    | Lateral  |
| 9  | M3    | Column | 12         |            |           |               |               |           |       |      |    | Lateral  |
| 10 | M4    | Column | 12         |            |           |               |               |           |       |      |    | Lateral  |
| 11 | M5    | Column | 12         |            |           |               |               |           |       |      |    | Lateral  |
| 12 | M6    | Column | 12         |            |           |               |               |           |       |      |    | Lateral  |
| 13 | M7    | Column | 12         |            |           |               |               |           |       |      |    | Lateral  |

**Joint Loads and Enforced Displacements (BLC 1 : Dead)**

|   | Joint Label | L.D.M | Direction | Magnitude[(k,k-ft), (in,rad), (k*s^2/f... |
|---|-------------|-------|-----------|---|
| 1 | N2          | L     | Y         | -5  |
| 2 | N4          | L     | Y         | -3  |
| 3 | N6          | L     | Y         | -3  |
| 4 | N8          | L     | Y         | -3  |
| 5 | N10         | L     | Y         | -3  |
| 6 | N12         | L     | Y         | -3  |
| 7 | N14         | L     | Y         | -5  |

**Joint Loads and Enforced Displacements (BLC 3 : Seismic)**

|   | Joint Label | L.D.M | Direction | Magnitude[(k,k-ft), (in,rad), (k*s^2/f... |
|---|-------------|-------|-----------|---|
| 1 | N14         | L     | X         | -1.1                                      |

**Member Point Loads**

| Member Label         | Direction | Magnitude[k,k-ft] | Location[ft,%] |
|----------------------|-----------|-------------------|----------------|
| No Data to Print ... |           |                   |                |

**Member Distributed Loads**

| Member Label         | Direction | Start Magnitude[k/ft,F] | End Magnitude[k/ft,F] | Start Location[ft,%] | End Location[ft,%] |
|----------------------|-----------|-------------------------|-----------------------|----------------------|--------------------|
| No Data to Print ... |           |                         |                       |                      |                    |

**Load Combinations**

|    | Description  | Sol. | PD... | SR... | BLC Fact... |
|----|--------------|------|-------|-------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 1  | Dead         |      | Y     | DL    | 1           |             |             |             |             |             |             |             |             |             |             |             |             |             |
| 2  | Live         |      | Y     | LL    | 1           |             |             |             |             |             |             |             |             |             |             |             |             |             |
| 3  | Seismic      |      | Y     | EL    | 1           |             |             |             |             |             |             |             |             |             |             |             |             |             |
| 4  | Wind         |      | Y     | WL    | 1           |             |             |             |             |             |             |             |             |             |             |             |             |             |
| 5  | IBC 16-8     | Yes  | Y     | DL    | 1           |             |             |             |             |             |             |             |             |             |             |             |             |             |
| 6  | IBC 16-9     | Yes  | Y     | DL    | 1           | LL          | 1           | LLS         | 1           |             |             |             |             |             |             |             |             |             |
| 7  | IBC 16-10... | Yes  | Y     | DL    | 1           | RLL         | 1           |             |             |             |             |             |             |             |             |             |             |             |
| 8  | IBC 16-10... | Yes  | Y     | DL    | 1           | SL          | 1           | SLN         | 1           |             |             |             |             |             |             |             |             |             |
| 9  | IBC 16-10... | Yes  | Y     | DL    | 1           | RL          | 1           |             |             |             |             |             |             |             |             |             |             |             |
| 10 | IBC 16-11... | Yes  | Y     | DL    | 1           | LL          | .75         | LLS         | .75         | RLL         | .75         |             |             |             |             |             |             |             |
| 11 | IBC 16-11... | Yes  | Y     | DL    | 1           | LL          | .75         | LLS         | .75         | SL          | .75         | SLN         | .75         |             |             |             |             |             |
| 12 | IBC 16-11... | Yes  | Y     | DL    | 1           | LL          | .75         | LLS         | .75         | RL          | .75         |             |             |             |             |             |             |             |
| 13 | IBC 16-12... | Yes  | Y     | DL    | 1           | WL          | .6          |             |             |             |             |             |             |             |             |             |             |             |
| 14 | IBC 16-12... | Yes  | Y     | DL    | 1           | WL          | -.6         |             |             |             |             |             |             |             |             |             |             |             |
| 15 | IBC 16-12... | Yes  | Y     | DL    | 1           | EL          | .7          |             |             |             |             |             |             |             |             |             |             |             |
| 16 | IBC 16-12... | Yes  | Y     | DL    | 1           | EL          | -.7         |             |             |             |             |             |             |             |             |             |             |             |
| 17 | IBC 16-13... | Yes  | Y     | DL    | 1           | WL          | .45         | LL          | .75         | LLS         | .75         | RLL         | .75         |             |             |             |             |             |
| 18 | IBC 16-13... | Yes  | Y     | DL    | 1           | WL          | -.45        | LL          | .75         | LLS         | .75         | RLL         | .75         |             |             |             |             |             |
| 19 | IBC 16-13... | Yes  | Y     | DL    | 1           | WL          | .45         | LL          | .75         | LLS         | .75         | SL          | .75         | SLN         | .75         |             |             |             |



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 Designer : EHS  
 Job Number : B16670 The Pump House  
 Model Name : Frame #1

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**Load Combinations (Continued)**

|    | Description  | Sol. | PD | SR | BLC Fact. |
|----|--------------|------|----|----|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 20 | IBC 16-13... | Yes  | Y  |    | DL        | 1         | WL        | -.45      | LL        | .75       | LLS       | .75       | SL        | .75       | SLN       | .75       |
| 21 | IBC 16-13... | Yes  | Y  |    | DL        | 1         | WL        | .45       | LL        | .75       | LLS       | .75       | RL        | .75       |           |           |
| 22 | IBC 16-13... | Yes  | Y  |    | DL        | 1         | WL        | -.45      | LL        | .75       | LLS       | .75       | RL        | .75       |           |           |
| 23 | IBC 16-14... | Yes  | Y  |    | DL        | 1         | EL        | .525      | LL        | .75       | LLS       | .75       | RLL       | .75       |           |           |
| 24 | IBC 16-14... | Yes  | Y  |    | DL        | 1         | EL        | -.525     | LL        | .75       | LLS       | .75       | RLL       | .75       |           |           |
| 25 | IBC 16-14... | Yes  | Y  |    | DL        | 1         | EL        | .525      | LL        | .75       | LLS       | .75       | SL        | .75       | SLN       | .75       |
| 26 | IBC 16-14... | Yes  | Y  |    | DL        | 1         | EL        | -.525     | LL        | .75       | LLS       | .75       | SL        | .75       | SLN       | .75       |
| 27 | IBC 16-14... | Yes  | Y  |    | DL        | 1         | EL        | .525      | LL        | .75       | LLS       | .75       | RL        | .75       |           |           |
| 28 | IBC 16-14... | Yes  | Y  |    | DL        | 1         | EL        | -.525     | LL        | .75       | LLS       | .75       | RL        | .75       |           |           |
| 29 | IBC 16-15... | Yes  | Y  |    | DL        | 6         | WL        | .6        |           |           |           |           |           |           |           |           |
| 30 | IBC 16-15... | Yes  | Y  |    | DL        | 6         | WL        | -.6       |           |           |           |           |           |           |           |           |
| 31 | IBC 16-16... | Yes  | Y  |    | DL        | 6         | EL        | .7        |           |           |           |           |           |           |           |           |
| 32 | IBC 16-16... | Yes  | Y  |    | DL        | 6         | EL        | -.7       |           |           |           |           |           |           |           |           |

**Load Combination Design**

|    | Description      | ASIF | CD   | ABIF | Service | Hot Rolled | Cold Form... | Wood | Concrete | Masonry | Footings | Aluminum |
|----|------------------|------|------|------|---------|------------|--------------|------|----------|---------|----------|----------|
| 1  | Dead             |      |      |      |         | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 2  | Live             |      |      |      |         | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 3  | Seismic          |      |      |      |         | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 4  | Wind             |      |      |      |         | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 5  | IBC 16-8         |      | .9   |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 6  | IBC 16-9         |      |      |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 7  | IBC 16-10 (a)    |      | 1.25 |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 8  | IBC 16-10 (b)    |      | 1.15 |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 9  | IBC 16-10 (c)    |      | 1.15 |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 10 | IBC 16-11 (a)    |      | 1.25 |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 11 | IBC 16-11 (b)    |      | 1.15 |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 12 | IBC 16-11 (c)    |      | 1.15 |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 13 | IBC 16-12 (a)... |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 14 | IBC 16-12 (a)... |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 15 | IBC 16-12 (b)... |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 16 | IBC 16-12 (b)... |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 17 | IBC 16-13 (a)... |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 18 | IBC 16-13 (a)... |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 19 | IBC 16-13 (b)... |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 20 | IBC 16-13 (b)... |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 21 | IBC 16-13 (c)... |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 22 | IBC 16-13 (c)... |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 23 | IBC 16-14 (a)... |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 24 | IBC 16-14 (a)... |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 25 | IBC 16-14 (b)... |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 26 | IBC 16-14 (b)... |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 27 | IBC 16-14 (c)... |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 28 | IBC 16-14 (c)... |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 29 | IBC 16-15 (a)    |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 30 | IBC 16-15 (b)    |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 31 | IBC 16-16 (a)    |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 32 | IBC 16-16 (b)    |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |

**Envelope Joint Reactions**

|   | Joint |     | X [k] | LC | Y [k] | LC | Moment [k-ft] | LC |
|---|-------|-----|-------|----|-------|----|---------------|----|
| 1 | N1    | max | .105  | 15 | .95   | 15 | 0             | 5  |
| 2 |       | min | -.105 | 32 | .231  | 32 | 0             | 5  |
| 3 | N3    | max | .113  | 31 | .737  | 16 | 0             | 5  |



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 Designer : EHS  
 Job Number : B16670 The Pump House  
 Model Name : Frame #1

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**Envelope Joint Reactions (Continued)**

| Joint |         | X [k] | LC    | Y [k] | LC    | Moment [k-ft] | LC |   |
|-------|---------|-------|-------|-------|-------|---------------|----|---|
| 4     |         | min   | -113  | 16    | .294  | 31            | 0  | 5 |
| 5     | N5      | max   | .111  | 15    | .641  | 15            | 0  | 5 |
| 6     |         | min   | -.111 | 16    | .353  | 32            | 0  | 5 |
| 7     | N7      | max   | .112  | 15    | .628  | 15            | 0  | 5 |
| 8     |         | min   | -.112 | 16    | .376  | 32            | 0  | 5 |
| 9     | N9      | max   | .111  | 15    | .641  | 16            | 0  | 5 |
| 10    |         | min   | -.111 | 16    | .353  | 31            | 0  | 5 |
| 11    | N11     | max   | .113  | 15    | .738  | 15            | 0  | 5 |
| 12    |         | min   | -.113 | 32    | .293  | 32            | 0  | 5 |
| 13    | N13     | max   | .106  | 31    | .951  | 16            | 0  | 5 |
| 14    |         | min   | -.105 | 16    | .229  | 31            | 0  | 5 |
| 15    | Totals: | max   | .77   | 31    | 4.629 | 5             |    |   |
| 16    |         | min   | -.77  | 32    | 2.778 | 31            |    |   |

**Envelope Joint Displacements**

| Joint |     | X [in] | LC    | Y [in] | LC    | Rotation [rad] | LC        |    |
|-------|-----|--------|-------|--------|-------|----------------|-----------|----|
| 1     | N1  | max    | 0     | 32     | 0     | 32             | 4.634e-3  | 15 |
| 2     |     | min    | 0     | 15     | 0     | 15             | -4.606e-3 | 16 |
| 3     | N2  | max    | .458  | 16     | 0     | 32             | 2.554e-4  | 31 |
| 4     |     | min    | -.458 | 15     | -.001 | 15             | -3.038e-4 | 16 |
| 5     | N3  | max    | 0     | 16     | 0     | 31             | 4.719e-3  | 15 |
| 6     |     | min    | 0     | 31     | 0     | 16             | -4.727e-3 | 16 |
| 7     | N4  | max    | .458  | 16     | 0     | 31             | 7.789e-5  | 15 |
| 8     |     | min    | -.458 | 15     | 0     | 16             | -6.463e-5 | 32 |
| 9     | N6  | max    | .458  | 16     | 0     | 32             | 1.157e-4  | 15 |
| 10    |     | min    | -.458 | 15     | 0     | 15             | -1.19e-4  | 16 |
| 11    | N8  | max    | .458  | 16     | 0     | 32             | 1.049e-4  | 15 |
| 12    |     | min    | -.458 | 15     | 0     | 15             | -1.049e-4 | 16 |
| 13    | N5  | max    | 0     | 16     | 0     | 32             | 4.703e-3  | 15 |
| 14    |     | min    | 0     | 15     | 0     | 15             | -4.701e-3 | 16 |
| 15    | N7  | max    | 0     | 16     | 0     | 32             | 4.712e-3  | 15 |
| 16    |     | min    | 0     | 15     | 0     | 15             | -4.712e-3 | 16 |
| 17    | N9  | max    | 0     | 16     | 0     | 31             | 4.71e-3   | 15 |
| 18    |     | min    | 0     | 15     | 0     | 16             | -4.712e-3 | 16 |
| 19    | N10 | max    | .459  | 16     | 0     | 31             | 1.192e-4  | 15 |
| 20    |     | min    | -.459 | 15     | 0     | 16             | -1.16e-4  | 16 |
| 21    | N11 | max    | 0     | 32     | 0     | 32             | 4.745e-3  | 15 |
| 22    |     | min    | 0     | 15     | 0     | 15             | -4.738e-3 | 16 |
| 23    | N12 | max    | .46   | 16     | 0     | 32             | 6.48e-5   | 31 |
| 24    |     | min    | -.46  | 15     | 0     | 15             | -7.807e-5 | 16 |
| 25    | N13 | max    | 0     | 16     | 0     | 31             | 4.633e-3  | 15 |
| 26    |     | min    | 0     | 31     | 0     | 16             | -4.661e-3 | 16 |
| 27    | N14 | max    | .46   | 16     | 0     | 31             | 3.055e-4  | 15 |
| 28    |     | min    | -.46  | 15     | -.001 | 16             | -2.571e-4 | 32 |

**Envelope Member Section Stresses**

| Member | Sec |   | Axial [ksi] | LC   | Shear [ksi] | LC    | Top Bending [k...] | LC     | Bottom Bending [k...] | LC     |    |
|--------|-----|---|-------------|------|-------------|-------|--------------------|--------|-----------------------|--------|----|
| 1      | M1  | 1 | max         | .221 | 15          | .069  | 16                 | 0      | 5                     | 0      | 5  |
| 2      |     |   | min         | .054 | 32          | -.071 | 15                 | 0      | 5                     | 0      | 5  |
| 3      |     | 2 | max         | .211 | 15          | .069  | 16                 | .693   | 16                    | .707   | 15 |
| 4      |     |   | min         | .047 | 32          | -.071 | 15                 | -.707  | 15                    | -.693  | 16 |
| 5      |     | 3 | max         | .2   | 15          | .069  | 16                 | 1.386  | 16                    | 1.414  | 15 |
| 6      |     |   | min         | .041 | 32          | -.071 | 15                 | -1.414 | 15                    | -1.386 | 16 |
| 7      |     | 4 | max         | .19  | 15          | .069  | 16                 | 2.079  | 16                    | 2.12   | 15 |



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**Envelope Member Section Stresses (Continued)**

| Member | Sec |     | Axial[ksi] | LC   | Shear[ksi] | LC   | Top Bending[k... | LC    | Bottom Bendin... | LC    |    |
|--------|-----|-----|------------|------|------------|------|------------------|-------|------------------|-------|----|
| 8      |     | min | .035       | 32   | -.071      | 15   | -2.12            | 15    | -2.079           | 16    |    |
| 9      | 5   | max | .18        | 15   | .069       | 16   | 2.772            | 16    | 2.827            | 15    |    |
| 10     |     | min | .029       | 32   | -.071      | 15   | -2.827           | 15    | -2.772           | 16    |    |
| 11     | M2  | 1   | max        | .171 | 16         | .075 | 16               | 0     | 0                | 5     |    |
| 12     |     | min | .068       | 31   | -.075      | 15   | 0                | 5     | 0                | 5     |    |
| 13     | 2   | max | .161       | 16   | .075       | 16   | .752             | 16    | .748             | 15    |    |
| 14     |     | min | .062       | 31   | -.075      | 15   | -.748            | 15    | -.752            | 16    |    |
| 15     | 3   | max | .151       | 16   | .075       | 16   | 1.503            | 16    | 1.495            | 15    |    |
| 16     |     | min | .056       | 31   | -.075      | 15   | -1.495           | 15    | -1.503           | 16    |    |
| 17     | 4   | max | .141       | 16   | .075       | 16   | 2.255            | 16    | 2.243            | 15    |    |
| 18     |     | min | .05        | 31   | -.075      | 15   | -2.243           | 15    | -2.255           | 16    |    |
| 19     | 5   | max | .131       | 16   | .075       | 16   | 3.006            | 16    | 2.991            | 15    |    |
| 20     |     | min | .044       | 31   | -.075      | 15   | -2.991           | 15    | -3.006           | 16    |    |
| 21     | M8  | 1   | max        | .024 | 15         | .119 | 15               | 1.115 | 16               | 1.138 | 15 |
| 22     |     | min | -.024      | 32   | -.076      | 32   | -1.138           | 15    | -1.115           | 16    |    |
| 23     | 2   | max | .024       | 15   | .103       | 15   | .742             | 16    | .607             | 31    |    |
| 24     |     | min | -.024      | 32   | -.086      | 32   | -.607            | 31    | -.742            | 16    |    |
| 25     | 3   | max | .024       | 15   | .088       | 31   | .288             | 16    | .142             | 31    |    |
| 26     |     | min | -.024      | 32   | -.099      | 16   | -.142            | 31    | -.288            | 16    |    |
| 27     | 4   | max | .024       | 15   | .078       | 31   | .283             | 15    | .253             | 32    |    |
| 28     |     | min | -.024      | 32   | -.115      | 16   | -.253            | 32    | -.283            | 15    |    |
| 29     | 5   | max | .024       | 15   | .069       | 31   | .64              | 31    | .866             | 16    |    |
| 30     |     | min | -.024      | 32   | -.132      | 16   | -.866            | 16    | -.64             | 31    |    |
| 31     | M9  | 1   | max        | .049 | 15         | .086 | 15               | .391  | 32               | .61   | 15 |
| 32     |     | min | -.049      | 32   | -.031      | 32   | -.61             | 15    | -.391            | 32    |    |
| 33     | 2   | max | .049       | 15   | .07        | 15   | .212             | 16    | .219             | 15    |    |
| 34     |     | min | -.049      | 32   | -.041      | 32   | -.219            | 15    | -.212            | 16    |    |
| 35     | 3   | max | .049       | 15   | .054       | 15   | .091             | 15    | .018             | 32    |    |
| 36     |     | min | -.049      | 32   | -.051      | 32   | -.018            | 32    | -.091            | 15    |    |
| 37     | 4   | max | .049       | 15   | .043       | 31   | .319             | 15    | .296             | 32    |    |
| 38     |     | min | -.049      | 32   | -.067      | 16   | -.296            | 32    | -.319            | 15    |    |
| 39     | 5   | max | .049       | 15   | .033       | 31   | .5               | 31    | .67              | 16    |    |
| 40     |     | min | -.049      | 32   | -.083      | 16   | -.67             | 16    | -.5              | 31    |    |
| 41     | M10 | 1   | max        | .075 | 15         | .093 | 15               | .553  | 32               | .724  | 15 |
| 42     |     | min | -.075      | 32   | -.041      | 32   | -.724            | 15    | -.553            | 32    |    |
| 43     | 2   | max | .075       | 15   | .077       | 15   | .334             | 16    | .303             | 31    |    |
| 44     |     | min | -.075      | 32   | -.051      | 32   | -.303            | 31    | -.334            | 16    |    |
| 45     | 3   | max | .075       | 15   | .061       | 15   | .068             | 16    | -.022            | 31    |    |
| 46     |     | min | -.075      | 32   | -.061      | 16   | .022             | 31    | -.068            | 16    |    |
| 47     | 4   | max | .075       | 15   | .05        | 31   | .306             | 15    | .282             | 32    |    |
| 48     |     | min | -.075      | 32   | -.078      | 16   | -.282            | 32    | -.306            | 15    |    |
| 49     | 5   | max | .075       | 15   | .04        | 31   | .524             | 31    | .708             | 16    |    |
| 50     |     | min | -.075      | 32   | -.094      | 16   | -.708            | 16    | -.524            | 31    |    |
| 51     | M11 | 1   | max        | .1   | 15         | .094 | 15               | .525  | 32               | .709  | 15 |
| 52     |     | min | -.1        | 32   | -.041      | 32   | -.709            | 15    | -.525            | 32    |    |
| 53     | 2   | max | .1         | 15   | .078       | 15   | .306             | 16    | .282             | 31    |    |
| 54     |     | min | -.1        | 32   | -.05       | 32   | -.282            | 31    | -.306            | 16    |    |
| 55     | 3   | max | .1         | 15   | .061       | 15   | .068             | 15    | -.021            | 32    |    |
| 56     |     | min | -.1        | 32   | -.061      | 16   | .021             | 32    | -.068            | 15    |    |
| 57     | 4   | max | .1         | 15   | .051       | 31   | .334             | 15    | .303             | 32    |    |
| 58     |     | min | -.1        | 32   | -.077      | 16   | -.303            | 32    | -.334            | 15    |    |
| 59     | 5   | max | .1         | 15   | .041       | 31   | .554             | 31    | .725             | 16    |    |
| 60     |     | min | -.1        | 32   | -.093      | 16   | -.725            | 16    | -.554            | 31    |    |
| 61     | M12 | 1   | max        | .125 | 15         | .083 | 15               | .502  | 32               | .672  | 15 |
| 62     |     | min | -.125      | 32   | -.033      | 32   | -.672            | 15    | -.502            | 32    |    |
| 63     | 2   | max | .125       | 15   | .067       | 15   | .32              | 16    | .297             | 31    |    |
| 64     |     | min | -.125      | 32   | -.043      | 32   | -.297            | 31    | -.32             | 16    |    |



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**Envelope Member Section Stresses (Continued)**

| Member | Sec |     | Axial[ksi] | LC | Shear[ksi] | LC | Top Bending[k... | LC | Bottom Bendin... | LC |
|--------|-----|-----|------------|----|------------|----|------------------|----|------------------|----|
| 65     |     | max | .125       | 15 | .051       | 31 | .091             | 16 | .018             | 31 |
| 66     |     | min | -.125      | 32 | -.054      | 16 | -.018            | 31 | -.091            | 16 |
| 67     |     | max | .125       | 15 | .041       | 31 | .213             | 15 | .219             | 16 |
| 68     |     | min | -.125      | 32 | -.07       | 16 | -.219            | 16 | -.213            | 15 |
| 69     |     | max | .125       | 15 | .031       | 31 | .393             | 31 | .611             | 16 |
| 70     |     | min | -.125      | 32 | -.087      | 16 | -.611            | 16 | -.393            | 31 |
| 71     | M13 | max | .151       | 15 | .132       | 15 | .644             | 32 | .87              | 15 |
| 72     |     | min | -.151      | 32 | -.069      | 32 | -.87             | 15 | -.644            | 32 |
| 73     |     | max | .151       | 15 | .116       | 15 | .284             | 16 | .254             | 31 |
| 74     |     | min | -.151      | 32 | -.079      | 32 | -.254            | 31 | -.284            | 16 |
| 75     |     | max | .151       | 15 | .1         | 15 | .289             | 15 | .144             | 32 |
| 76     |     | min | -.151      | 32 | -.089      | 32 | -.144            | 32 | -.289            | 15 |
| 77     |     | max | .151       | 15 | .086       | 31 | .746             | 15 | .611             | 32 |
| 78     |     | min | -.151      | 32 | -.103      | 16 | -.611            | 32 | -.746            | 15 |
| 79     |     | max | .151       | 15 | .077       | 31 | 1.122            | 15 | 1.144            | 16 |
| 80     |     | min | -.151      | 32 | -.12       | 16 | -1.144           | 16 | -1.122           | 15 |
| 81     | M3  | max | .149       | 15 | .074       | 16 | 0                | 5  | 0                | 5  |
| 82     |     | min | .082       | 32 | -.074      | 15 | 0                | 5  | 0                | 5  |
| 83     |     | max | .139       | 15 | .074       | 16 | .738             | 16 | .739             | 15 |
| 84     |     | min | .076       | 32 | -.074      | 15 | -.739            | 15 | -.738            | 16 |
| 85     |     | max | .129       | 15 | .074       | 16 | 1.477            | 16 | 1.478            | 15 |
| 86     |     | min | .07        | 32 | -.074      | 15 | -1.478           | 15 | -1.477           | 16 |
| 87     |     | max | .118       | 15 | .074       | 16 | 2.215            | 16 | 2.217            | 15 |
| 88     |     | min | .064       | 32 | -.074      | 15 | -2.217           | 15 | -2.215           | 16 |
| 89     |     | max | .108       | 15 | .074       | 16 | 2.953            | 16 | 2.956            | 15 |
| 90     |     | min | .058       | 32 | -.074      | 15 | -2.956           | 15 | -2.953           | 16 |
| 91     | M4  | max | .105       | 15 | .074       | 16 | 2.969            | 15 | 2.969            | 16 |
| 92     |     | min | .063       | 32 | -.074      | 15 | -2.969           | 16 | -2.969           | 15 |
| 93     |     | max | .115       | 15 | .074       | 16 | 2.227            | 15 | 2.227            | 16 |
| 94     |     | min | .069       | 32 | -.074      | 15 | -2.227           | 16 | -2.227           | 15 |
| 95     |     | max | .126       | 15 | .074       | 16 | 1.485            | 15 | 1.485            | 16 |
| 96     |     | min | .075       | 32 | -.074      | 15 | -1.485           | 16 | -1.485           | 15 |
| 97     |     | max | .136       | 15 | .074       | 16 | .742             | 15 | .742             | 16 |
| 98     |     | min | .081       | 32 | -.074      | 15 | -.742            | 16 | -.742            | 15 |
| 99     |     | max | .146       | 15 | .074       | 16 | 0                | 5  | 0                | 5  |
| 100    |     | min | .088       | 32 | -.074      | 15 | 0                | 5  | 0                | 5  |
| 101    | M5  | max | .149       | 16 | .074       | 16 | 0                | 5  | 0                | 5  |
| 102    |     | min | .082       | 31 | -.074      | 15 | 0                | 5  | 0                | 5  |
| 103    |     | max | .139       | 16 | .074       | 16 | .741             | 16 | .74              | 15 |
| 104    |     | min | .076       | 31 | -.074      | 15 | -.74             | 15 | -.741            | 16 |
| 105    |     | max | .129       | 16 | .074       | 16 | 1.481            | 16 | 1.479            | 15 |
| 106    |     | min | .07        | 31 | -.074      | 15 | -1.479           | 15 | -1.481           | 16 |
| 107    |     | max | .118       | 16 | .074       | 16 | 2.222            | 16 | 2.219            | 15 |
| 108    |     | min | .064       | 31 | -.074      | 15 | -2.219           | 15 | -2.222           | 16 |
| 109    |     | max | .108       | 16 | .074       | 16 | 2.962            | 16 | 2.959            | 15 |
| 110    |     | min | .058       | 31 | -.074      | 15 | -2.959           | 15 | -2.962           | 16 |
| 111    | M6  | max | .172       | 15 | .075       | 16 | 0                | 5  | 0                | 5  |
| 112    |     | min | .068       | 32 | -.076      | 15 | 0                | 5  | 0                | 5  |
| 113    |     | max | .161       | 15 | .075       | 16 | .751             | 16 | .754             | 15 |
| 114    |     | min | .062       | 32 | -.076      | 15 | -.754            | 15 | -.751            | 16 |
| 115    |     | max | .151       | 15 | .075       | 16 | 1.501            | 16 | 1.509            | 15 |
| 116    |     | min | .056       | 32 | -.076      | 15 | -1.509           | 15 | -1.501           | 16 |
| 117    |     | max | .141       | 15 | .075       | 16 | 2.252            | 16 | 2.263            | 15 |
| 118    |     | min | .05        | 32 | -.076      | 15 | -2.263           | 15 | -2.252           | 16 |
| 119    |     | max | .131       | 15 | .075       | 16 | 3.003            | 16 | 3.018            | 15 |
| 120    |     | min | .044       | 32 | -.076      | 15 | -3.018           | 15 | -3.003           | 16 |
| 121    | M7  | max | .221       | 16 | .071       | 16 | 0                | 5  | 0                | 5  |



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**Envelope Member Section Stresses (Continued)**

| Member | Sec |     | Axial[ksi] | LC | Shear[ksi] | LC | Top Bending[k... | LC | Bottom Bendin... | LC |
|--------|-----|-----|------------|----|------------|----|------------------|----|------------------|----|
| 122    |     | min | .053       | 31 | -.07       | 15 | 0                | 5  | 0                | 5  |
| 123    | 2   | max | .211       | 16 | .071       | 16 | .711             | 16 | .697             | 15 |
| 124    |     | min | .047       | 31 | -.07       | 15 | -.697            | 15 | -.711            | 16 |
| 125    | 3   | max | .201       | 16 | .071       | 16 | 1.422            | 16 | 1.394            | 15 |
| 126    |     | min | .041       | 31 | -.07       | 15 | -1.394           | 15 | -1.422           | 16 |
| 127    | 4   | max | .19        | 16 | .071       | 16 | 2.133            | 16 | 2.092            | 15 |
| 128    |     | min | .035       | 31 | -.07       | 15 | -2.092           | 15 | -2.133           | 16 |
| 129    | 5   | max | .18        | 16 | .071       | 16 | 2.844            | 16 | 2.789            | 15 |
| 130    |     | min | .029       | 31 | -.07       | 15 | -2.789           | 15 | -2.844           | 16 |

**Envelope Member Section Deflections**

| Member | Sec |   | x [in] | LC    | y [in] | LC    | L/y Ratio | LC       |    |
|--------|-----|---|--------|-------|--------|-------|-----------|----------|----|
| 1      | M1  | 1 | max    | 0     | 5      | 0     | 5         | NC       | 5  |
| 2      |     |   | min    | 0     | 5      | 0     | 5         | NC       | 5  |
| 3      |     | 2 | max    | 0     | 32     | .164  | 15        | NC       | 5  |
| 4      |     |   | min    | 0     | 15     | -.163 | 16        | 2917.772 | 15 |
| 5      |     | 3 | max    | 0     | 32     | .308  | 15        | NC       | 5  |
| 6      |     |   | min    | 0     | 15     | -.306 | 16        | 1823.608 | 15 |
| 7      |     | 4 | max    | 0     | 32     | .412  | 15        | NC       | 5  |
| 8      |     |   | min    | 0     | 15     | -.411 | 16        | 2084.123 | 15 |
| 9      |     | 5 | max    | 0     | 32     | .458  | 15        | NC       | 5  |
| 10     |     |   | min    | -.001 | 15     | -.458 | 16        | NC       | 5  |
| 11     | M2  | 1 | max    | 0     | 5      | 0     | 5         | NC       | 5  |
| 12     |     |   | min    | 0     | 5      | 0     | 5         | NC       | 5  |
| 13     |     | 2 | max    | 0     | 31     | .167  | 15        | NC       | 5  |
| 14     |     |   | min    | 0     | 16     | -.167 | 16        | 2744.069 | 16 |
| 15     |     | 3 | max    | 0     | 31     | .312  | 15        | NC       | 5  |
| 16     |     |   | min    | 0     | 16     | -.313 | 16        | 1715.043 | 16 |
| 17     |     | 4 | max    | 0     | 31     | .416  | 15        | NC       | 5  |
| 18     |     |   | min    | 0     | 16     | -.417 | 16        | 1960.049 | 16 |
| 19     |     | 5 | max    | 0     | 31     | .458  | 15        | NC       | 5  |
| 20     |     |   | min    | 0     | 16     | -.458 | 16        | NC       | 5  |
| 21     | M8  | 1 | max    | .458  | 16     | 0     | 32        | NC       | 5  |
| 22     |     |   | min    | -.458 | 15     | -.001 | 15        | NC       | 5  |
| 23     |     | 2 | max    | .458  | 16     | .003  | 31        | NC       | 5  |
| 24     |     |   | min    | -.458 | 15     | -.006 | 16        | NC       | 5  |
| 25     |     | 3 | max    | .458  | 16     | .002  | 31        | NC       | 5  |
| 26     |     |   | min    | -.458 | 15     | -.005 | 16        | NC       | 5  |
| 27     |     | 4 | max    | .458  | 16     | 0     | 31        | NC       | 5  |
| 28     |     |   | min    | -.458 | 15     | -.002 | 16        | NC       | 5  |
| 29     |     | 5 | max    | .458  | 16     | 0     | 31        | NC       | 5  |
| 30     |     |   | min    | -.458 | 15     | 0     | 16        | NC       | 5  |
| 31     | M9  | 1 | max    | .458  | 16     | 0     | 31        | NC       | 5  |
| 32     |     |   | min    | -.458 | 15     | 0     | 16        | NC       | 5  |
| 33     |     | 2 | max    | .458  | 16     | 0     | 31        | NC       | 5  |
| 34     |     |   | min    | -.458 | 15     | -.001 | 16        | NC       | 5  |
| 35     |     | 3 | max    | .458  | 16     | 0     | 32        | NC       | 5  |
| 36     |     |   | min    | -.458 | 15     | -.002 | 15        | NC       | 5  |
| 37     |     | 4 | max    | .458  | 16     | 0     | 32        | NC       | 5  |
| 38     |     |   | min    | -.458 | 15     | -.002 | 15        | NC       | 5  |
| 39     |     | 5 | max    | .458  | 16     | 0     | 32        | NC       | 5  |
| 40     |     |   | min    | -.458 | 15     | 0     | 15        | NC       | 5  |
| 41     | M10 | 1 | max    | .458  | 16     | 0     | 32        | NC       | 5  |
| 42     |     |   | min    | -.458 | 15     | 0     | 15        | NC       | 5  |
| 43     |     | 2 | max    | .458  | 16     | 0     | 31        | NC       | 5  |



Company : DEI  
 Designer : EHS  
 Job Number : B16670 The Pump House  
 Model Name : Frame #1

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**Envelope Member Section Deflections (Continued)**

| Member | Sec |     | x [in] | LC   | y [in] | LC   | L/y Ratio | LC |   |
|--------|-----|-----|--------|------|--------|------|-----------|----|---|
| 44     |     | min | -.458  | 15   | -.002  | 16   | NC        | 5  |   |
| 45     | 3   | max | .458   | 16   | 0      | 31   | NC        | 5  |   |
| 46     |     | min | -.458  | 15   | -.001  | 16   | NC        | 5  |   |
| 47     | 4   | max | .458   | 16   | 0      | 32   | NC        | 5  |   |
| 48     |     | min | -.458  | 15   | -.002  | 15   | NC        | 5  |   |
| 49     | 5   | max | .458   | 16   | 0      | 32   | NC        | 5  |   |
| 50     |     | min | -.458  | 15   | 0      | 15   | NC        | 5  |   |
| 51     | M11 | 1   | max    | .458 | 16     | 0    | 32        | NC | 5 |
| 52     |     | min | -.458  | 15   | 0      | 15   | NC        | 5  |   |
| 53     | 2   | max | .459   | 16   | 0      | 31   | NC        | 5  |   |
| 54     |     | min | -.459  | 15   | -.002  | 16   | NC        | 5  |   |
| 55     | 3   | max | .459   | 16   | 0      | 32   | NC        | 5  |   |
| 56     |     | min | -.459  | 15   | -.001  | 15   | NC        | 5  |   |
| 57     | 4   | max | .459   | 16   | 0      | 32   | NC        | 5  |   |
| 58     |     | min | -.459  | 15   | -.002  | 15   | NC        | 5  |   |
| 59     | 5   | max | .459   | 16   | 0      | 31   | NC        | 5  |   |
| 60     |     | min | -.459  | 15   | 0      | 16   | NC        | 5  |   |
| 61     | M12 | 1   | max    | .459 | 16     | 0    | 31        | NC | 5 |
| 62     |     | min | -.459  | 15   | 0      | 16   | NC        | 5  |   |
| 63     | 2   | max | .459   | 16   | 0      | 31   | NC        | 5  |   |
| 64     |     | min | -.459  | 15   | -.002  | 16   | NC        | 5  |   |
| 65     | 3   | max | .459   | 16   | 0      | 31   | NC        | 5  |   |
| 66     |     | min | -.459  | 15   | -.002  | 16   | NC        | 5  |   |
| 67     | 4   | max | .459   | 16   | 0      | 32   | NC        | 5  |   |
| 68     |     | min | -.459  | 15   | -.001  | 15   | NC        | 5  |   |
| 69     | 5   | max | .46    | 16   | 0      | 32   | NC        | 5  |   |
| 70     |     | min | -.46   | 15   | 0      | 15   | NC        | 5  |   |
| 71     | M13 | 1   | max    | .46  | 16     | 0    | 32        | NC | 5 |
| 72     |     | min | -.46   | 15   | 0      | 15   | NC        | 5  |   |
| 73     | 2   | max | .46    | 16   | 0      | 32   | NC        | 5  |   |
| 74     |     | min | -.46   | 15   | -.002  | 15   | NC        | 5  |   |
| 75     | 3   | max | .46    | 16   | .002   | 32   | NC        | 5  |   |
| 76     |     | min | -.46   | 15   | -.005  | 15   | NC        | 5  |   |
| 77     | 4   | max | .46    | 16   | .003   | 32   | NC        | 5  |   |
| 78     |     | min | -.46   | 15   | -.006  | 15   | NC        | 5  |   |
| 79     | 5   | max | .46    | 16   | 0      | 31   | NC        | 5  |   |
| 80     |     | min | -.46   | 15   | -.001  | 16   | NC        | 5  |   |
| 81     | M3  | 1   | max    | 0    | 5      | 0    | 5         | NC | 5 |
| 82     |     | min | 0      | 5    | 0      | 5    | NC        | 5  |   |
| 83     | 2   | max | 0      | 32   | .166   | 15   | NC        | 5  |   |
| 84     |     | min | 0      | 15   | -.166  | 16   | 2790.377  | 15 |   |
| 85     | 3   | max | 0      | 32   | .312   | 15   | NC        | 5  |   |
| 86     |     | min | 0      | 15   | -.312  | 16   | 1743.986  | 15 |   |
| 87     | 4   | max | 0      | 32   | .416   | 15   | NC        | 5  |   |
| 88     |     | min | 0      | 15   | -.416  | 16   | 1993.127  | 15 |   |
| 89     | 5   | max | 0      | 32   | .458   | 15   | NC        | 5  |   |
| 90     |     | min | 0      | 15   | -.458  | 16   | NC        | 5  |   |
| 91     | M4  | 1   | max    | 0    | 15     | .458 | 16        | NC | 5 |
| 92     |     | min | 0      | 32   | -.458  | 15   | NC        | 5  |   |
| 93     | 2   | max | 0      | 15   | .416   | 16   | NC        | 5  |   |
| 94     |     | min | 0      | 32   | -.416  | 15   | 1984.409  | 16 |   |
| 95     | 3   | max | 0      | 15   | .312   | 16   | NC        | 5  |   |
| 96     |     | min | 0      | 32   | -.312  | 15   | 1736.358  | 16 |   |
| 97     | 4   | max | 0      | 15   | .166   | 16   | NC        | 5  |   |
| 98     |     | min | 0      | 32   | -.166  | 15   | 2778.172  | 16 |   |
| 99     | 5   | max | 0      | 5    | 0      | 5    | NC        | 5  |   |
| 100    |     | min | 0      | 5    | 0      | 5    | NC        | 5  |   |



Company : DEI  
 Designer : EHS  
 Job Number : B16670 The Pump House  
 Model Name : Frame #1

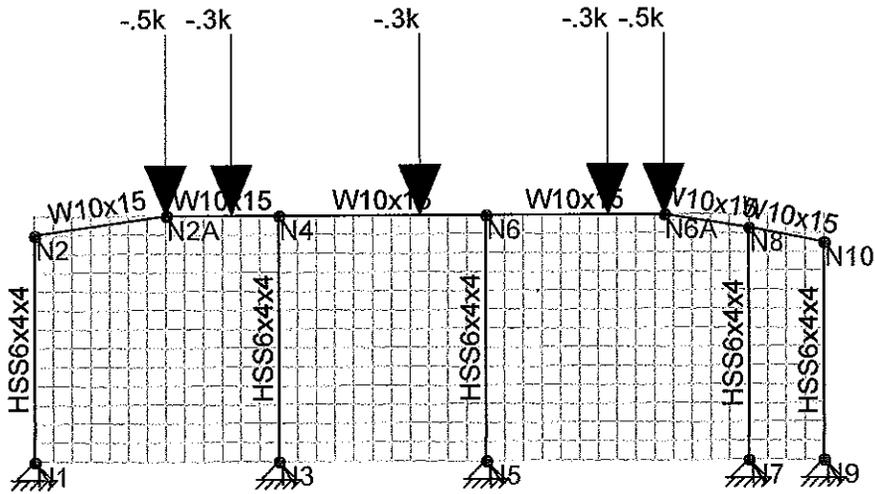
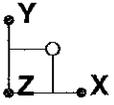
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**Envelope Member Section Deflections (Continued)**

| Member | Sec |   | x [in] | LC    | y [in] | LC    | L/y Ratio | LC       |    |
|--------|-----|---|--------|-------|--------|-------|-----------|----------|----|
| 101    | M5  | 1 | max    | 0     | 5      | 0     | 5         | NC       | 5  |
| 102    |     |   | min    | 0     | 5      | 0     | 5         | NC       | 5  |
| 103    |     | 2 | max    | 0     | 31     | .166  | 15        | NC       | 5  |
| 104    |     |   | min    | 0     | 16     | -.166 | 16        | 2784.896 | 16 |
| 105    |     | 3 | max    | 0     | 31     | .312  | 15        | NC       | 5  |
| 106    |     |   | min    | 0     | 16     | -.312 | 16        | 1740.56  | 16 |
| 107    |     | 4 | max    | 0     | 31     | .417  | 15        | NC       | 5  |
| 108    |     |   | min    | 0     | 16     | -.417 | 16        | 1989.211 | 16 |
| 109    |     | 5 | max    | 0     | 31     | .459  | 15        | NC       | 5  |
| 110    |     |   | min    | 0     | 16     | -.459 | 16        | NC       | 5  |
| 111    | M6  | 1 | max    | 0     | 5      | 0     | 5         | NC       | 5  |
| 112    |     |   | min    | 0     | 5      | 0     | 5         | NC       | 5  |
| 113    |     | 2 | max    | 0     | 32     | .168  | 15        | NC       | 5  |
| 114    |     |   | min    | 0     | 15     | -.167 | 16        | 2733.275 | 15 |
| 115    |     | 3 | max    | 0     | 32     | .314  | 15        | NC       | 5  |
| 116    |     |   | min    | 0     | 15     | -.314 | 16        | 1708.297 | 15 |
| 117    |     | 4 | max    | 0     | 32     | .418  | 15        | NC       | 5  |
| 118    |     |   | min    | 0     | 15     | -.418 | 16        | 1952.339 | 15 |
| 119    |     | 5 | max    | 0     | 32     | .46   | 15        | NC       | 5  |
| 120    |     |   | min    | 0     | 15     | -.46  | 16        | NC       | 5  |
| 121    | M7  | 1 | max    | 0     | 5      | 0     | 5         | NC       | 5  |
| 122    |     |   | min    | 0     | 5      | 0     | 5         | NC       | 5  |
| 123    |     | 2 | max    | 0     | 31     | .164  | 15        | NC       | 5  |
| 124    |     |   | min    | 0     | 16     | -.165 | 16        | 2900.857 | 16 |
| 125    |     | 3 | max    | 0     | 31     | .308  | 15        | NC       | 5  |
| 126    |     |   | min    | 0     | 16     | -.31  | 16        | 1813.036 | 16 |
| 127    |     | 4 | max    | 0     | 31     | .413  | 15        | NC       | 5  |
| 128    |     |   | min    | 0     | 16     | -.415 | 16        | 2072.041 | 16 |
| 129    |     | 5 | max    | 0     | 31     | .46   | 15        | NC       | 5  |
| 130    |     |   | min    | -.001 | 16     | -.46  | 16        | NC       | 5  |

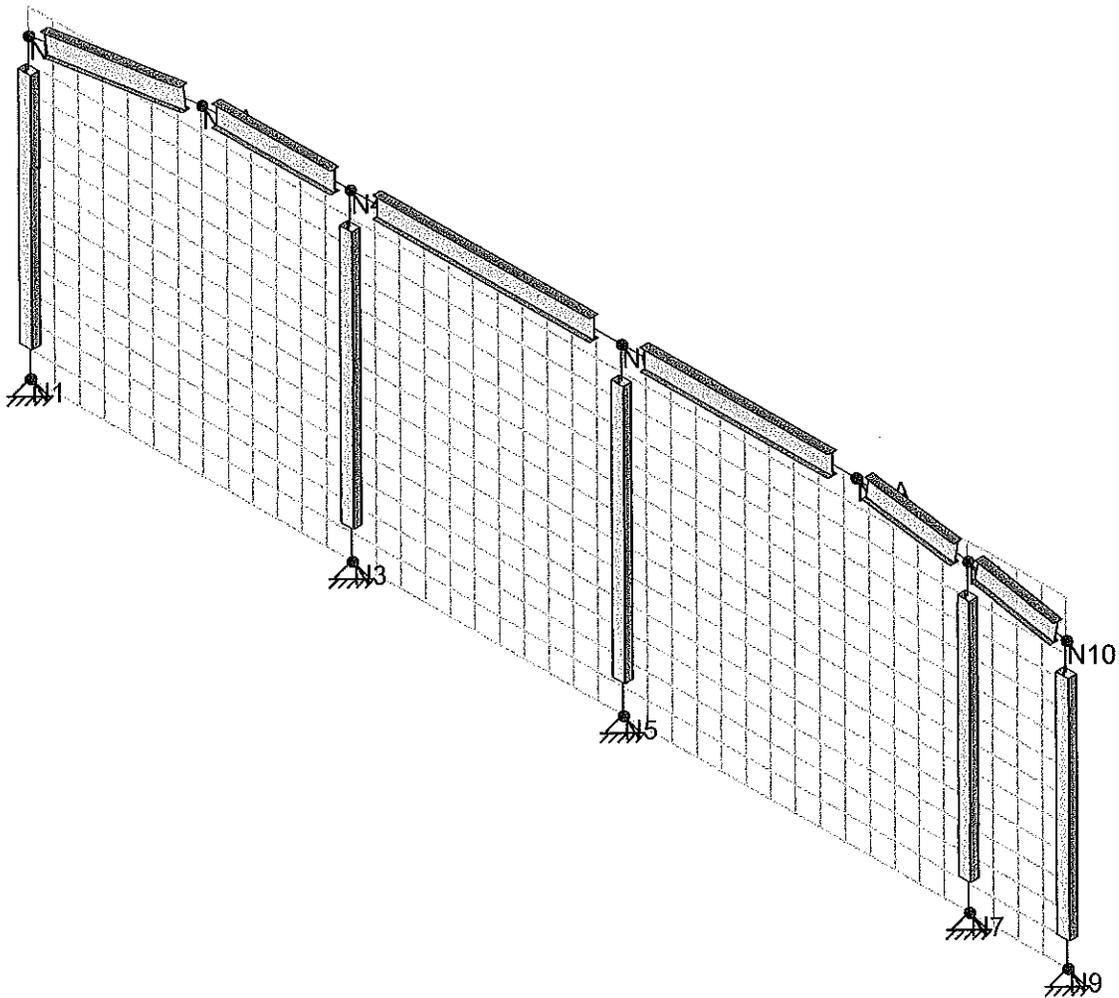
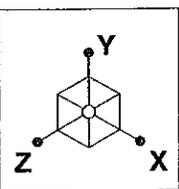
**Envelope AISC 14th(360-10): ASD Steel Code Checks**

| Member | Shape | Code Check | Loc..... | Shea.. | Loc..... | Pnc/o... | Pnt/o...        | Mn/om.... | Eqn       |
|--------|-------|------------|----------|--------|----------|----------|-----------------|-----------|-----------|
| 1      | M1    | HSS6x4x4   | .094     | 12 15  | .004     | 0 15     | 68.998 118.443  | 14.805    | 1 H1-1b   |
| 2      | M2    | HSS6x4x4   | .098     | 12 16  | .005     | 0 16     | 68.998 118.443  | 14.805    | 1 H1-1b   |
| 3      | M8    | W10x15     | .033     | 0 15   | .007     | 10 16    | 119.111 132.036 | 39.92     | ... H1-1b |
| 4      | M9    | W10x15     | .021     | 0 15   | .004     | 0 15     | 30.166 132.036  | 39.92     | ... H1-1b |
| 5      | M10   | W10x15     | .026     | 0 15   | .005     | 10 16    | 30.166 132.036  | 39.92     | ... H1-1b |
| 6      | M11   | W10x15     | .028     | 0 15   | .005     | 0 15     | 30.166 132.036  | 39.92     | ... H1-1b |
| 7      | M12   | W10x15     | .028     | 0 15   | .004     | 10 16    | 30.166 132.036  | 39.92     | ... H1-1b |
| 8      | M13   | W10x15     | .045     | 10 15  | .007     | 0 15     | 30.166 132.036  | 38.305    | ... H1-1b |
| 9      | M3    | HSS6x4x4   | .096     | 12 15  | .004     | 0 15     | 68.998 118.443  | 14.805    | 1 H1-1b   |
| 10     | M4    | HSS6x4x4   | .096     | 0 15   | .005     | 0 16     | 68.998 118.443  | 14.805    | 1 H1-1b   |
| 11     | M5    | HSS6x4x4   | .096     | 12 16  | .004     | 0 16     | 68.998 118.443  | 14.805    | 1 H1-1b   |
| 12     | M6    | HSS6x4x4   | .098     | 12 15  | .005     | 0 15     | 68.998 118.443  | 14.805    | 1 H1-1b   |
| 13     | M7    | HSS6x4x4   | .094     | 12 16  | .004     | 0 16     | 68.998 118.443  | 14.805    | 1 H1-1b   |



Loads: BLC 1, Dead  
Envelope Only Solution

|                       |          |                          |
|-----------------------|----------|--------------------------|
| DEI                   | Frame #2 | SK - 7                   |
| EHS                   |          | Sept 19, 2016 at 1:37 PM |
| B16670 The Pump House |          | Frame #2.r2d             |



Envelope Only Solution

DEI

EHS

B16670 The Pump House

Frame #2

SK - 3

Sept 19, 2016 at 1:34 PM

Frame #2.r2d



Company : DEI  
 Designer : EHS  
 Job Number : B16670 The Pump House  
 Model Name : Frame #2

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### Hot Rolled Steel Properties

|   | Label          | E [ksi] | G [ksi] | Nu | Therm (1/E5 F) | Density[k/ft^3] | Yield[ksi] |
|---|----------------|---------|---------|----|----------------|-----------------|------------|
| 1 | A36 Gr.36      | 29000   | 11154   | .3 | .65            | .49             | 36         |
| 2 | A572 Gr.50     | 29000   | 11154   | .3 | .65            | .49             | 50         |
| 3 | A992           | 29000   | 11154   | .3 | .65            | .49             | 50         |
| 4 | A500 Gr.B RND  | 29000   | 11154   | .3 | .65            | .49             | 42         |
| 5 | A500 Gr.B Rect | 29000   | 11154   | .3 | .65            | .49             | 46         |
| 6 | A53 Gr.B       | 29000   | 11154   | .3 | .65            | .49             | 35         |

### Hot Rolled Steel Section Sets

|   | Label    | Shape     | Type   | Design List      | Material       | Design Rul... | A [in2] | I (90,270)... | I (0.180) [.. |
|---|----------|-----------|--------|------------------|----------------|---------------|---------|---------------|---------------|
| 1 | Column   | HSS6x4x4  | Column | SquareTube A1085 | A500 Gr.B Rect | Typical       | 4.3     | 11.1          | 20.9          |
| 2 | Column 2 | W12x65    | Column | Wide Flange      | A992           | Typical       | 19.1    | 174           | 533           |
| 3 | Beam     | HSS10x4x4 | Beam   | SquareTube A1085 | A500 Gr.B Rect | Typical       | 6.17    | 17.7          | 74.7          |
| 4 | Beam 2   | W10x15    | Beam   | Wide Flange      | A992           | Typical       | 4.41    | 2.89          | 68.9          |

### Joint Coordinates and Temperatures

|    | Label | X [ft] | Y [ft] | Temp [F] |
|----|-------|--------|--------|----------|
| 1  | N1    | 0      | 0      | 0        |
| 2  | N2    | 0      | 12     | 0        |
| 3  | N2A   | 7      | 13     | 0        |
| 4  | N3    | 13     | 0      | 0        |
| 5  | N4    | 13     | 13     | 0        |
| 6  | N6    | 24     | 13     | 0        |
| 7  | N6A   | 33.5   | 13     | 0        |
| 8  | N8    | 38     | 12.3   | 0        |
| 9  | N5    | 24     | 0      | 0        |
| 10 | N7    | 38     | 0      | 0        |
| 11 | N9    | 42     | 0      | 0        |
| 12 | N10   | 42     | 11.5   | 0        |

### Joint Boundary Conditions

|   | Joint Label | X [k/in] | Y [k/in] | Rotation[k-ft/rad] | Footing |
|---|-------------|----------|----------|--------------------|---------|
| 1 | N1          | Reaction | Reaction |                    |         |
| 2 | N3          | Reaction | Reaction |                    |         |
| 3 | N5          | Reaction | Reaction |                    |         |
| 4 | N7          | Reaction | Reaction |                    |         |
| 5 | N9          | Reaction | Reaction |                    |         |

### Hot Rolled Steel Design Parameters

|    | Label | Shape  | Length[ft] | Lb-out[ft] | Lb-in[ft] | Lcomp top[ft] | Lcomp bot[ft] | L-torq... | K-out | K-in | Cb | Function |
|----|-------|--------|------------|------------|-----------|---------------|---------------|-----------|-------|------|----|----------|
| 1  | M1    | Column | 12         |            |           | Lb out        |               |           |       |      |    | Lateral  |
| 2  | M2    | Column | 13         |            |           | Lb out        |               |           |       |      |    | Lateral  |
| 3  | M6    | Beam 2 | 7.071      | 2          |           | 2             |               |           |       |      |    | Lateral  |
| 4  | M8    | Beam 2 | 11         |            |           | Lb out        |               |           |       |      |    | Lateral  |
| 5  | M7    | Beam 2 | 6          |            |           | Lb out        |               |           |       |      |    | Lateral  |
| 6  | M9    | Beam 2 | 9.5        |            |           | Lb out        |               |           |       |      |    | Lateral  |
| 7  | M10   | Beam 2 | 4.554      |            |           | Lb out        |               |           |       |      |    | Lateral  |
| 8  | M11   | Beam 2 | 4.079      |            |           | Lb out        |               |           |       |      |    | Lateral  |
| 9  | M3    | Column | 13         |            |           |               |               |           |       |      |    | Lateral  |
| 10 | M4    | Column | 12.3       |            |           |               |               |           |       |      |    | Lateral  |
| 11 | M5    | Column | 11.5       |            |           |               |               |           |       |      |    | Lateral  |



Company : DEI  
 Designer : EHS  
 Job Number : B16670 The Pump House  
 Model Name : Frame #2

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**Joint Loads and Enforced Displacements (BLC 1 : Dead)**

|   | Joint Label | L,D,M | Direction | Magnitude[(k.k-ft), (in.rad), (k*s^2/f... |
|---|-------------|-------|-----------|---|
| 1 | N2A         | L     | Y         | -5  |
| 2 | N6A         | L     | Y         | -5  |

**Joint Loads and Enforced Displacements (BLC 3 : Seismic)**

|   | Joint Label | L,D,M | Direction | Magnitude[(k.k-ft), (in.rad), (k*s^2/f... |
|---|-------------|-------|-----------|---|
| 1 | N10         | L     | X         | -1.1                                      |

**Member Point Loads (BLC 1 : Dead)**

|   | Member Label | Direction | Magnitude[k.k-ft] | Location[ft.%] |
|---|--------------|-----------|-------------------|----------------|
| 1 | M7           | Y         | -3                | 3.5            |
| 2 | M8           | Y         | -3                | 7.5            |
| 3 | M9           | Y         | -3                | 6.5            |

**Member Distributed Loads**

| Member Label         | Direction | Start Magnitude[k/ft.F] | End Magnitude[k/ft.F] | Start Location[ft.%] | End Location[ft.%] |
|----------------------|-----------|-------------------------|-----------------------|----------------------|--------------------|
| No Data to Print ... |           |                         |                       |                      |                    |

**Load Combinations**

|    | Description | Sol. | PD. | SR. | BLC Fact. |     |
|----|-------------|------|-----|-----|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----|
| 1  | Dead        |      | Y   |     | DL        | 1         |           |           |           |           |           |           |           |           |           |     |
| 2  | Live        |      | Y   |     | LL        | 1         |           |           |           |           |           |           |           |           |           |     |
| 3  | Seismic     |      | Y   |     | EL        | 1         |           |           |           |           |           |           |           |           |           |     |
| 4  | Wind        |      | Y   |     | WL        | 1         |           |           |           |           |           |           |           |           |           |     |
| 5  | IBC 16-8    | Yes  | Y   |     | DL        | 1         |           |           |           |           |           |           |           |           |           |     |
| 6  | IBC 16-9    | Yes  | Y   |     | DL        | 1         | LL        | 1         | LLS       | 1         |           |           |           |           |           |     |
| 7  | IBC 16-10   | Yes  | Y   |     | DL        | 1         | RLL       | 1         |           |           |           |           |           |           |           |     |
| 8  | IBC 16-10   | Yes  | Y   |     | DL        | 1         | SL        | 1         | SLN       | 1         |           |           |           |           |           |     |
| 9  | IBC 16-10   | Yes  | Y   |     | DL        | 1         | RL        | 1         |           |           |           |           |           |           |           |     |
| 10 | IBC 16-11   | Yes  | Y   |     | DL        | 1         | LL        | .75       | LLS       | .75       | RLL       | .75       |           |           |           |     |
| 11 | IBC 16-11   | Yes  | Y   |     | DL        | 1         | LL        | .75       | LLS       | .75       | SL        | .75       | SLN       | .75       |           |     |
| 12 | IBC 16-11   | Yes  | Y   |     | DL        | 1         | LL        | .75       | LLS       | .75       | RL        | .75       |           |           |           |     |
| 13 | IBC 16-12   | Yes  | Y   |     | DL        | 1         | WL        | .6        |           |           |           |           |           |           |           |     |
| 14 | IBC 16-12   | Yes  | Y   |     | DL        | 1         | WL        | -.6       |           |           |           |           |           |           |           |     |
| 15 | IBC 16-12   | Yes  | Y   |     | DL        | 1         | EL        | .7        |           |           |           |           |           |           |           |     |
| 16 | IBC 16-12   | Yes  | Y   |     | DL        | 1         | EL        | -.7       |           |           |           |           |           |           |           |     |
| 17 | IBC 16-13   | Yes  | Y   |     | DL        | 1         | WL        | .45       | LL        | .75       | LLS       | .75       | RLL       | .75       |           |     |
| 18 | IBC 16-13   | Yes  | Y   |     | DL        | 1         | WL        | -.45      | LL        | .75       | LLS       | .75       | RLL       | .75       |           |     |
| 19 | IBC 16-13   | Yes  | Y   |     | DL        | 1         | WL        | .45       | LL        | .75       | LLS       | .75       | SL        | .75       | SLN       | .75 |
| 20 | IBC 16-13   | Yes  | Y   |     | DL        | 1         | WL        | -.45      | LL        | .75       | LLS       | .75       | SL        | .75       | SLN       | .75 |
| 21 | IBC 16-13   | Yes  | Y   |     | DL        | 1         | WL        | .45       | LL        | .75       | LLS       | .75       | RL        | .75       |           |     |
| 22 | IBC 16-13   | Yes  | Y   |     | DL        | 1         | WL        | -.45      | LL        | .75       | LLS       | .75       | RL        | .75       |           |     |
| 23 | IBC 16-14   | Yes  | Y   |     | DL        | 1         | EL        | .525      | LL        | .75       | LLS       | .75       | RLL       | .75       |           |     |
| 24 | IBC 16-14   | Yes  | Y   |     | DL        | 1         | EL        | -.525     | LL        | .75       | LLS       | .75       | RLL       | .75       |           |     |
| 25 | IBC 16-14   | Yes  | Y   |     | DL        | 1         | EL        | .525      | LL        | .75       | LLS       | .75       | SL        | .75       | SLN       | .75 |
| 26 | IBC 16-14   | Yes  | Y   |     | DL        | 1         | EL        | -.525     | LL        | .75       | LLS       | .75       | SL        | .75       | SLN       | .75 |
| 27 | IBC 16-14   | Yes  | Y   |     | DL        | 1         | EL        | .525      | LL        | .75       | LLS       | .75       | RL        | .75       |           |     |
| 28 | IBC 16-14   | Yes  | Y   |     | DL        | 1         | EL        | -.525     | LL        | .75       | LLS       | .75       | RL        | .75       |           |     |
| 29 | IBC 16-15   | Yes  | Y   |     | DL        | .6        | WL        | .6        |           |           |           |           |           |           |           |     |
| 30 | IBC 16-15   | Yes  | Y   |     | DL        | .6        | WL        | -.6       |           |           |           |           |           |           |           |     |
| 31 | IBC 16-16   | Yes  | Y   |     | DL        | .6        | EL        | .7        |           |           |           |           |           |           |           |     |
| 32 | IBC 16-16   | Yes  | Y   |     | DL        | .6        | EL        | -.7       |           |           |           |           |           |           |           |     |



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**Load Combination Design**

| Description        | ASIF | CD   | ABIF | Service | Hot Rolled | Cold Form... | Wood | Concrete | Masonry | Footings | Aluminum |
|--------------------|------|------|------|---------|------------|--------------|------|----------|---------|----------|----------|
| 1 Dead             |      |      |      |         | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 2 Live             |      |      |      |         | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 3 Seismic          |      |      |      |         | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 4 Wind             |      |      |      |         | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 5 IBC 16-8         |      | .9   |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 6 IBC 16-9         |      |      |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 7 IBC 16-10 (a)    |      | 1.25 |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 8 IBC 16-10 (b)    |      | 1.15 |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 9 IBC 16-10 (c)    |      | 1.15 |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 10 IBC 16-11 (a)   |      | 1.25 |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 11 IBC 16-11 (b)   |      | 1.15 |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 12 IBC 16-11 (c)   |      | 1.15 |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 13 IBC 16-12 (a).. |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 14 IBC 16-12 (a).. |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 15 IBC 16-12 (b).. |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 16 IBC 16-12 (b).. |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 17 IBC 16-13 (a).. |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 18 IBC 16-13 (a).. |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 19 IBC 16-13 (b).. |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 20 IBC 16-13 (b).. |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 21 IBC 16-13 (c).. |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 22 IBC 16-13 (c).. |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 23 IBC 16-14 (a).. |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 24 IBC 16-14 (a).. |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 25 IBC 16-14 (b).. |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 26 IBC 16-14 (b).. |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 27 IBC 16-14 (c).. |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 28 IBC 16-14 (c).. |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 29 IBC 16-15 (a)   |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 30 IBC 16-15 (b)   |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 31 IBC 16-16 (a)   |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |
| 32 IBC 16-16 (b)   |      | 1.6  |      | Yes     | Yes        | Yes          | Yes  | Yes      | Yes     | Yes      | Yes      |

**Envelope Joint Reactions**

| Joint |         | X [k] | LC | Y [k] | LC | Moment [k-ft] | LC |
|-------|---------|-------|----|-------|----|---------------|----|
| 1     | N1      | max   | 15 | .172  | 15 | .726          | 15 |
| 2     |         | min   | 32 | -.133 | 32 | .061          | 32 |
| 3     | N3      | max   | 31 | .128  | 16 | 1.144         | 16 |
| 4     |         | min   | 16 | -.154 | 31 | .555          | 31 |
| 5     | N5      | max   | 15 | .141  | 16 | .926          | 16 |
| 6     |         | min   | 32 | -.125 | 31 | .453          | 31 |
| 7     | N7      | max   | 31 | .151  | 15 | 1.787         | 15 |
| 8     |         | min   | 16 | -.181 | 32 | .018          | 32 |
| 9     | N9      | max   | 15 | .193  | 32 | .685          | 32 |
| 10    |         | min   | 16 | -.191 | 15 | -.853         | 15 |
| 11    | Totals: | max   | 15 | .77   | 16 | 3.438         | 16 |
| 12    |         | min   | 16 | -.77  | 31 | 2.063         | 31 |

**Envelope Joint Displacements**

| Joint |    | X [in] | LC | Y [in] | LC | Rotation [rad] | LC |
|-------|----|--------|----|--------|----|----------------|----|
| 1     | N1 | max    | 32 | 0      | 32 | 3.876e-3       | 15 |
| 2     |    | min    | 15 | 0      | 15 | -3.575e-3      | 32 |
| 3     | N2 | max    | 16 | .382   | 32 | 2.904e-4       | 31 |



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**Envelope Joint Displacements (Continued)**

| Joint |     | X [in] | LC    | Y [in] | LC    | Rotation [rad] | LC        |
|-------|-----|--------|-------|--------|-------|----------------|-----------|
| 4     |     | min    | -.38  | 15     | 0     | 15             | -8.854e-4 |
| 5     | N2A | max    | .386  | 16     | -.006 | 31             | 1.979e-4  |
| 6     |     | min    | -.378 | 15     | -.031 | 16             | -1.134e-4 |
| 7     | N3  | max    | 0     | 16     | 0     | 31             | 3.504e-3  |
| 8     |     | min    | 0     | 31     | 0     | 16             | -3.798e-3 |
| 9     | N4  | max    | .386  | 16     | 0     | 31             | 3.43e-4   |
| 10    |     | min    | -.378 | 15     | -.002 | 16             | 7.724e-5  |
| 11    | N6  | max    | .387  | 16     | 0     | 31             | 9.576e-5  |
| 12    |     | min    | -.379 | 15     | -.001 | 16             | -3.987e-4 |
| 13    | N6A | max    | .387  | 16     | -.011 | 31             | 3.175e-4  |
| 14    |     | min    | -.379 | 15     | -.019 | 16             | 6.231e-5  |
| 15    | N8  | max    | .39   | 16     | 0     | 32             | 2.942e-4  |
| 16    |     | min    | -.377 | 31     | -.003 | 15             | 2.174e-5  |
| 17    | N5  | max    | 0     | 32     | 0     | 31             | 3.622e-3  |
| 18    |     | min    | 0     | 15     | 0     | 16             | -3.513e-3 |
| 19    | N7  | max    | 0     | 16     | 0     | 32             | 3.717e-3  |
| 20    |     | min    | 0     | 31     | 0     | 15             | -4.006e-3 |
| 21    | N9  | max    | 0     | 16     | 0     | 15             | 3.959e-3  |
| 22    |     | min    | 0     | 15     | 0     | 32             | -4.088e-3 |
| 23    | N10 | max    | .39   | 16     | .001  | 15             | 2.515e-4  |
| 24    |     | min    | -.377 | 31     | 0     | 32             | -2.925e-4 |

**Envelope Member Section Stresses**

| Member | Sec |   | Axial[ksi] | LC    | Shear[ksi] | LC    | Top Bending[k... | LC     | Bottom Bendin... | LC     |    |
|--------|-----|---|------------|-------|------------|-------|------------------|--------|------------------|--------|----|
| 1      | M1  | 1 | max        | .169  | 15         | .054  | 32               | 0      | 5                | 0      | 5  |
| 2      |     |   | min        | .014  | 32         | -.071 | 15               | 0      | 5                | 0      | 5  |
| 3      |     | 2 | max        | .159  | 15         | .054  | 32               | .686   | 32               | .902   | 15 |
| 4      |     |   | min        | .008  | 32         | -.071 | 15               | -.902  | 15               | -.686  | 32 |
| 5      |     | 3 | max        | .149  | 15         | .054  | 32               | 1.373  | 32               | 1.803  | 15 |
| 6      |     |   | min        | .002  | 32         | -.071 | 15               | -1.803 | 15               | -1.373 | 32 |
| 7      |     | 4 | max        | .138  | 15         | .054  | 32               | 2.059  | 32               | 2.705  | 15 |
| 8      |     |   | min        | -.004 | 32         | -.071 | 15               | -2.705 | 15               | -2.059 | 32 |
| 9      |     | 5 | max        | .128  | 15         | .054  | 32               | 2.746  | 32               | 3.606  | 15 |
| 10     |     |   | min        | -.01  | 32         | -.071 | 15               | -3.606 | 15               | -2.746 | 32 |
| 11     | M2  | 1 | max        | .266  | 16         | .064  | 16               | 0      | 5                | 0      | 5  |
| 12     |     |   | min        | .129  | 31         | -.053 | 31               | 0      | 5                | 0      | 5  |
| 13     |     | 2 | max        | .255  | 16         | .064  | 16               | .888   | 16               | .729   | 31 |
| 14     |     |   | min        | .123  | 31         | -.053 | 31               | -.729  | 31               | -.888  | 16 |
| 15     |     | 3 | max        | .244  | 16         | .064  | 16               | 1.775  | 16               | 1.457  | 31 |
| 16     |     |   | min        | .116  | 31         | -.053 | 31               | -1.457 | 31               | -1.775 | 16 |
| 17     |     | 4 | max        | .233  | 16         | .064  | 16               | 2.663  | 16               | 2.186  | 31 |
| 18     |     |   | min        | .109  | 31         | -.053 | 31               | -2.186 | 31               | -2.663 | 16 |
| 19     |     | 5 | max        | .222  | 16         | .064  | 16               | 3.551  | 16               | 2.915  | 31 |
| 20     |     |   | min        | .103  | 31         | -.053 | 31               | -2.915 | 31               | -3.551 | 16 |
| 21     | M6  | 1 | max        | .056  | 15         | .227  | 15               | 1.387  | 32               | 1.821  | 15 |
| 22     |     |   | min        | -.031 | 32         | -.011 | 32               | -1.821 | 15               | -1.387 | 32 |
| 23     |     | 2 | max        | .055  | 15         | .215  | 15               | 1.419  | 16               | 1.108  | 31 |
| 24     |     |   | min        | -.032 | 32         | -.018 | 32               | -1.108 | 31               | -1.419 | 16 |
| 25     |     | 3 | max        | .055  | 15         | .204  | 15               | 1.506  | 16               | .535   | 31 |
| 26     |     |   | min        | -.032 | 32         | -.025 | 32               | -.535  | 31               | -1.506 | 16 |
| 27     |     | 4 | max        | .054  | 15         | .192  | 15               | 1.554  | 16               | -.013  | 31 |
| 28     |     |   | min        | -.033 | 32         | -.032 | 32               | .013   | 31               | -1.554 | 16 |
| 29     |     | 5 | max        | .053  | 15         | .181  | 15               | 1.561  | 16               | -.538  | 31 |
| 30     |     |   | min        | -.033 | 32         | -.039 | 32               | .538   | 31               | -1.561 | 16 |
| 31     | M8  | 1 | max        | .066  | 15         | .15   | 15               | .077   | 32               | 1.52   | 15 |



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**Envelope Member Section Stresses (Continued)**

| Member | Sec |     | Axial[ksi] | LC   | Shear[ksi] | LC    | Top Bending[k... | LC    | Bottom Bending... | LC    |    |
|--------|-----|-----|------------|------|------------|-------|------------------|-------|-------------------|-------|----|
| 32     |     | min | -.064      | 32   | -.017      | 32    | -1.52            | 15    | -.077             | 32    |    |
| 33     | 2   | max | .066       | 15   | .132       | 15    | -.044            | 32    | .746              | 15    |    |
| 34     |     | min | -.064      | 32   | -.027      | 32    | -.746            | 15    | .044              | 32    |    |
| 35     | 3   | max | .066       | 15   | .114       | 15    | .002             | 31    | .298              | 16    |    |
| 36     |     | min | -.064      | 32   | -.038      | 32    | -.298            | 16    | -.002             | 31    |    |
| 37     | 4   | max | .066       | 15   | .005       | 31    | .375             | 31    | .652              | 16    |    |
| 38     |     | min | -.064      | 32   | -.168      | 16    | -.652            | 16    | -.375             | 31    |    |
| 39     | 5   | max | .066       | 15   | -.005      | 31    | .375             | 31    | 1.626             | 16    |    |
| 40     |     | min | -.064      | 32   | -.186      | 16    | -1.626           | 16    | -.375             | 31    |    |
| 41     | M7  | 1   | max        | .039 | 15         | .026  | 31               | 1.561 | 16                | -.538 | 31 |
| 42     |     | min | -.03       | 32   | -.229      | 16    | .538             | 31    | -1.561            | 16    |    |
| 43     | 2   | max | .039       | 15   | .02        | 31    | .974             | 15    | -.494             | 32    |    |
| 44     |     | min | -.03       | 32   | -.239      | 16    | .494             | 32    | -.974             | 15    |    |
| 45     | 3   | max | .039       | 15   | .014       | 31    | .858             | 15    | .066              | 32    |    |
| 46     |     | min | -.03       | 32   | -.249      | 16    | -.066            | 32    | -.858             | 15    |    |
| 47     | 4   | max | .039       | 15   | -.07       | 31    | .535             | 31    | .892              | 16    |    |
| 48     |     | min | -.03       | 32   | -.389      | 16    | -.892            | 16    | -.535             | 31    |    |
| 49     | 5   | max | .039       | 15   | -.076      | 31    | .316             | 31    | 2.072             | 16    |    |
| 50     |     | min | -.03       | 32   | -.399      | 16    | -2.072           | 16    | -.316             | 31    |    |
| 51     | M9  | 1   | max        | .098 | 15         | .212  | 15               | .128  | 32                | 1.554 | 15 |
| 52     |     | min | -.092      | 32   | .065       | 32    | -1.554           | 15    | -.128             | 32    |    |
| 53     | 2   | max | .098       | 15   | .196       | 15    | .415             | 32    | .585              | 15    |    |
| 54     |     | min | -.092      | 32   | .056       | 32    | -.585            | 15    | -.415             | 32    |    |
| 55     | 3   | max | .098       | 15   | .181       | 15    | .901             | 16    | -.07              | 31    |    |
| 56     |     | min | -.092      | 32   | .046       | 32    | .07              | 31    | -.901             | 16    |    |
| 57     | 4   | max | .098       | 15   | .036       | 31    | 1.189            | 16    | -.537             | 31    |    |
| 58     |     | min | -.092      | 32   | -.043      | 16    | .537             | 31    | -1.189            | 16    |    |
| 59     | 5   | max | .098       | 15   | .027       | 31    | 1.097            | 15    | -.539             | 32    |    |
| 60     |     | min | -.092      | 32   | -.059      | 16    | .539             | 32    | -1.097            | 15    |    |
| 61     | M10 | 1   | max        | .113 | 15         | -.074 | 31               | 1.097 | 15                | -.539 | 32 |
| 62     |     | min | -.076      | 32   | -.3        | 16    | .539             | 32    | -1.097            | 15    |    |
| 63     | 2   | max | .114       | 15   | -.078      | 31    | .708             | 15    | -.065             | 32    |    |
| 64     |     | min | -.076      | 32   | -.307      | 16    | .065             | 32    | -.708             | 15    |    |
| 65     | 3   | max | .114       | 15   | -.083      | 31    | .33              | 31    | .451              | 16    |    |
| 66     |     | min | -.076      | 32   | -.314      | 16    | -.451            | 16    | -.33              | 31    |    |
| 67     | 4   | max | .115       | 15   | -.087      | 31    | .136             | 31    | 1.174             | 16    |    |
| 68     |     | min | -.075      | 32   | -.322      | 16    | -1.174           | 16    | -.136             | 31    |    |
| 69     | 5   | max | .115       | 15   | -.092      | 31    | -.067            | 31    | 1.915             | 16    |    |
| 70     |     | min | -.075      | 32   | -.329      | 16    | -1.915           | 16    | .067              | 31    |    |
| 71     | M11 | 1   | max        | .086 | 31         | .511  | 15               | .459  | 32                | 2.169 | 15 |
| 72     |     | min | -.11       | 16   | -.283      | 32    | -2.169           | 15    | -.459             | 32    |    |
| 73     | 2   | max | .087       | 31   | .505       | 15    | -.122            | 32    | 1.134             | 15    |    |
| 74     |     | min | -.109      | 16   | -.287      | 32    | -1.134           | 15    | .122              | 32    |    |
| 75     | 3   | max | .087       | 31   | .498       | 15    | .092             | 31    | .92               | 16    |    |
| 76     |     | min | -.109      | 16   | -.291      | 32    | -.92             | 16    | -.092             | 31    |    |
| 77     | 4   | max | .088       | 31   | .491       | 15    | .995             | 31    | 1.42              | 16    |    |
| 78     |     | min | -.108      | 16   | -.295      | 32    | -1.42            | 16    | -.995             | 31    |    |
| 79     | 5   | max | .088       | 31   | .485       | 15    | 1.892            | 15    | 1.933             | 16    |    |
| 80     |     | min | -.107      | 16   | -.299      | 32    | -1.933           | 16    | -1.892            | 15    |    |
| 81     | M3  | 1   | max        | .215 | 16         | .051  | 32               | 0     | 5                 | 0     | 5  |
| 82     |     | min | .105       | 31   | -.058      | 15    | 0                | 5     | 0                 | 5     |    |
| 83     | 2   | max | .204       | 16   | .051       | 32    | .712             | 32    | .803              | 15    |    |
| 84     |     | min | .099       | 31   | -.058      | 15    | -.803            | 15    | -.712             | 32    |    |
| 85     | 3   | max | .193       | 16   | .051       | 32    | 1.423            | 32    | 1.607             | 15    |    |
| 86     |     | min | .092       | 31   | -.058      | 15    | -1.607           | 15    | -1.423            | 32    |    |
| 87     | 4   | max | .182       | 16   | .051       | 32    | 2.135            | 32    | 2.41              | 15    |    |
| 88     |     | min | .086       | 31   | -.058      | 15    | -2.41            | 15    | -2.135            | 32    |    |



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**Envelope Member Section Stresses (Continued)**

| Member | Sec |   | Axial[ksi] | LC    | Shear[ksi] | LC    | Top Bending[k... | LC     | Bottom Bendin... | LC     |    |
|--------|-----|---|------------|-------|------------|-------|------------------|--------|------------------|--------|----|
| 89     |     | 5 | max        | .171  | 16         | .051  | 32               | 2.847  | 32               | 3.213  | 15 |
| 90     |     |   | min        | .079  | 31         | -.058 | 15               | -3.213 | 15               | -2.847 | 32 |
| 91     | M4  | 1 | max        | .374  | 15         | .074  | 16               | 3.303  | 31               | 3.872  | 16 |
| 92     |     |   | min        | -.021 | 32         | -.063 | 31               | -3.872 | 16               | -3.303 | 31 |
| 93     |     | 2 | max        | .384  | 15         | .074  | 16               | 2.477  | 31               | 2.904  | 16 |
| 94     |     |   | min        | -.015 | 32         | -.063 | 31               | -2.904 | 16               | -2.477 | 31 |
| 95     |     | 3 | max        | .395  | 15         | .074  | 16               | 1.651  | 31               | 1.936  | 16 |
| 96     |     |   | min        | -.008 | 32         | -.063 | 31               | -1.936 | 16               | -1.651 | 31 |
| 97     |     | 4 | max        | .405  | 15         | .074  | 16               | .826   | 31               | .968   | 16 |
| 98     |     |   | min        | -.002 | 32         | -.063 | 31               | -.968  | 16               | -.826  | 31 |
| 99     |     | 5 | max        | .415  | 15         | .074  | 16               | 0      | 5                | 0      | 5  |
| 100    |     |   | min        | .004  | 32         | -.063 | 31               | 0      | 5                | 0      | 5  |
| 101    | M5  | 1 | max        | .159  | 32         | .078  | 16               | 0      | 5                | 0      | 5  |
| 102    |     |   | min        | -.198 | 15         | -.077 | 15               | 0      | 5                | 0      | 5  |
| 103    |     | 2 | max        | .153  | 32         | .078  | 16               | .957   | 16               | .937   | 15 |
| 104    |     |   | min        | -.208 | 15         | -.077 | 15               | -.937  | 15               | -.957  | 16 |
| 105    |     | 3 | max        | .148  | 32         | .078  | 16               | 1.914  | 16               | 1.873  | 15 |
| 106    |     |   | min        | -.218 | 15         | -.077 | 15               | -1.873 | 15               | -1.914 | 16 |
| 107    |     | 4 | max        | .142  | 32         | .078  | 16               | 2.871  | 16               | 2.81   | 15 |
| 108    |     |   | min        | -.228 | 15         | -.077 | 15               | -2.81  | 15               | -2.871 | 16 |
| 109    |     | 5 | max        | .136  | 32         | .078  | 16               | 3.828  | 16               | 3.746  | 15 |
| 110    |     |   | min        | -.237 | 15         | -.077 | 15               | -3.746 | 15               | -3.828 | 16 |

**Envelope Member Section Deflections**

| Member | Sec |   | x [in] | LC    | y [in] | LC    | L/y Ratio | LC       |    |
|--------|-----|---|--------|-------|--------|-------|-----------|----------|----|
| 1      | M1  | 1 | max    | 0     | 5      | 0     | 5         | NC       | 5  |
| 2      |     |   | min    | 0     | 5      | 0     | 5         | NC       | 5  |
| 3      |     | 2 | max    | 0     | 32     | .137  | 15        | NC       | 5  |
| 4      |     |   | min    | 0     | 15     | -.127 | 32        | 3431.316 | 15 |
| 5      |     | 3 | max    | 0     | 32     | .257  | 15        | NC       | 5  |
| 6      |     |   | min    | 0     | 15     | -.241 | 32        | 2144.572 | 15 |
| 7      |     | 4 | max    | 0     | 32     | .344  | 15        | NC       | 5  |
| 8      |     |   | min    | 0     | 15     | -.329 | 32        | 2450.94  | 15 |
| 9      |     | 5 | max    | 0     | 32     | .38   | 15        | NC       | 5  |
| 10     |     |   | min    | 0     | 15     | -.382 | 16        | NC       | 5  |
| 11     | M2  | 1 | max    | 0     | 5      | 0     | 5         | NC       | 5  |
| 12     |     |   | min    | 0     | 5      | 0     | 5         | NC       | 5  |
| 13     |     | 2 | max    | 0     | 31     | .134  | 31        | NC       | 5  |
| 14     |     |   | min    | 0     | 16     | -.145 | 16        | 3216.79  | 16 |
| 15     |     | 3 | max    | 0     | 31     | .252  | 31        | NC       | 5  |
| 16     |     |   | min    | 0     | 16     | -.271 | 16        | 2010.494 | 16 |
| 17     |     | 4 | max    | 0     | 31     | .339  | 31        | NC       | 5  |
| 18     |     |   | min    | -.001 | 16     | -.358 | 16        | 2297.707 | 16 |
| 19     |     | 5 | max    | 0     | 31     | .378  | 15        | NC       | 5  |
| 20     |     |   | min    | -.002 | 16     | -.386 | 16        | NC       | 5  |
| 21     | M6  | 1 | max    | .378  | 16     | .053  | 15        | NC       | 5  |
| 22     |     |   | min    | -.376 | 15     | -.054 | 16        | NC       | 5  |
| 23     |     | 2 | max    | .378  | 16     | .056  | 31        | NC       | 5  |
| 24     |     |   | min    | -.376 | 15     | -.07  | 16        | 9930.016 | 16 |
| 25     |     | 3 | max    | .378  | 16     | .054  | 31        | NC       | 5  |
| 26     |     |   | min    | -.376 | 15     | -.081 | 16        | 7318.277 | 16 |
| 27     |     | 4 | max    | .378  | 16     | .051  | 31        | NC       | 5  |
| 28     |     |   | min    | -.376 | 15     | -.086 | 16        | 9633.961 | 16 |
| 29     |     | 5 | max    | .378  | 16     | .047  | 31        | NC       | 5  |
| 30     |     |   | min    | -.376 | 15     | -.085 | 16        | NC       | 5  |



Company : DEI  
 Designer : EHS  
 Job Number : B16670 The Pump House  
 Model Name : Frame #2

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**Envelope Member Section Deflections (Continued)**

| Member | Sec |   | x [in] | LC    | y [in] | LC    | L/y Ratio | LC       |    |
|--------|-----|---|--------|-------|--------|-------|-----------|----------|----|
| 31     | M8  | 1 | max    | .386  | 16     | 0     | 31        | NC       | 5  |
| 32     |     |   | min    | -.378 | 15     | -.002 | 16        | NC       | 5  |
| 33     |     | 2 | max    | .386  | 16     | .004  | 15        | NC       | 5  |
| 34     |     |   | min    | -.378 | 15     | .002  | 32        | NC       | 5  |
| 35     |     | 3 | max    | .387  | 16     | .006  | 16        | NC       | 5  |
| 36     |     |   | min    | -.378 | 15     | 0     | 31        | NC       | 5  |
| 37     |     | 4 | max    | .387  | 16     | .006  | 16        | NC       | 5  |
| 38     |     |   | min    | -.379 | 15     | -.002 | 31        | NC       | 5  |
| 39     |     | 5 | max    | .387  | 16     | 0     | 31        | NC       | 5  |
| 40     |     |   | min    | -.379 | 15     | -.001 | 16        | NC       | 5  |
| 41     | M7  | 1 | max    | .386  | 16     | -.006 | 31        | NC       | 5  |
| 42     |     |   | min    | -.378 | 15     | -.031 | 16        | 3528.412 | 32 |
| 43     |     | 2 | max    | .386  | 16     | -.007 | 31        | NC       | 5  |
| 44     |     |   | min    | -.378 | 15     | -.025 | 16        | 4596.201 | 32 |
| 45     |     | 3 | max    | .386  | 16     | -.007 | 31        | NC       | 5  |
| 46     |     |   | min    | -.378 | 15     | -.016 | 16        | 7540.373 | 32 |
| 47     |     | 4 | max    | .386  | 16     | -.005 | 31        | NC       | 5  |
| 48     |     |   | min    | -.378 | 15     | -.008 | 16        | NC       | 5  |
| 49     |     | 5 | max    | .386  | 16     | 0     | 31        | NC       | 5  |
| 50     |     |   | min    | -.378 | 15     | -.002 | 16        | NC       | 5  |
| 51     | M9  | 1 | max    | .387  | 16     | 0     | 31        | NC       | 5  |
| 52     |     |   | min    | -.379 | 15     | -.001 | 16        | NC       | 5  |
| 53     |     | 2 | max    | .387  | 16     | -.002 | 31        | NC       | 5  |
| 54     |     |   | min    | -.379 | 15     | -.013 | 16        | NC       | 5  |
| 55     |     | 3 | max    | .387  | 16     | -.006 | 31        | NC       | 5  |
| 56     |     |   | min    | -.379 | 15     | -.022 | 16        | 9866.672 | 16 |
| 57     |     | 4 | max    | .387  | 16     | -.011 | 31        | NC       | 5  |
| 58     |     |   | min    | -.379 | 15     | -.025 | 16        | NC       | 5  |
| 59     |     | 5 | max    | .387  | 16     | -.011 | 31        | NC       | 5  |
| 60     |     |   | min    | -.379 | 15     | -.019 | 16        | NC       | 5  |
| 61     | M10 | 1 | max    | .386  | 16     | .047  | 32        | NC       | 15 |
| 62     |     |   | min    | -.372 | 31     | -.077 | 15        | 3036.524 | 5  |
| 63     |     | 2 | max    | .386  | 16     | .051  | 32        | NC       | 15 |
| 64     |     |   | min    | -.372 | 31     | -.074 | 15        | 3972.509 | 5  |
| 65     |     | 3 | max    | .386  | 16     | .055  | 32        | NC       | 15 |
| 66     |     |   | min    | -.372 | 31     | -.07  | 15        | 6251.305 | 5  |
| 67     |     | 4 | max    | .386  | 16     | .058  | 32        | NC       | 5  |
| 68     |     |   | min    | -.372 | 31     | -.065 | 15        | NC       | 5  |
| 69     |     | 5 | max    | .386  | 16     | .059  | 16        | NC       | 5  |
| 70     |     |   | min    | -.372 | 31     | -.06  | 15        | NC       | 5  |
| 71     | M11 | 1 | max    | .383  | 16     | .076  | 16        | NC       | 5  |
| 72     |     |   | min    | -.369 | 31     | -.076 | 15        | NC       | 5  |
| 73     |     | 2 | max    | .383  | 16     | .077  | 16        | NC       | 5  |
| 74     |     |   | min    | -.369 | 31     | -.075 | 31        | NC       | 5  |
| 75     |     | 3 | max    | .383  | 16     | .078  | 16        | NC       | 5  |
| 76     |     |   | min    | -.37  | 31     | -.074 | 31        | NC       | 5  |
| 77     |     | 4 | max    | .383  | 16     | .078  | 16        | NC       | 5  |
| 78     |     |   | min    | -.37  | 31     | -.074 | 31        | NC       | 5  |
| 79     |     | 5 | max    | .383  | 16     | .076  | 16        | NC       | 5  |
| 80     |     |   | min    | -.37  | 31     | -.073 | 31        | NC       | 5  |
| 81     | M3  | 1 | max    | 0     | 5      | 0     | 5         | NC       | 5  |
| 82     |     |   | min    | 0     | 5      | 0     | 5         | NC       | 5  |
| 83     |     | 2 | max    | 0     | 31     | .139  | 15        | NC       | 5  |
| 84     |     |   | min    | 0     | 16     | -.135 | 16        | 3554.737 | 15 |
| 85     |     | 3 | max    | 0     | 31     | .26   | 15        | NC       | 5  |
| 86     |     |   | min    | 0     | 16     | -.254 | 16        | 2221.711 | 15 |
| 87     |     | 4 | max    | 0     | 31     | .345  | 15        | NC       | 5  |



Company : DEI  
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**Envelope Member Section Deflections (Continued)**

| Member | Sec |     | x [in] | LC | y [in] | LC | L/y Ratio | LC |
|--------|-----|-----|--------|----|--------|----|-----------|----|
| 88     |     | min | 0      | 16 | -.343  | 16 | 2539.098  | 15 |
| 89     | 5   | max | 0      | 31 | .379   | 15 | NC        | 5  |
| 90     |     | min | -.001  | 16 | -.387  | 16 | NC        | 5  |
| 91     | M4  | max | .003   | 15 | .39    | 16 | NC        | 5  |
| 92     |     | min | 0      | 32 | -.377  | 31 | NC        | 5  |
| 93     | 2   | max | .002   | 15 | .359   | 16 | NC        | 5  |
| 94     |     | min | 0      | 32 | -.339  | 31 | 2226.616  | 16 |
| 95     | 3   | max | .001   | 15 | .271   | 16 | NC        | 5  |
| 96     |     | min | 0      | 32 | -.253  | 31 | 1948.289  | 16 |
| 97     | 4   | max | 0      | 15 | .145   | 16 | NC        | 5  |
| 98     |     | min | 0      | 32 | -.135  | 31 | 3117.262  | 16 |
| 99     | 5   | max | 0      | 5  | 0      | 5  | NC        | 5  |
| 100    |     | min | 0      | 5  | 0      | 5  | NC        | 5  |
| 101    | M5  | max | 0      | 5  | 0      | 5  | NC        | 5  |
| 102    |     | min | 0      | 5  | 0      | 5  | NC        | 5  |
| 103    | 2   | max | 0      | 15 | .134   | 31 | NC        | 5  |
| 104    |     | min | 0      | 32 | -.139  | 16 | 3372.633  | 16 |
| 105    | 3   | max | 0      | 15 | .252   | 31 | NC        | 5  |
| 106    |     | min | 0      | 32 | -.261  | 16 | 2107.895  | 16 |
| 107    | 4   | max | 0      | 15 | .338   | 31 | NC        | 5  |
| 108    |     | min | 0      | 32 | -.35   | 16 | 2409.023  | 16 |
| 109    | 5   | max | .001   | 15 | .377   | 31 | NC        | 5  |
| 110    |     | min | 0      | 32 | -.39   | 16 | NC        | 5  |

**Envelope AISC 14th(360-10): ASD Steel Code Checks**

| Member | Shape | Code Check | Loc..... | Shea..         | Loc.....  | Pnc/o... | Pnt/o... | Mn/om.... | Egn       |
|--------|-------|------------|----------|----------------|-----------|----------|----------|-----------|-----------|
| 1      | M1    | HSS6x4x4   | .111     | 12 15 .004     | 0 15      | 68.998   | 118.443  | 19.58     | ... H1-1b |
| 2      | M2    | HSS6x4x4   | .113     | 13 16 .004     | 0 16      | 62.82    | 118.443  | 19.58     | ... H1-1b |
| 3      | M6    | W10x15     | .053     | 0 15 .011      | 0 15      | 119.409  | 132.036  | 39.92     | ... H1-1b |
| 4      | M8    | W10x15     | .050     | 0 15 .009      | 11 16     | 24.93    | 132.036  | 39.92     | ... H1-1b |
| 5      | M7    | W10x15     | .060     | 6 16 .020      | 6 16      | 74.045   | 132.036  | 39.92     | ... H1-1b |
| 6      | M9    | W10x15     | .052     | 6.5... 16 .011 | 0 15      | 33.425   | 132.036  | 27.917    | ... H1-1b |
| 7      | M10   | W10x15     | .056     | 4.5... 16 .016 | 4.5... 16 | 94.619   | 132.036  | 39.92     | ... H1-1b |
| 8      | M11   | W10x15     | .064     | 0 15 .026      | 0 15      | 100.818  | 132.036  | 39.92     | ... H1-1b |
| 9      | M3    | HSS6x4x4   | .100     | 13 15 .004     | 0 15      | 62.82    | 118.443  | 19.58     | ... H1-1b |
| 10     | M4    | HSS6x4x4   | .117     | 0 16 .004      | 0 16      | 67.136   | 118.443  | 19.58     | ... H1-1b |
| 11     | M5    | HSS6x4x4   | .117     | 11.5 16 .005   | 0 16      | 72.108   | 118.443  | 19.58     | ... H1-1b |

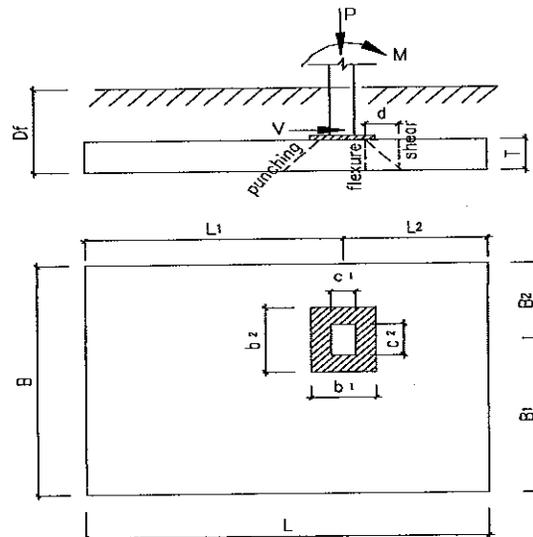
**Eccentric Footing Design Based on ACI 318-05**

**INPUT DATA**

|                                  |           |   |      |             |
|----------------------------------|-----------|---|------|-------------|
| COLUMN WIDTH                     | $c_1$     | = | 4    | in          |
| COLUMN DEPTH                     | $c_2$     | = | 6    | in          |
| BASE PLATE WIDTH                 | $b_1$     | = | 12   | in          |
| BASE PLATE DEPTH                 | $b_2$     | = | 12   | in          |
| FOOTING CONCRETE STRENGTH        | $f'_c$    | = | 2.5  | ksi         |
| REBAR YIELD STRESS               | $f_y$     | = | 60   | ksi         |
| AXIAL DEAD LOAD                  | $P_{DL}$  | = | 1    | k           |
| AXIAL LIVE LOAD                  | $P_{LL}$  | = | 0    | k           |
| LATERAL LOAD (0=WIND, 1=SEISMIC) |           | = | 1    | Seismic, SD |
| SEISMIC AXIAL LOAD               | $P_{LAT}$ | = | 0.25 | k, SD       |
| SEISMIC MOMENT LOAD              | $M_{LAT}$ | = | 0    | ft-k, SD    |
| SEISMIC SHEAR LOAD               | $V_{LAT}$ | = | 0.11 | k, SD       |
| SURCHARGE                        | $q_s$     | = | 0.1  | ksf         |
| SOIL WEIGHT                      | $w_s$     | = | 0.11 | kcf         |
| FOOTING EMBEDMENT DEPTH          | $D_f$     | = | 2    | ft          |
| FOOTING THICKNESS                | $T$       | = | 12   | in          |
| ALLOW SOIL PRESSURE              | $Q_a$     | = | 1.5  | ksf         |
| FOOTING WIDTH                    | $B_1$     | = | 1    | ft          |
|                                  | $B_2$     | = | 1    | ft          |
| FOOTING LENGTH                   | $L_1$     | = | 1    | ft          |
|                                  | $L_2$     | = | 1    | ft          |
| REINFORCING SIZE                 | #         | = | 4    |             |

**DESIGN SUMMARY**

|                           |     |   |                    |    |
|---------------------------|-----|---|--------------------|----|
| FOOTING WIDTH             | $B$ | = | 2.00               | ft |
| FOOTING LENGTH            | $L$ | = | 2.00               | ft |
| FOOTING THICKNESS         | $T$ | = | 12                 | in |
| LONGITUDINAL REINF., TOP  |     | = | Not Required       |    |
| LONGITUDINAL REINF., BOT. |     | = | 2 # 4 @ 18 in o.c. |    |
| TRANSVERSE REINF., BOT.   |     | = | 2 # 4 @ 18 in o.c. |    |



**THE FOOTING DESIGN IS ADEQUATE.**

**ANALYSIS**

**DESIGN LOADS AT TOP OF FOOTING (IBC SEC.1605.3.2 & ACI 318-05 SEC.9.2.1)**

|         |                   |                         |                           |                           |
|---------|-------------------|-------------------------|---------------------------|---------------------------|
| CASE 1: | DL + LL           | $P = 1$ kips            | $1.2 DL + 1.6 LL$         | $P_u = 1$ kips            |
|         |                   | $M = 0$ ft-kips         |                           | $M_u = 0$ ft-kips         |
|         |                   | $e = 0.0$ ft, fr cl ftg |                           | $e_u = 0.0$ ft, fr cl ftg |
| CASE 2: | DL + LL + E / 1.4 | $P = 1$ kips            | $1.2 DL + 1.0 LL + 1.0 E$ | $P_u = 1$ kips            |
|         |                   | $M = 0$ ft-kips         |                           | $M_u = 0$ ft-kips         |
|         |                   | $V = 0$ kips            |                           | $V_u = 0$ kips            |
|         |                   | $e = 0.1$ ft, fr cl ftg |                           | $e_u = 0.0$ ft, fr cl ftg |
| CASE 3: | 0.9 DL + E / 1.4  | $P = 1$ kips            | $0.9 DL + 1.0 E$          | $P_u = 1$ kips            |
|         |                   | $M = 0$ ft-kips         |                           | $M_u = 0$ ft-kips         |
|         |                   | $V = 0$ kips            |                           | $V_u = 0$ kips            |
|         |                   | $e = 0.1$ ft, fr cl ftg |                           | $e_u = 0.0$ ft, fr cl ftg |

**CHECK OVERTURNING FACTOR (IBC 06 1605.2.1, 1801.2.1, & ASCE 7-05 12.13.4)**

$M_R / M_O = 204000000.0 > F = 0.75 / 0.9 = 0.83$  [Satisfactory]

Where  $M_O = M_{LAT} + V_{LAT} T - P_{LAT} L_2 = 0$  k-ft

$P_{ftg} = (0.15 \text{ kcf}) T B L = 0.60$  k, footing weight

$P_{soil} = w_s (D_f - T) B L = 0.44$  k, soil weight

$M_R = P_{DL} L_2 + 0.5 (P_{ftg} + P_{soil}) L = 2$  k-ft

**FOR REVERSED LATERAL LOADS,**

$M_R / M_O = 204000000.0 > F = 0.75 / (0.9 \times 1.4)$  [Satisfactory]

Where  $M_O = M_{LAT} + V_{LAT} D_f - P_{LAT} L_1 = 0$  k-ft

$M_R = P_{DL} L_1 + 0.5 (P_{ftg} + P_{soil}) L = 2$  k-ft

**CHECK SLIDING (IBC 06 1806.1)**

$1.5 (V_{Lat, ASD}) = 0.1179$  kips  $< \mu \Sigma W = 0.64$  kips [Satisfactory]

Where  $\mu = 0.4$

## CHECK SOIL BEARING CAPACITY (ACI 318-05 SEC.15.2.2)

| Service Loads     | CASE 1    | CASE 2    | CASE 3    |                             |
|-------------------|-----------|-----------|-----------|-----------------------------|
| P                 | 1.0       | 1.2       | 1.1       | k                           |
| e                 | 0.0       | 0.1       | 0.1       | ft (from center of footing) |
| $q_s B L$         | 0.4       | 0.4       | 0.0       | k, (surcharge load)         |
| $(0.15-w_s)T B L$ | 0.2       | 0.2       | 0.1       | k, (footing increased)      |
| $\Sigma P$        | 1.6       | 1.7       | 1.2       | k                           |
| $e_L$             | 0.0 < L/6 | 0.1 < L/6 | 0.1 < L/6 | ft                          |
| $e_B$             | 0.0 < B/6 | 0.0 < B/6 | 0.0 < B/6 | ft                          |
| $q_L$             | 0.8       | 1.1       | 0.8       | k / ft                      |
| $q_{max}$         | 0.4       | 0.6       | 0.4       | ksf                         |
| $q_{allow}$       | 1.5       | 2.0       | 2.0       | ksf                         |

Where

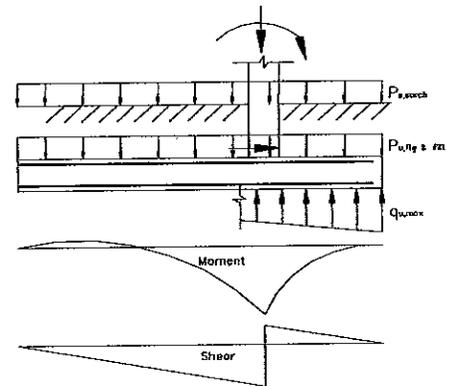
$$q_L = \begin{cases} \frac{(\Sigma P) \left(1 + \frac{6e_L}{L}\right)}{L}, & \text{for } e_L \leq \frac{L}{6} \\ \frac{2(\Sigma P)}{3(0.5L - e_L)}, & \text{for } e_L > \frac{L}{6} \end{cases} \quad q_{MAX} = \begin{cases} \frac{q_L \left(1 + \frac{6e_B}{B}\right)}{B}, & \text{for } e_B \leq \frac{B}{6} \\ \frac{2q_L}{3(0.5B - e_B)}, & \text{for } e_B > \frac{B}{6} \end{cases} \quad \text{[Satisfactory]}$$

## DESIGN FLEXURE &amp; CHECK FLEXURE SHEAR

(ACI 318-05 SEC.15.4.2, 10.2, 10.3.5, 10.5.4, 7.12.2, 12.2, 12.5, 15.5.2, 11.1.3.1, &amp; 11.3)

$$q_{u,MAX} = \begin{cases} \frac{(\Sigma P_u) \left(1 + \frac{6e_u}{L}\right)}{BL}, & \text{for } e_u \leq \frac{L}{6} \\ \frac{2(\Sigma P_u)}{3B(0.5L - e_u)}, & \text{for } e_u > \frac{L}{6} \end{cases} \quad \rho_{MAX} = \frac{0.85\beta_1 f'_c}{f_y} \frac{\epsilon_u}{\epsilon_u + \epsilon_t}$$

$$\rho = \frac{0.85 f'_c \left(1 - \sqrt{1 - \frac{M_u}{0.383bd^2 f'_c}}\right)}{f_y} \quad \rho_{MIN} = \text{MIN} \left( 0.0018 \frac{T}{d}, \frac{4}{3} \rho \right)$$



## FACTORED SOIL PRESSURE

| Factored Loads                   | CASE 1    | CASE 2    | CASE 3    |  |
|----------------------------------|-----------|-----------|-----------|--|
| $P_u$                            | 1.2       | 1.5       | 1.2       | k                                      |
| $e_u$                            | 0.0       | 0.1       | 0.1       | ft                                     |
| $\gamma q_s B L$                 | 0.6       | 0.4       | 0.0       | k, (factored surcharge load)           |
| $\gamma[0.15T + w_s(D_f - T)]BL$ | 1.2       | 1.2       | 0.9       | k, (factored footing & backfill loads) |
| $\Sigma P_u$                     | 3.1       | 3.1       | 2.1       | k                                      |
| $e_u$                            | 0.0 < L/6 | 0.0 < L/6 | 0.1 < L/6 | ft                                     |
| $q_{u,max}$                      | 0.772     | 0.857     | 0.604     | ksf                                    |

## FOOTING MOMENT &amp; SHEAR AT LONGITUDINAL SECTIONS FOR CASE 1

| Section                                | 0    | 0.25 L <sub>1</sub> | 0.50 L <sub>1</sub> | 0.75 L <sub>1</sub> | Col <sub>L</sub> | Col <sub>R</sub> | 0.25 L <sub>2</sub> | 0.50 L <sub>2</sub> | 0.75 L <sub>2</sub> | L    |
|--|------|---------------------|---------------------|---------------------|------------------|------------------|---------------------|---------------------|---------------------|------|
| $X_u$ (ft, dist. from left of footing) | 0    | 0.25                | 0.50                | 0.75                | 0.67             | 1.33             | 1.25                | 1.50                | 1.75                | 2.00 |
| $M_{u,col}$ (ft-k)                     | 0    | 0                   | 0                   | 0                   | 0                | -0.4             | -0.3                | -0.6                | -0.9                | -1.2 |
| $V_{u,col}$ (k)                        | 0    | 0.0                 | 0.0                 | 0.0                 | 0.0              | 1.2              | 1.2                 | 1.2                 | 1.2                 | 1.2  |
| $P_{u,surch}$ (klf)                    | 0.32 | 0.32                | 0.32                | 0.32                | 0.32             | 0.32             | 0.32                | 0.32                | 0.32                | 0.32 |
| $M_{u,surch}$ (ft-k)                   | 0    | 0.0                 | 0.0                 | -0.1                | -0.1             | -0.3             | -0.3                | -0.4                | -0.5                | -0.6 |
| $V_{u,surch}$ (k)                      | 0    | 0.1                 | 0.2                 | 0.2                 | 0.2              | 0.4              | 0.4                 | 0.5                 | 0.6                 | 0.6  |
| $P_{u,fig \& fill}$ (klf)              | 0.62 | 0.62                | 0.62                | 0.62                | 0.62             | 0.62             | 0.62                | 0.62                | 0.62                | 0.62 |
| $M_{u,fig \& fill}$ (ft-k)             | 0    | 0.0                 | -0.1                | -0.2                | -0.1             | -0.6             | -0.5                | -0.7                | -1.0                | -1.2 |
| $V_{u,fig \& fill}$ (k)                | 0    | 0.2                 | 0.3                 | 0.5                 | 0.4              | 0.8              | 0.8                 | 0.9                 | 1.1                 | 1.2  |
| $q_{u,soil}$ (ksf)                     | 0.77 | 0.77                | 0.77                | 0.77                | 0.77             | 0.77             | 0.77                | 0.77                | 0.77                | 0.77 |
| $M_{u,soil}$ (ft-k)                    | 0    | 0.0                 | 0.2                 | 0.4                 | 0.3              | 1.4              | 1.2                 | 1.7                 | 2.4                 | 3.1  |
| $V_{u,soil}$ (k)                       | 0    | -0.4                | -0.8                | -1.2                | -1.0             | -2.1             | -1.9                | -2.3                | -2.7                | -3.1 |
| $\Sigma M_u$ (ft-k)                    | 0    | 0.0                 | 0.1                 | 0.2                 | 0.1              | 0.1              | 0.2                 | 0.1                 | 0.0                 | 0    |
| $\Sigma V_u$ (kips)                    | 0    | -0.2                | -0.3                | -0.5                | -0.4             | 0.4              | 0.5                 | 0.3                 | 0.2                 | 0    |

## FOOTING MOMENT &amp; SHEAR AT LONGITUDINAL SECTIONS FOR CASE 2

| Section   | 0    | 0.25 L <sub>1</sub> | 0.50 L <sub>1</sub> | 0.75 L <sub>1</sub> | Col <sub>L</sub> | Col <sub>R</sub> | 0.25 L <sub>2</sub> | 0.50 L <sub>2</sub> | 0.75 L <sub>2</sub> | L    |
|---|------|---------------------|---------------------|---------------------|------------------|------------------|---------------------|---------------------|---------------------|------|
| X <sub>u</sub> (ft, dist. from left of footing) | 0    | 0.25                | 0.50                | 0.75                | 0.67             | 1.33             | 1.25                | 1.50                | 1.75                | 2.00 |
| M <sub>u,col</sub> (ft-k)                       | 0    | 0                   | 0                   | 0                   | 0                | -0.4             | -0.3                | -0.6                | -1.0                | -1.3 |
| V <sub>u,col</sub> (k)                          | 0    | 0.0                 | 0.0                 | 0.0                 | 0.0              | 1.5              | 1.5                 | 1.5                 | 1.5                 | 1.5  |
| P <sub>u,surch</sub> (klf)                      | 0.20 | 0.20                | 0.20                | 0.20                | 0.20             | 0.20             | 0.20                | 0.20                | 0.20                | 0.20 |
| M <sub>u,surch</sub> (ft-k)                     | 0    | 0.0                 | 0.0                 | -0.1                | 0.0              | -0.2             | -0.2                | -0.2                | -0.3                | -0.4 |
| V <sub>u,surch</sub> (k)                        | 0    | 0.1                 | 0.1                 | 0.2                 | 0.1              | 0.3              | 0.3                 | 0.3                 | 0.4                 | 0.4  |
| P <sub>u,fig &amp; fill</sub> (klf)             | 0.62 | 0.62                | 0.62                | 0.62                | 0.62             | 0.62             | 0.62                | 0.62                | 0.62                | 0.62 |
| M <sub>u,fig &amp; fill</sub> (ft-k)            | 0    | 0.0                 | -0.1                | -0.2                | -0.1             | -0.6             | -0.5                | -0.7                | -1.0                | -1.2 |
| V <sub>u,fig &amp; fill</sub> (k)               | 0    | 0.2                 | 0.3                 | 0.5                 | 0.4              | 0.8              | 0.8                 | 0.9                 | 1.1                 | 1.2  |
| q <sub>u,soil</sub> (ksf)                       | 0.69 | 0.71                | 0.73                | 0.75                | 0.75             | 0.80             | 0.80                | 0.82                | 0.84                | 0.86 |
| M <sub>u,soil</sub> (ft-k)                      | 0    | 0.0                 | 0.2                 | 0.4                 | 0.3              | 1.3              | 1.1                 | 1.6                 | 2.3                 | 3.0  |
| V <sub>u,soil</sub> (k)                         | 0    | -0.4                | -0.7                | -1.1                | -1.0             | -2.0             | -1.9                | -2.3                | -2.7                | -3.1 |
| Σ M <sub>u</sub> (ft-k)                         | 0    | 0.0                 | 0.1                 | 0.2                 | 0.1              | 0.2              | 0.2                 | 0.1                 | 0.0                 | 0    |
| Σ V <sub>u</sub> (kips)                         | 0    | -0.1                | -0.3                | -0.5                | -0.4             | 0.6              | 0.6                 | 0.4                 | 0.2                 | 0    |

## FOOTING MOMENT &amp; SHEAR AT LONGITUDINAL SECTIONS FOR CASE 3

| Section   | 0    | 0.25 L <sub>1</sub> | 0.50 L <sub>1</sub> | 0.75 L <sub>1</sub> | Col <sub>L</sub> | Col <sub>R</sub> | 0.25 L <sub>2</sub> | 0.50 L <sub>2</sub> | 0.75 L <sub>2</sub> | L    |
|---|------|---------------------|---------------------|---------------------|------------------|------------------|---------------------|---------------------|---------------------|------|
| X <sub>u</sub> (ft, dist. from left of footing) | 0    | 0.25                | 0.50                | 0.75                | 0.67             | 1.33             | 1.25                | 1.50                | 1.75                | 2.00 |
| M <sub>u,col</sub> (ft-k)                       | 0    | 0                   | 0                   | 0                   | 0                | -0.3             | -0.2                | -0.5                | -0.8                | -1.0 |
| V <sub>u,col</sub> (k)                          | 0    | 0.0                 | 0.0                 | 0.0                 | 0.0              | 1.2              | 1.2                 | 1.2                 | 1.2                 | 1.2  |
| P <sub>u,surch</sub> (klf)                      | 0.00 | 0.00                | 0.00                | 0.00                | 0.00             | 0.00             | 0.00                | 0.00                | 0.00                | 0.00 |
| M <sub>u,surch</sub> (ft-k)                     | 0    | 0.0                 | 0.0                 | 0.0                 | 0.0              | 0.0              | 0.0                 | 0.0                 | 0.0                 | 0.0  |
| V <sub>u,surch</sub> (k)                        | 0    | 0.0                 | 0.0                 | 0.0                 | 0.0              | 0.0              | 0.0                 | 0.0                 | 0.0                 | 0.0  |
| P <sub>u,fig &amp; fill</sub> (klf)             | 0.47 | 0.47                | 0.47                | 0.47                | 0.47             | 0.47             | 0.47                | 0.47                | 0.47                | 0.47 |
| M <sub>u,fig &amp; fill</sub> (ft-k)            | 0    | 0.0                 | -0.1                | -0.1                | -0.1             | -0.4             | -0.4                | -0.5                | -0.7                | -0.9 |
| V <sub>u,fig &amp; fill</sub> (k)               | 0    | 0.1                 | 0.2                 | 0.4                 | 0.3              | 0.6              | 0.6                 | 0.7                 | 0.8                 | 0.9  |
| q <sub>u,soil</sub> (ksf)                       | 0.44 | 0.46                | 0.48                | 0.50                | 0.49             | 0.55             | 0.54                | 0.56                | 0.58                | 0.60 |
| M <sub>u,soil</sub> (ft-k)                      | 0    | 0.0                 | 0.1                 | 0.3                 | 0.2              | 0.8              | 0.7                 | 1.1                 | 1.5                 | 2.0  |
| V <sub>u,soil</sub> (k)                         | 0    | -0.2                | -0.5                | -0.7                | -0.6             | -1.3             | -1.2                | -1.5                | -1.8                | -2.1 |
| Σ M <sub>u</sub> (ft-k)                         | 0    | 0.0                 | 0.1                 | 0.1                 | 0.1              | 0.2              | 0.2                 | 0.1                 | 0.0                 | 0    |
| Σ V <sub>u</sub> (kips)                         | 0    | -0.1                | -0.2                | -0.4                | -0.3             | 0.5              | 0.5                 | 0.3                 | 0.2                 | 0    |

## DESIGN FLEXURE

| Location            | M <sub>u,max</sub> | d (in) | ρ <sub>min</sub> | ρ <sub>reqd</sub> | ρ <sub>max</sub> | s <sub>max</sub> | use               | ρ <sub>prov'd</sub> |
|---------------------|--------------------|--------|------------------|-------------------|------------------|------------------|-------------------|---------------------|
| Top Longitudinal    | 0.0 ft-k           | 9.75   | 0.0000           | 0.0000            | 0.0129           | no limit         | Not Required      | 0.0000              |
| Bottom Longitudinal | 0.2 ft-k           | 8.75   | 0.0000           | 0.0000            | 0.0129           | 18               | 2 #4 @ 18 in o.c. | 0.0019              |
| Bottom Transverse   | 0 ft-k/ft          | 8.50   | 0.0000           | 0.0000            | 0.0129           | 18               | 2 #4 @ 18 in o.c. | 0.0020              |

[Satisfactory]

## CHECK FLEXURE SHEAR

| Direction    | V <sub>u,max</sub> | φV <sub>c</sub> = 2 φ b d (f' <sub>c</sub> ) <sup>0.5</sup> | check V <sub>u</sub> < φ V <sub>c</sub> |
|--------------|--------------------|---|---|
| Longitudinal | 0.6 k              | 16 k  | [Satisfactory]                          |
| Transverse   | 0.3 k/ft           | 8 k/ft  | [Satisfactory]                          |

## CHECK PUNCHING SHEAR (ACI 318-05 SEC.15.5.2, 11.12.1.2, 11.12.6, &amp; 13.5.3.2)

$$v_u(\text{psi}) = \frac{P_u - R}{A_p} + \frac{0.5 \gamma_v M_u b_1}{J}$$

$$J = \left( \frac{db_1^3}{6} \right) \left[ 1 + \left( \frac{d}{b_1} \right)^2 + 3 \left( \frac{b_2}{b_1} \right) \right]$$

$$R = \frac{P_u b_1 b_2}{A_f}$$

$$A_p = 2(b_1 + b_2)d$$

$$\gamma_v = 1 - \frac{1}{1 + \frac{2}{3} \sqrt{\frac{b_1}{b_2}}}$$

$$A_f = BL$$

$$\phi v_c(\text{psi}) = \phi(2 + y) \sqrt{f'_c}$$

$$y = \text{MIN} \left( 2, \frac{4}{\beta_c}, 40 \frac{d}{b_0} \right)$$

$$b_0 = \frac{A_p}{d}, b_1 = (0.5c_1 + 0.5b_1 + d), b_2 = (0.5c_2 + 0.5b_2 + d)$$

| Case | P <sub>u</sub> | M <sub>u</sub> | b <sub>1</sub> | b <sub>2</sub> | b <sub>0</sub> | γ <sub>v</sub> | β <sub>c</sub> | y   | A <sub>f</sub> | A <sub>p</sub> | R   | J   | v <sub>u</sub> (psi) | φ V <sub>c</sub> |
|------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----|----------------|----------------|-----|-----|----------------------|------------------|
| 1    | 1.2            | 0.0            | 16.5           | 17.5           | 0.5            | 0.4            | 1.1            | 2.0 | 4.0            | 4.0            | 0.6 | 1.4 | 1.0                  | 150.0            |
| 2    | 1.5            | 0.0            | 16.5           | 17.5           | 0.5            | 0.4            | 1.1            | 2.0 | 4.0            | 4.0            | 0.7 | 1.4 | 1.3                  | 150.0            |
| 3    | 1.2            | 0.0            | 16.5           | 17.5           | 0.5            | 0.4            | 1.1            | 2.0 | 4.0            | 4.0            | 0.6 | 1.4 | 1.0                  | 150.0            |

[Satisfactory]

where φ = 0.75 (ACI 318-05, Section 9.3.2.3)

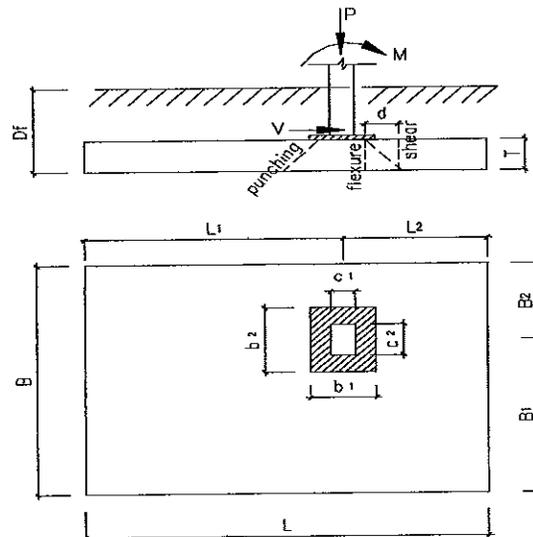
**Eccentric Footing Design Based on ACI 318-05**

**INPUT DATA**

|                                  |                   |             |
|----------------------------------|-------------------|-------------|
| COLUMN WIDTH                     | $c_1 = 4$         | in          |
| COLUMN DEPTH                     | $c_2 = 6$         | in          |
| BASE PLATE WIDTH                 | $b_1 = 12$        | in          |
| BASE PLATE DEPTH                 | $b_2 = 12$        | in          |
| FOOTING CONCRETE STRENGTH        | $f'_c = 2.5$      | ksi         |
| REBAR YIELD STRESS               | $f_y = 60$        | ksi         |
| AXIAL DEAD LOAD                  | $P_{DL} = 1.787$  | k           |
| AXIAL LIVE LOAD                  | $P_{LL} = 0$      | k           |
| LATERAL LOAD (0=WIND, 1=SEISMIC) | $= 1$             | Seismic, SD |
| SEISMIC AXIAL LOAD               | $P_{LAT} = 0.5$   | k, SD       |
| SEISMIC MOMENT LOAD              | $M_{LAT} = 0$     | ft-k, SD    |
| SEISMIC SHEAR LOAD               | $V_{LAT} = 0.151$ | k, SD       |
| SURCHARGE                        | $q_s = 0.1$       | ksf         |
| SOIL WEIGHT                      | $w_s = 0.11$      | kcf         |
| FOOTING EMBEDMENT DEPTH          | $D_f = 2$         | ft          |
| FOOTING THICKNESS                | $T = 12$          | in          |
| ALLOW SOIL PRESSURE              | $Q_a = 1.5$       | ksf         |
| FOOTING WIDTH                    | $B_1 = 1$         | ft          |
|                                  | $B_2 = 1$         | ft          |
| FOOTING LENGTH                   | $L_1 = 1$         | ft          |
|                                  | $L_2 = 1$         | ft          |
| REINFORCING SIZE                 | $\# 4$            |             |

**DESIGN SUMMARY**

|                           |                    |    |
|---------------------------|--------------------|----|
| FOOTING WIDTH             | $B = 2.00$         | ft |
| FOOTING LENGTH            | $L = 2.00$         | ft |
| FOOTING THICKNESS         | $T = 12$           | in |
| LONGITUDINAL REINF., TOP  | Not Required       |    |
| LONGITUDINAL REINF., BOT. | 2 # 4 @ 18 in o.c. |    |
| TRANSVERSE REINF., BOT.   | 2 # 4 @ 18 in o.c. |    |



**THE FOOTING DESIGN IS ADEQUATE.**

**ANALYSIS**

**DESIGN LOADS AT TOP OF FOOTING (IBC SEC.1605.3.2 & ACI 318-05 SEC.9.2.1)**

|         |                   |                         |                           |                           |
|---------|-------------------|-------------------------|---------------------------|---------------------------|
| CASE 1: | DL + LL           | $P = 2$ kips            | $1.2 DL + 1.6 LL$         | $P_u = 2$ kips            |
|         |                   | $M = 0$ ft-kips         |                           | $M_u = 0$ ft-kips         |
|         |                   | $e = 0.0$ ft, fr cl ftg |                           | $e_u = 0.0$ ft, fr cl ftg |
| CASE 2: | DL + LL + E / 1.4 | $P = 2$ kips            | $1.2 DL + 1.0 LL + 1.0 E$ | $P_u = 3$ kips            |
|         |                   | $M = 0$ ft-kips         |                           | $M_u = 0$ ft-kips         |
|         |                   | $V = 0$ kips            |                           | $V_u = 0$ kips            |
|         |                   | $e = 0.1$ ft, fr cl ftg |                           | $e_u = 0.0$ ft, fr cl ftg |
| CASE 3: | 0.9 DL + E / 1.4  | $P = 2$ kips            | $0.9 DL + 1.0 E$          | $P_u = 2$ kips            |
|         |                   | $M = 0$ ft-kips         |                           | $M_u = 0$ ft-kips         |
|         |                   | $V = 0$ kips            |                           | $V_u = 0$ kips            |
|         |                   | $e = 0.1$ ft, fr cl ftg |                           | $e_u = 0.0$ ft, fr cl ftg |

**CHECK OVERTURNING FACTOR (IBC 06 1605.2.1, 1801.2.1, & ASCE 7-05 12.13.4)**

$M_R / M_O = 282700000.0 > F = 0.75 / 0.9 = 0.83$  [Satisfactory]

Where  $M_O = M_{LAT} + V_{LAT} T - P_{LAT} L_2 = 0$  k-ft

$P_{ftg} = (0.15 \text{ kcf}) T B L = 0.60$  k, footing weight

$P_{soil} = w_s (D_f - T) B L = 0.44$  k, soil weight

$M_R = P_{DL} L_2 + 0.5 (P_{ftg} + P_{soil}) L = 3$  k-ft

**FOR REVERSED LATERAL LOADS,**

$M_R / M_O = 282700000.0 > F = 0.75 / (0.9 \times 1.4)$  [Satisfactory]

Where  $M_O = M_{LAT} + V_{LAT} D_f - P_{LAT} L_1 = 0$  k-ft

$M_R = P_{DL} L_1 + 0.5 (P_{ftg} + P_{soil}) L = 3$  k-ft

**CHECK SLIDING (IBC 06 1806.1)**

$1.5 (V_{Lat, ASD}) = 0.1618$  kips  $< \mu \Sigma W = 0.95$  kips [Satisfactory]

Where  $\mu = 0.4$

## CHECK SOIL BEARING CAPACITY (ACI 318-05 SEC.15.2.2)

| Service Loads     | CASE 1    | CASE 2    | CASE 3    |                             |
|-------------------|-----------|-----------|-----------|-----------------------------|
| P                 | 1.8       | 2.1       | 2.0       | k                           |
| e                 | 0.0       | 0.1       | 0.1       | ft (from center of footing) |
| $q_s B L$         | 0.4       | 0.4       | 0.0       | k, (surcharge load)         |
| $(0.15-w_s)T B L$ | 0.2       | 0.2       | 0.1       | k, (footing increased)      |
| $\Sigma P$        | 2.3       | 2.7       | 2.1       | k                           |
| $e_L$             | 0.0 < L/6 | 0.1 < L/6 | 0.1 < L/6 | ft                          |
| $e_B$             | 0.0 < B/6 | 0.0 < B/6 | 0.0 < B/6 | ft                          |
| $q_L$             | 1.2       | 1.7       | 1.4       | k / ft                      |
| $q_{max}$         | 0.6       | 0.8       | 0.7       | ksf                         |
| $q_{allow}$       | 1.5       | 2.0       | 2.0       | ksf                         |

Where

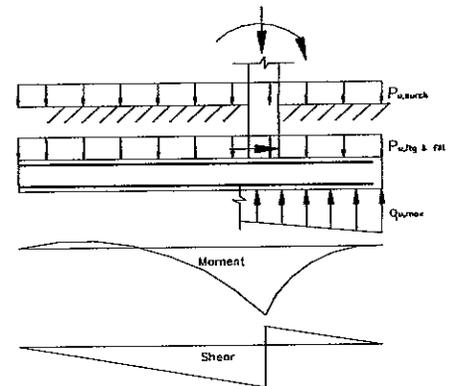
$$q_L = \begin{cases} \frac{(\Sigma P) \left(1 + \frac{6e_L}{L}\right)}{L}, & \text{for } e_L \leq \frac{L}{6} \\ \frac{2(\Sigma P)}{3(0.5L - e_L)}, & \text{for } e_L > \frac{L}{6} \end{cases} \quad q_{MAX} = \begin{cases} \frac{q_L \left(1 + \frac{6e_B}{B}\right)}{B}, & \text{for } e_B \leq \frac{B}{6} \\ \frac{2q_L}{3(0.5B - e_B)}, & \text{for } e_B > \frac{B}{6} \end{cases} \quad \text{[Satisfactory]}$$

## DESIGN FLEXURE &amp; CHECK FLEXURE SHEAR

(ACI 318-05 SEC.15.4.2, 10.2, 10.3.5, 10.5.4, 7.12.2, 12.2, 12.5, 15.5.2, 11.1.3.1, &amp; 11.3)

$$q_{u,MAX} = \begin{cases} \frac{(\Sigma P_u) \left(1 + \frac{6e_u}{L}\right)}{BL}, & \text{for } e_u \leq \frac{L}{6} \\ \frac{2(\Sigma P_u)}{3B(0.5L - e_u)}, & \text{for } e_u > \frac{L}{6} \end{cases} \quad \rho_{MAX} = \frac{0.85\beta_1 f'_c e_u}{f_y \varepsilon_u + \varepsilon_t}$$

$$\rho = \frac{0.85 f'_c \left(1 - \sqrt{1 - \frac{M_u}{0.383bd^2 f'_c}}\right)}{f_y} \quad \rho_{MIN} = \text{MIN} \left(0.0018 \frac{T}{d}, \frac{4}{3} \rho\right)$$



## FACTORED SOIL PRESSURE

| Factored Loads                   | CASE 1    | CASE 2    | CASE 3    |  |
|----------------------------------|-----------|-----------|-----------|--|
| $P_u$                            | 2.1       | 2.6       | 2.1       | k                                      |
| $e_u$                            | 0.0       | 0.1       | 0.1       | ft                                     |
| $\gamma q_s B L$                 | 0.6       | 0.4       | 0.0       | k, (factored surcharge load)           |
| $\gamma[0.15T + w_s(D_f - T)]BL$ | 1.2       | 1.2       | 0.9       | k, (factored footing & backfill loads) |
| $\Sigma P_u$                     | 4.0       | 4.3       | 3.0       | k                                      |
| $e_u$                            | 0.0 < L/6 | 0.0 < L/6 | 0.0 < L/6 | ft                                     |
| $q_{u,max}$                      | 1.008     | 1.186     | 0.874     | ksf                                    |

## FOOTING MOMENT &amp; SHEAR AT LONGITUDINAL SECTIONS FOR CASE 1

| Section                                | 0    | 0.25 L <sub>1</sub> | 0.50 L <sub>1</sub> | 0.75 L <sub>1</sub> | Col <sub>L</sub> | Col <sub>R</sub> | 0.25 L <sub>2</sub> | 0.50 L <sub>2</sub> | 0.75 L <sub>2</sub> | L    |
|--|------|---------------------|---------------------|---------------------|------------------|------------------|---------------------|---------------------|---------------------|------|
| $X_u$ (ft, dist. from left of footing) | 0    | 0.25                | 0.50                | 0.75                | 0.67             | 1.33             | 1.25                | 1.50                | 1.75                | 2.00 |
| $M_{u,col}$ (ft-k)                     | 0    | 0                   | 0                   | 0                   | 0                | -0.7             | -0.5                | -1.1                | -1.6                | -2.1 |
| $V_{u,col}$ (k)                        | 0    | 0.0                 | 0.0                 | 0.0                 | 0.0              | 2.1              | 2.1                 | 2.1                 | 2.1                 | 2.1  |
| $P_{u,surch}$ (klf)                    | 0.32 | 0.32                | 0.32                | 0.32                | 0.32             | 0.32             | 0.32                | 0.32                | 0.32                | 0.32 |
| $M_{u,surch}$ (ft-k)                   | 0    | 0.0                 | 0.0                 | -0.1                | -0.1             | -0.3             | -0.3                | -0.4                | -0.5                | -0.6 |
| $V_{u,surch}$ (k)                      | 0    | 0.1                 | 0.2                 | 0.2                 | 0.2              | 0.4              | 0.4                 | 0.5                 | 0.6                 | 0.6  |
| $P_{u,ftg \& fill}$ (klf)              | 0.62 | 0.62                | 0.62                | 0.62                | 0.62             | 0.62             | 0.62                | 0.62                | 0.62                | 0.62 |
| $M_{u,ftg \& fill}$ (ft-k)             | 0    | 0.0                 | -0.1                | -0.2                | -0.1             | -0.6             | -0.5                | -0.7                | -1.0                | -1.2 |
| $V_{u,ftg \& fill}$ (k)                | 0    | 0.2                 | 0.3                 | 0.5                 | 0.4              | 0.8              | 0.8                 | 0.9                 | 1.1                 | 1.2  |
| $q_{u,soil}$ (ksf)                     | 1.01 | 1.01                | 1.01                | 1.01                | 1.01             | 1.01             | 1.01                | 1.01                | 1.01                | 1.01 |
| $M_{u,soil}$ (ft-k)                    | 0    | 0.1                 | 0.3                 | 0.6                 | 0.4              | 1.8              | 1.6                 | 2.3                 | 3.1                 | 4.0  |
| $V_{u,soil}$ (k)                       | 0    | -0.5                | -1.0                | -1.5                | -1.3             | -2.7             | -2.5                | -3.0                | -3.5                | -4.0 |
| $\Sigma M_u$ (ft-k)                    | 0    | 0.0                 | 0.1                 | 0.3                 | 0.2              | 0.2              | 0.3                 | 0.1                 | 0.0                 | 0    |
| $\Sigma V_u$ (kips)                    | 0    | -0.3                | -0.5                | -0.8                | -0.7             | 0.7              | 0.8                 | 0.5                 | 0.3                 | 0    |

FOOTING MOMENT & SHEAR AT LONGITUDINAL SECTIONS FOR CASE 2

| Section   | 0    | 0.25 L <sub>1</sub> | 0.50 L <sub>1</sub> | 0.75 L <sub>1</sub> | Col <sub>L</sub> | Col <sub>R</sub> | 0.25 L <sub>2</sub> | 0.50 L <sub>2</sub> | 0.75 L <sub>2</sub> | L    |
|---|------|---------------------|---------------------|---------------------|------------------|------------------|---------------------|---------------------|---------------------|------|
| X <sub>u</sub> (ft, dist. from left of footing) | 0    | 0.25                | 0.50                | 0.75                | 0.67             | 1.33             | 1.25                | 1.50                | 1.75                | 2.00 |
| M <sub>u,col</sub> (ft-k)                       | 0    | 0                   | 0                   | 0                   | 0                | -0.7             | -0.5                | -1.2                | -1.8                | -2.5 |
| V <sub>u,col</sub> (k)                          | 0    | 0.0                 | 0.0                 | 0.0                 | 0.0              | 2.6              | 2.6                 | 2.6                 | 2.6                 | 2.6  |
| P <sub>u,surch</sub> (klf)                      | 0.20 | 0.20                | 0.20                | 0.20                | 0.20             | 0.20             | 0.20                | 0.20                | 0.20                | 0.20 |
| M <sub>u,surch</sub> (ft-k)                     | 0    | 0.0                 | 0.0                 | -0.1                | 0.0              | -0.2             | -0.2                | -0.2                | -0.3                | -0.4 |
| V <sub>u,surch</sub> (k)                        | 0    | 0.1                 | 0.1                 | 0.2                 | 0.1              | 0.3              | 0.3                 | 0.3                 | 0.4                 | 0.4  |
| P <sub>u,fig &amp; fill</sub> (klf)             | 0.62 | 0.62                | 0.62                | 0.62                | 0.62             | 0.62             | 0.62                | 0.62                | 0.62                | 0.62 |
| M <sub>u,fig &amp; fill</sub> (ft-k)            | 0    | 0.0                 | -0.1                | -0.2                | -0.1             | -0.6             | -0.5                | -0.7                | -1.0                | -1.2 |
| V <sub>u,fig &amp; fill</sub> (k)               | 0    | 0.2                 | 0.3                 | 0.5                 | 0.4              | 0.8              | 0.8                 | 0.9                 | 1.1                 | 1.2  |
| q <sub>u,soil</sub> (ksf)                       | 0.96 | 0.99                | 1.02                | 1.04                | 1.04             | 1.11             | 1.10                | 1.13                | 1.16                | 1.19 |
| M <sub>u,soil</sub> (ft-k)                      | 0    | 0.1                 | 0.2                 | 0.6                 | 0.4              | 1.8              | 1.6                 | 2.3                 | 3.1                 | 4.1  |
| V <sub>u,soil</sub> (k)                         | 0    | -0.5                | -1.0                | -1.5                | -1.3             | -2.8             | -2.6                | -3.1                | -3.7                | -4.3 |
| Σ M <sub>u</sub> (ft-k)                         | 0    | 0.0                 | 0.1                 | 0.3                 | 0.3              | 0.3              | 0.4                 | 0.2                 | 0.0                 | 0    |
| Σ V <sub>u</sub> (kips)                         | 0    | -0.3                | -0.6                | -0.9                | -0.8             | 1.0              | 1.1                 | 0.7                 | 0.4                 | 0    |

FOOTING MOMENT & SHEAR AT LONGITUDINAL SECTIONS FOR CASE 3

| Section   | 0    | 0.25 L <sub>1</sub> | 0.50 L <sub>1</sub> | 0.75 L <sub>1</sub> | Col <sub>L</sub> | Col <sub>R</sub> | 0.25 L <sub>2</sub> | 0.50 L <sub>2</sub> | 0.75 L <sub>2</sub> | L    |
|---|------|---------------------|---------------------|---------------------|------------------|------------------|---------------------|---------------------|---------------------|------|
| X <sub>u</sub> (ft, dist. from left of footing) | 0    | 0.25                | 0.50                | 0.75                | 0.67             | 1.33             | 1.25                | 1.50                | 1.75                | 2.00 |
| M <sub>u,col</sub> (ft-k)                       | 0    | 0                   | 0                   | 0                   | 0                | -0.6             | -0.4                | -0.9                | -1.4                | -2.0 |
| V <sub>u,col</sub> (k)                          | 0    | 0.0                 | 0.0                 | 0.0                 | 0.0              | 2.1              | 2.1                 | 2.1                 | 2.1                 | 2.1  |
| P <sub>u,surch</sub> (klf)                      | 0.00 | 0.00                | 0.00                | 0.00                | 0.00             | 0.00             | 0.00                | 0.00                | 0.00                | 0.00 |
| M <sub>u,surch</sub> (ft-k)                     | 0    | 0.0                 | 0.0                 | 0.0                 | 0.0              | 0.0              | 0.0                 | 0.0                 | 0.0                 | 0.0  |
| V <sub>u,surch</sub> (k)                        | 0    | 0.0                 | 0.0                 | 0.0                 | 0.0              | 0.0              | 0.0                 | 0.0                 | 0.0                 | 0.0  |
| P <sub>u,fig &amp; fill</sub> (klf)             | 0.47 | 0.47                | 0.47                | 0.47                | 0.47             | 0.47             | 0.47                | 0.47                | 0.47                | 0.47 |
| M <sub>u,fig &amp; fill</sub> (ft-k)            | 0    | 0.0                 | -0.1                | -0.1                | -0.1             | -0.4             | -0.4                | -0.5                | -0.7                | -0.9 |
| V <sub>u,fig &amp; fill</sub> (k)               | 0    | 0.1                 | 0.2                 | 0.4                 | 0.3              | 0.6              | 0.6                 | 0.7                 | 0.8                 | 0.9  |
| q <sub>u,soil</sub> (ksf)                       | 0.65 | 0.68                | 0.70                | 0.73                | 0.72             | 0.80             | 0.79                | 0.82                | 0.85                | 0.87 |
| M <sub>u,soil</sub> (ft-k)                      | 0    | 0.0                 | 0.2                 | 0.4                 | 0.3              | 1.2              | 1.1                 | 1.6                 | 2.2                 | 2.9  |
| V <sub>u,soil</sub> (k)                         | 0    | -0.3                | -0.7                | -1.0                | -0.9             | -1.9             | -1.8                | -2.2                | -2.6                | -3.0 |
| Σ M <sub>u</sub> (ft-k)                         | 0    | 0.0                 | 0.1                 | 0.2                 | 0.2              | 0.3              | 0.3                 | 0.2                 | 0.0                 | 0    |
| Σ V <sub>u</sub> (kips)                         | 0    | -0.2                | -0.4                | -0.7                | -0.6             | 0.8              | 0.9                 | 0.6                 | 0.3                 | 0    |

DESIGN FLEXURE

| Location            | M <sub>u,max</sub> | d (in) | ρ <sub>min</sub> | ρ <sub>reqd</sub> | ρ <sub>max</sub> | s <sub>max</sub> | use                | ρ <sub>prov'd</sub> |
|---------------------|--------------------|--------|------------------|-------------------|------------------|------------------|--------------------|---------------------|
| Top Longitudinal    | 0.0 ft-k           | 9.75   | 0.0000           | 0.0000            | 0.0129           | no limit         | Not Required       | 0.0000              |
| Bottom Longitudinal | 0.4 ft-k           | 8.75   | 0.0001           | 0.0001            | 0.0129           | 18               | 2 # 4 @ 18 in o.c. | 0.0019              |
| Bottom Transverse   | 0 ft-k / ft        | 8.50   | 0.0001           | 0.0000            | 0.0129           | 18               | 2 # 4 @ 18 in o.c. | 0.0020              |

[Satisfactory]

CHECK FLEXURE SHEAR

| Direction    | V <sub>u,max</sub> | φV <sub>c</sub> = 2 φ b d (f' <sub>c</sub> ) <sup>0.5</sup> | check V <sub>u</sub> < φ V <sub>c</sub> |
|--------------|--------------------|---|---|
| Longitudinal | 1.1 k              | 16 k  | [Satisfactory]                          |
| Transverse   | 0.5 k / ft         | 8 k / ft  | [Satisfactory]                          |

CHECK PUNCHING SHEAR (ACI 318-05 SEC.15.5.2, 11.12.1.2, 11.12.6, & 13.5.3.2)

$$v_u(ksi) = \frac{P_u - R}{A_p} + \frac{0.5 \gamma_v M_u b_1}{J}$$

$$AP = 2(b_1 + b_2)d$$

$$\phi v_c(ksi) = \phi(2 + y)\sqrt{f'_c}$$

$$J = \left( \frac{db_1^3}{6} \right) \left[ 1 + \left( \frac{d}{b_1} \right)^2 + 3 \left( \frac{b_2}{b_1} \right) \right]$$

$$\gamma_v = 1 - \frac{1}{1 + \frac{2}{3} \sqrt{\frac{b_1}{b_2}}}$$

$$y = \text{MIN} \left( 2, \frac{4}{\beta_c}, 40 \frac{d}{b_0} \right)$$

$$R = \frac{P_u b_1 b_2}{A_f}$$

$$Af = BL$$

$$b_0 = \frac{AP}{d}, b_1 = (0.5c_1 + 0.5b_1 + d), b_2 = (0.5c_2 + 0.5b_2 + d)$$

| Case | P <sub>u</sub> | M <sub>u</sub> | b <sub>1</sub> | b <sub>2</sub> | b <sub>0</sub> | γ <sub>v</sub> | β <sub>c</sub> | y   | A <sub>f</sub> | A <sub>p</sub> | R   | J   | V <sub>u</sub> (psi) | φ V <sub>c</sub> |
|------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----|----------------|----------------|-----|-----|----------------------|------------------|
| 1    | 2.1            | 0.0            | 16.5           | 17.5           | 0.5            | 0.4            | 1.1            | 2.0 | 4.0            | 4.0            | 1.1 | 1.4 | 1.9                  | 150.0            |
| 2    | 2.6            | 0.0            | 16.5           | 17.5           | 0.5            | 0.4            | 1.1            | 2.0 | 4.0            | 4.0            | 1.3 | 1.4 | 2.3                  | 150.0            |
| 3    | 2.1            | 0.0            | 16.5           | 17.5           | 0.5            | 0.4            | 1.1            | 2.0 | 4.0            | 4.0            | 1.1 | 1.4 | 1.8                  | 150.0            |

[Satisfactory]

where φ = 0.75 (ACI 318-05, Section 9.3.2.3)



PROJECT : The Pump House  
 JOB NO. : B16670  
 ARCHITECT: Nautilus Design

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 Engr : EHS

**SEISMIC DRIFT**

**Allowable Story Drift per ASCE 7 Table 12.12-1**

$\Delta_a = .020 h_{sx}$   
 $\Delta_a = 0.025 \cdot \text{Story Height}$

**Design Story Drift per ASCE 7 Equation 12.8-15**

$\delta_x = C_d \cdot \delta_{xe} / I_E$   
 $\delta_{xe} = \text{See RISA Output}$   
 $C_d = 3.00$   
 $I_E = 1.00$

| Level          | Story Height (ft) | Actual Drift $\delta_{xe}$ (in) | ASCE 12.8-15 $\delta_x$ (in) | ASCE 12.12-1 $\Delta_a$ (in) |    |
|----------------|-------------------|---------------------------------|------------------------------|------------------------------|----|
| Lower Floor    | 12.0              | 0.504                           | 1.51                         | 3.60                         | OK |
| $\Sigma$ Total |                   | 0.504                           | 1.51                         | 3.60                         | OK |

1.20



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**SEISMIC DRIFT**

**Allowable Story Drift per ASCE 7 Table 12.12-1**

$$\Delta_a = .020 h_{sx}$$

$\Delta_a = 0.025$  \* Story Height

**Design Story Drift per ASCE 7 Equation 12.8-15**

$$\delta_x = C_d * \delta_{xe} / I_E$$

$\delta_{xe}$  = See RISA Output  
 $C_d = 3.00$   
 $I_E = 1.00$

| Level          | Story Height (ft) | Actual Drift $\delta_{xe}$ (in) | ASCE 12.8-15 $\delta_x$ (in) | ASCE 12.12-1 $\Delta_a$ (in) |    |
|----------------|-------------------|---------------------------------|------------------------------|------------------------------|----|
| Lower Floor    | 13.0              | 0.504                           | 1.51                         | 3.90                         | OK |
| $\Sigma$ Total |                   | 0.504                           | 1.51                         | 3.90                         | OK |

1.30

# DEI

engineers

Project: PUMP HOUSE

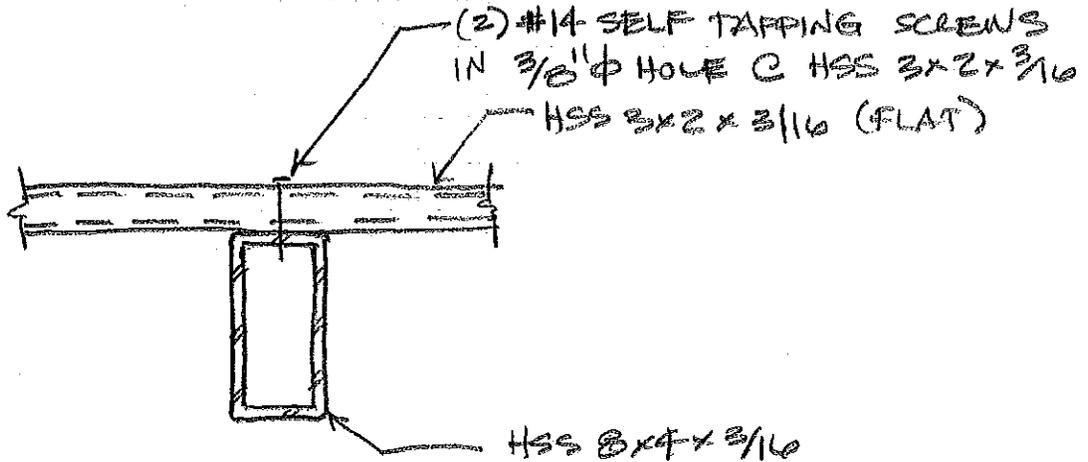
Prepared By: BOZ Date: 9/16

STEEL CONNECTIONS

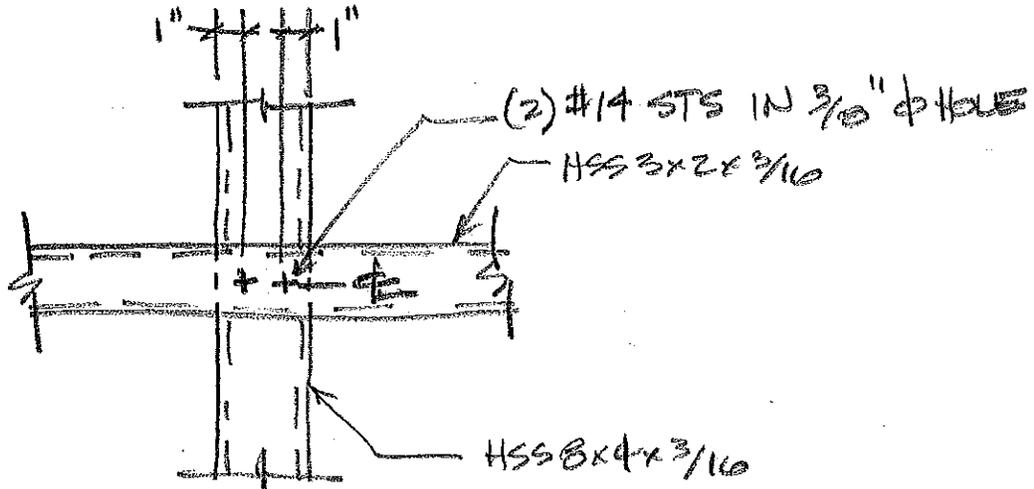
Sheet #: \_\_\_\_\_ of \_\_\_\_\_

Job #: B/C670

## "RAFTER" TO BEAM (R BEAM #1)



SECTION



(A) PLAN VIEW

# DEI

engineers

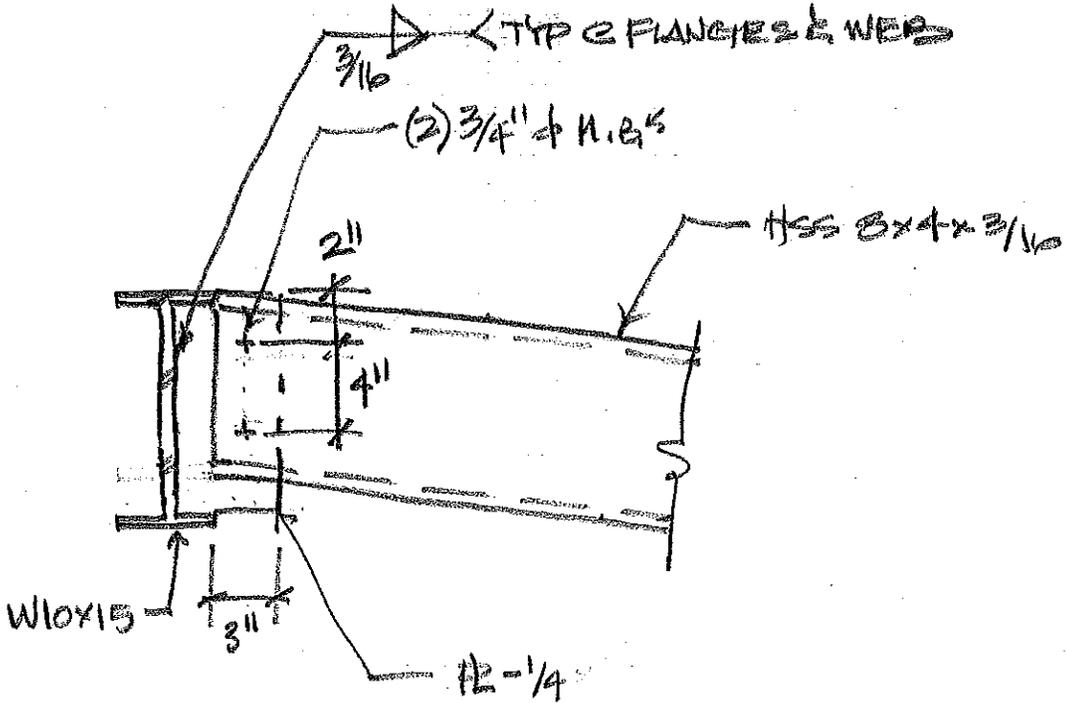
Project: PUMPHOUSE  
STEEL CONNECTION

Prepared By: BDZ Date: 9/16

Sheet #: \_\_\_\_\_ of \_\_\_\_\_

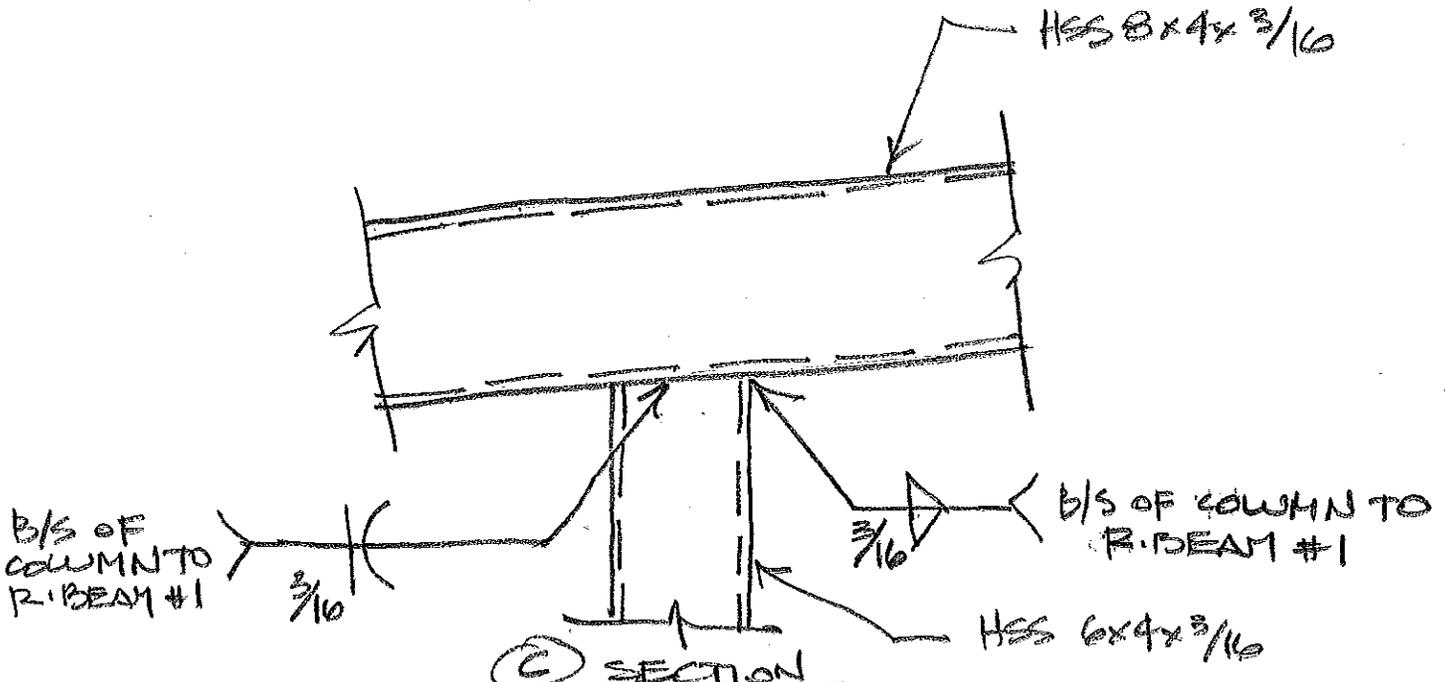
Job #: B16670

## R-BEAM #1 TO R-BEAM #3



(B) SECTION

## R-BEAM #1 TO COLUMN:



# DEI

engineers

Project: PUMPHOUSE

Prepared By: ~~BD~~<sup>2</sup> Date: 9/16

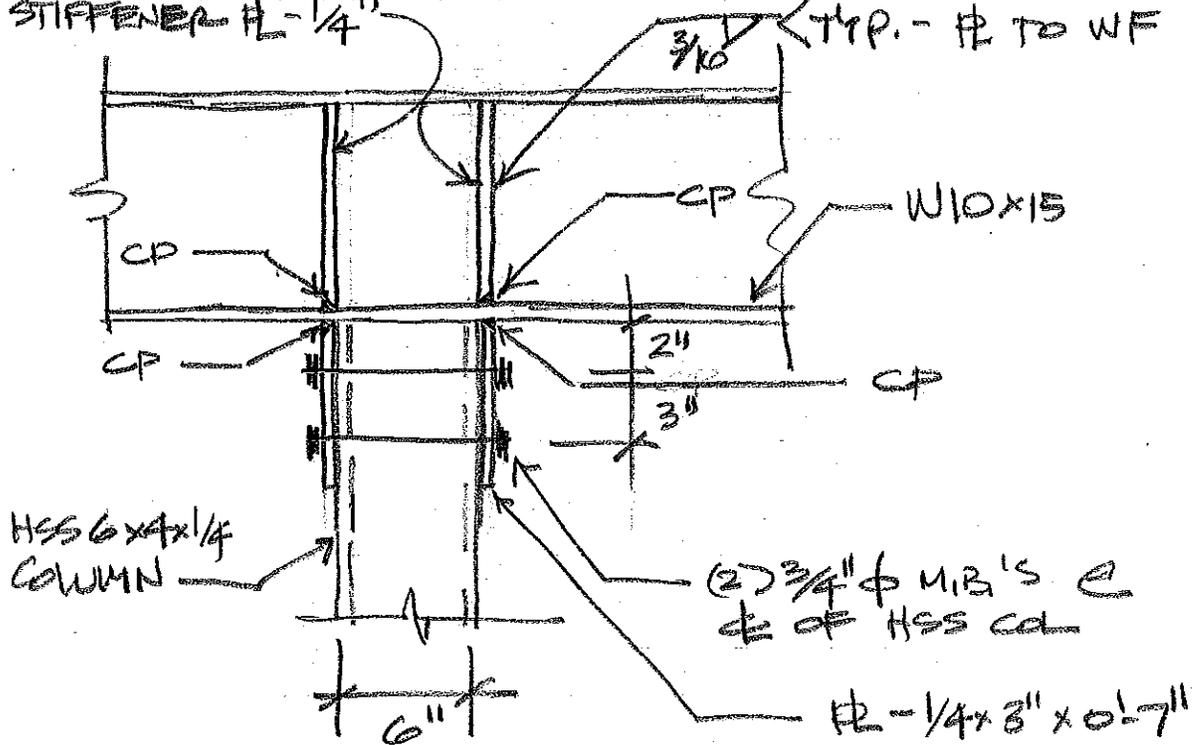
STEEL CONNECTIONS

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Job #: D16670

R-BEAM #3, 4, & 5 TO COLUMN (ALL CONNECTION : SIMILAR)

STIFFENER PL-1/4"



E SECTION

# DEI

engineers

Project: PUMP HOUSE

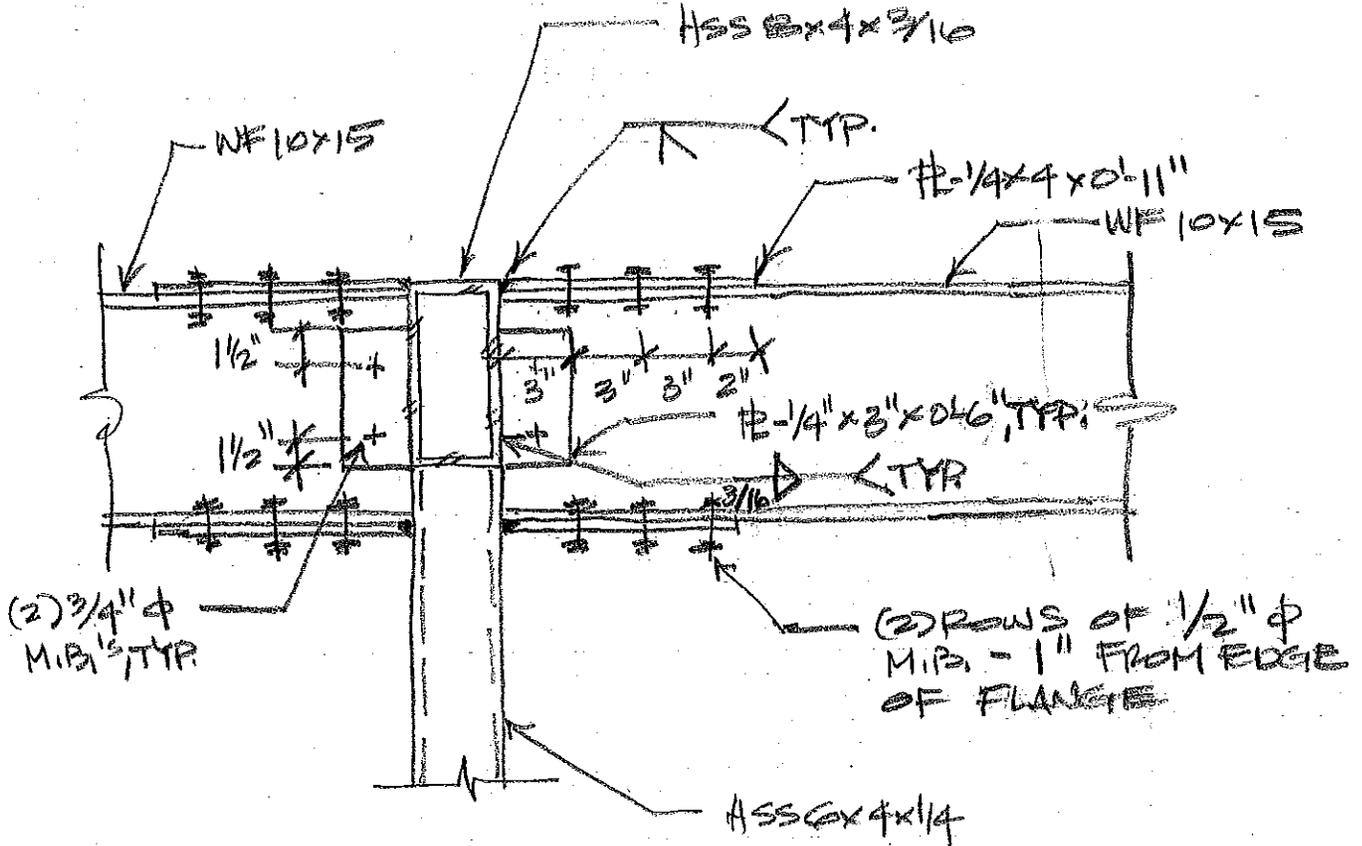
Prepared By: RD<sup>2</sup> Date: \_\_\_\_\_

STEEL CONNECTIONS

Sheet #: \_\_\_\_\_ of \_\_\_\_\_

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R-BEAM #6 TO COLUMN:



(E) SECTION

NOTE: SEE DETAIL  
(C) FOR HSS 8x4 TO  
HSS 6x4 CONNECTION

# DEI

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Project: PUMP HOUSE

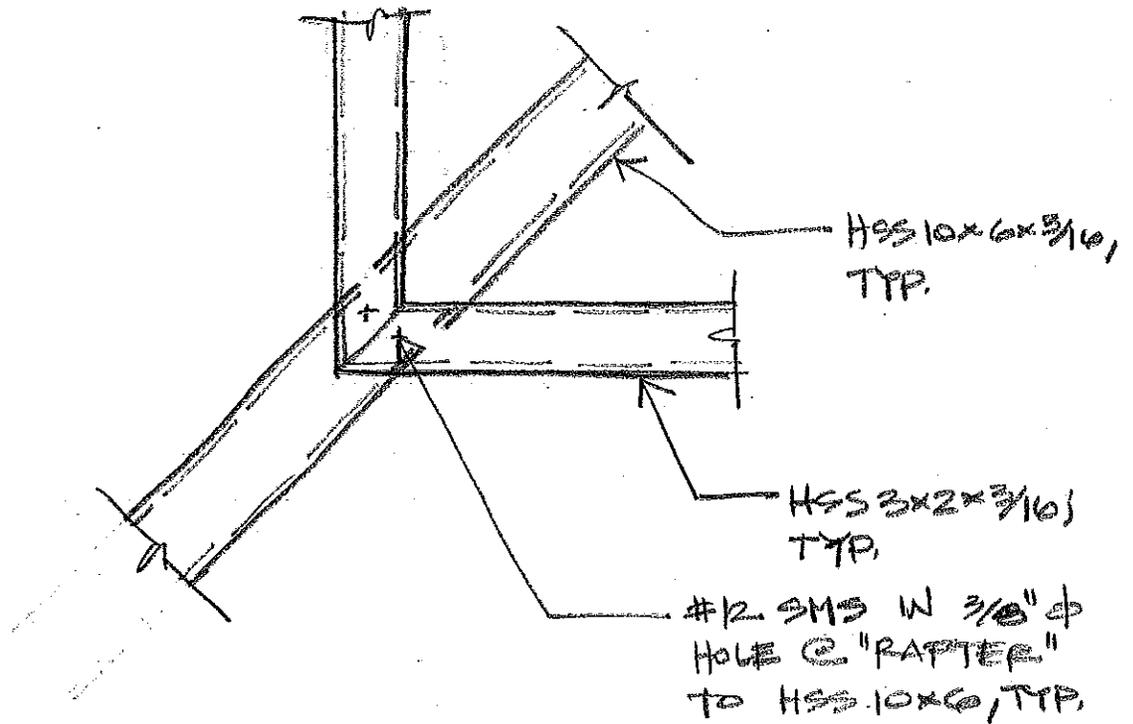
Prepared By: ED<sup>2</sup> Date: 9/10

STEEL CONNECTIONS

Sheet #: \_\_\_\_\_ of \_\_\_\_\_

Job #: B216670

"RAFTER" TO HIP BEAM



⑥ PLAN VIEW



# DEI

engineers

Project: THE PUMP HOUSE

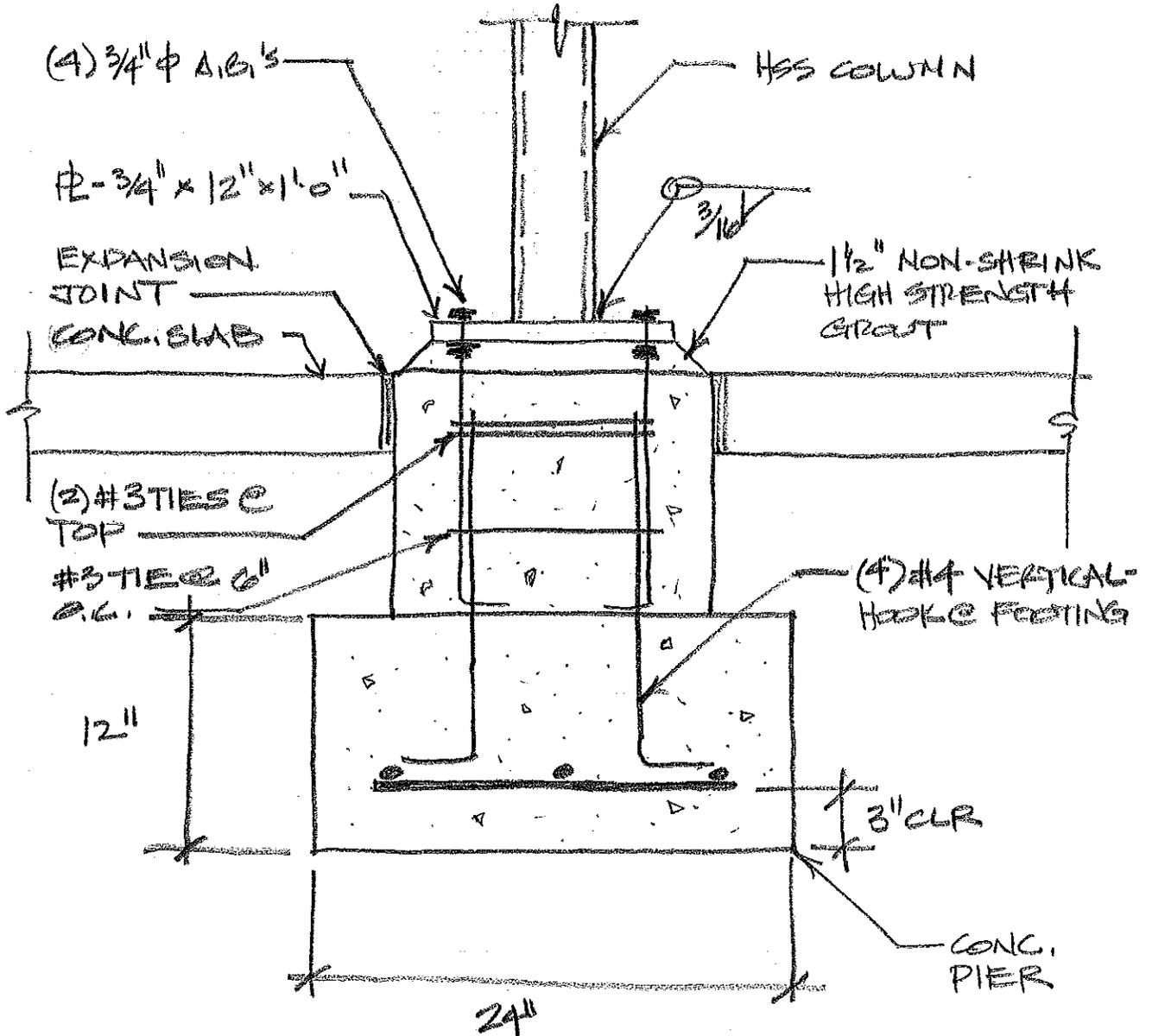
Prepared By: BD<sup>2</sup> Date: 9/16

DETAILS

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FOUNDATION

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(J) SECTION