

STRUCTURAL CALCULATIONS

for

**Meyerhoffer Pole Building Plan
1348 South 3500 West
Ogden, UT**

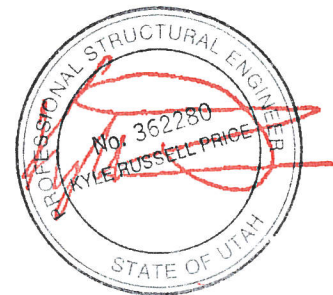
for

**Roper Buildings
Dan Scarbrough
801-540-5586**

Date: 06/06/14



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JUN 13 2014

6/16/14

Project: Roper Meyerhoffer
Design: K. Price
Date: 06/16/14

Project No.:

Sheet: of

DESIGN CRITERIA

Structure Type: Wood, Concrete

Design Codes: 2012 IBC, Risk Category I

Dead Loads:

| | | |
|-----|---------|-----------------|
| 3 | psf for | Roof Structure |
| N/A | psf for | Floor Structure |
| 3 | psf for | Walls |
| N/A | psf for | Brick Veneer |
| N/A | psf for | Deck/Porch |

Snow Loads:

Pg: 43 Ce: 0.9 Ct: 1.1 I: 0.8
Cs: 0.85

Ps=> (Pg*Cs*Ce*Ct*I*0.7)
Ps*= 30 psf

Seismic Loads:

Sd: 92.0% Dsgn Cat: D I: 1 Site Class: D
R: 7 (SW) Bldg Height (ft): 24 ft.
R: 1.5 (Cant Col.)

Wind Loads:

Exposure: C I: 0.87 Wind (3 sec. Gust): 120 mph

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FOUNDATION CRITERIA

Soil Report: Not Available

By: Not Available

Date of Report: Not Available

Proj No. of Report: Not Available

Foundation Type: Conc. Piers

Bearing Pressure: $Q_a = 1500$ psf
(Assumed)

Minium Depth: See Plans
Below: Exterior Finished Grade

Lateral Design Pressure: $Y_p = 533$ pcf
(Assumed, 200 psf x 2 for allowable movement + 33% wind/siesmic)

Coeff. of Friction: 0.4 alone 0.3 with passive

Active Pressure: $Y_a = 35$ pcf
(Assumed)

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**MATERIAL SPECIFICATIONS FOR
REINFORCING STEEL, CONCRETE AND MASONRY**

Reinforcing Steel: ASTM A615, Grade 60
ASTM A706, Grade 60 Weldable Rebar

Welded Wire Fabric: ASTM A185

Concrete Strengths: (Strength)

| | | |
|-------------------|------|-----|
| Footings: | 3000 | psi |
| Grade Beams: | n/a | psi |
| Piles: | n/a | psi |
| Caissons: | n/a | psi |
| Slabs on Grade: | 3500 | psi |
| Structural Slabs: | n/a | psi |
| Columns: | n/a | psi |
| Walls: | n/a | psi |

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MATERIAL SPECIFICATIONS FOR WOOD FRAMING

Sawn Lumber: Douglas Fir Larch (North)

| | |
|--------------------------------|------------|
| 2 x 6 studs up to 12' 0" long: | Stud Grade |
| Other Studs: | Grade #2 |
| Posts: | Grade #1 |
| Joists: | Grade #2 |
| Beams: | Grade #1 |
| Headers: | Grade #2 |
| Subpurlins: | Grade #1 |
| Purlins: | Grade #1 |

Framing Hardware: Simpson Strong-Tie Connectors

Structural Nails: Common Wire Type or Galvanized Box

Bolts in Wood: ASTM A307 or better

Prefabricated Wood Joists: RE: Plan

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Bending Capacities of Douglas Fir Larch (North):

2 X 10's

Headers

Snow Loads 1075 psi

Normal Loads 935 psi

Joists

Snow Loads 1237 psi

Normal Loads 1075 psi

2 X 12's

Headers

Snow Loads 978 psi

Normal Loads 850 psi

Joists

Snow Loads 1124 psi

Normal Loads 978 psi

Glu Laminated Members

24F-V4, 24F-V8

Snow Loads 2760 psi

Normal Loads 2400 psi

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Earthquake Loading Calculations

V= (SDS)(Fa)(W)(2/3)/R *Seismic Base Shear*
SDS= (2/3)SM_s *Design Spectral Responce Acceleration*
SMS= Fa(SS) *Max Considered Spectral Responce Acceleration*
SS= 1.370 *Short Period Spectral Acceleration*
S1= 0.75 *1 Second Period Spectral Acceleration*
Fa= 1.00 *Site Coefficient for Short Period Acceleration*
 D *Site Class (Assumed if no Soils Report)*
 E *Seismic Design Category*
 No *Soils Investigation Required?*

Diaphragm Description **60 x 120 Main**

| | | | |
|----------|---|-----|----------------------|
| Wall DL | 3 | psf | |
| Floor DL | 0 | psf | |
| Roof DL | 3 | psf | |
| Roof SL | 0 | psf | (Applicable Portion) |

Cantilever System

| | | |
|------------------------|----|----|
| Traverse Dimension (w) | 40 | ft |
| Long. dimension (L) | 60 | ft |
| Wall Hieght | 16 | ft |

R= 1.5 *RMC*
V= 0.6089 *(W)*
E*0.7= 0.426 *(W)*

V= 7161 *lbs. @ base Total*
V= 5115 *lbs. @ top Total*

Shear Wall System

| | | |
|------------------------|----|----|
| Traverse Dimension (w) | 40 | ft |
| Long. dimension (L) | 60 | ft |
| Wall Hieght | 16 | ft |

R= 7.0 *RMC*
V= 0.1305 *(W)*
E*0.7= 0.091 *(W)*

V= 767 *lbs. @ base*
V= 548 *lbs. @ top*

Basic Load Combonations
 (Engineer may compare w/ NDS factors)

| | |
|---------------|-----------|
| Ea.Col | |
| Col Trib | 12 ft |
| Col Trip Roof | 240 sq ft |
| Roof Snow | 30 psf |

| | Axial | Moment |
|-----------------|-------|--------|
| D+S | 7920 | 0 |
| D+.7E | 720 | 4262 |
| D+.75(.7E)+.75S | 6120 | 3197 |

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Seismic Cantilever System

Seismic Shear Wall System

No. Columns
 Col Ht ft
 Col Depth in
 Col. Width in
 Col Area si
 Col. F'b psi
 Col 'E psi
 Col F'c psi
 Col Sx

Width Total ft
 Length Total ft
 Allowable Shear plf

Width Allow Total lbs
 Length Allowable Total lbs

Check Width OK
 Check Length OK

Mom Ea Col lb*ft
 Axial Load lbs, Ea Column

Column Uplift

fb 799 psi
 fc 15 psi
 c 0.8
 Fce 2078 psi
 Cp 0.904
 F'c 723 psi

Column Ht ft
 Shear Wall Width ft
 Design Shear lbs.

Total Uplift lbs
 Pier Diameter ft

ratio 0.839
 Check OK See Shear Wall

Requ'd Pier Depth ft

Allowable Lat. Load psf
 S3 psf
 S psf
 Provide ft Wide Pier
 Provide ft Deep Pier

| | |
|---|---|
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|---|---|

Diaphragm Description Main 40x60 Building Roof

Wind Loading Calculations

| | | |
|-------------------|------|------------------|
| Wind Speed | 120 | mph, 3 sec. gust |
| Exposure | C | |
| Risk | 0.87 | |
| Kz | 0.90 | |
| Topo Factor (Kzt) | 1.00 | |

| | | |
|------------------------|------|---------|
| Traverse Dimension (w) | 40 | ft |
| Long. dimension (L) | 60 | ft |
| Ridge Hieght | 23 | ft |
| Wind Wall Hieght | 16 | ft |
| Roof Rise | 4 | ft |
| Roof Run | 12 | ft |
| Roof Slope | 18.4 | degrees |

| | | | |
|---------|--------------|--------------|--------------|
| | Long. | Gable | |
| sum Ps= | 6,877 | 5,357 | Base Ea Wall |
| sum Ps= | 2,927 | 2,485 | Top Ea Wall |
| | Uplift | -56 | plf |

Basic Load Combonations
(Engineer may compare w/ NDS factors)

| | | |
|---------------|-----|-------|
| Roof DL | 3 | psf |
| Col Trib | 12 | ft |
| Col Trib Roof | 240 | sq ft |
| Roof Snow | 30 | psf |

| | | |
|-------------------|-------|--------|
| | Axial | Moment |
| D+S | 7920 | 0 |
| D+0.6*W | 720 | 1464 |
| D+(0.6*).75W+.75S | 6120 | 1098 |

| | |
|---|---|
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|---|---|

Wind Cantilever System

| | | |
|-------------|---------|-----|
| No. Columns | 18 | |
| Col Ht | 15 | ft |
| Col Depth | 6 | in |
| Col. Width | 6 | in |
| Col Area | 36 | si |
| Col. F'b | 960 | psi |
| Col 'E | 1280000 | psi |
| Col F'c | 800 | psi |

Mom Ea Col Trav 4205 lb*ft wind only
 Mom Ea Col Long 2897 lb*ft wind only

Col Sx/y Trav 36
 Req'd Sx/y Trav 53
 Col Sx/y Long 36
 Req'd Sx/y Long 36

Axial Load 720 lbs, Ea Column
 Moment 1464 lb*ft Ea Column

fb 488 psi
 fc 20 psi
 c 0.8
 Fce 1169 psi
 Cp 0.804
 F'c 643 psi

ratio 0.518
 check OK

Allowable Lat. Load 533 psf
 S3 1151 psf
 S 1152 psf
 Provide 2.5 ft Wide Pier
 Provide 2.2 ft Deep Pier

Wind Shear Wall System

| | | |
|------------------------|------|-----|
| Shear Walls | | |
| Width Total | 17 | ft |
| Length Total | 60.0 | ft |
| Allowable Shear | 100 | plf |
| Wind Factor | 1.4 | |
| Width Allow Total | 2380 | lbs |
| Length Allowable Total | 8400 | lbs |

Check Width OK
 Check Length OK

Column Uplift

| | | |
|------------------|------|------|
| Column Ht | 15 | ft |
| Shear Wall Width | 17.0 | ft |
| Design Shear | 2927 | lbs. |

Total Uplift 1291 lbs
 Pier Diameter 2.5 ft

Requ'd Pier Depth 1.8 ft
 (See Cantilever System)

2355

Assumed Allow. Bearing Press 1500 psf
 Depth 3 ft
 Soil Density 120 pcf
 Allow. End Bearing @ Depth 1860 psf
 Controlling Axial Load 8,136 lbs
 Pier Dia Req'd 2.4 ft

| | |
|-------------------|----------------------------|
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| Willard, Utah | Design: K. Price |
| O: 801-771-0542 | Date: 6/16/2014 |

Tables & Load Sumations

| 110 | Design Wind Pressures | | | | | | | |
|-----|-----------------------|------|------|------|-------|-------|------|-------|
| | A | B | C | D | E | F | G | H |
| 15 | 24.1 | -8 | 16 | -4.6 | -23.1 | -15.1 | -16 | -11.5 |
| 20 | 26.6 | -7 | 17.1 | -3.9 | -23.1 | -16 | -16 | -12.2 |
| 25 | 24.1 | 3.9 | 17.4 | 4 | -10.7 | -14.6 | -7.7 | -11.7 |
| 30 | 21.6 | 14.8 | 17.2 | 11.8 | 8.3 | -6.5 | 7.2 | -4.6 |

| 120 | Design Wind Pressures | | | | | | | |
|-----|-----------------------|------|------|------|-------|-------|-------|-------|
| | A | B | C | D | E | F | G | H |
| 15 | 28.7 | -9.5 | 19.1 | -5.4 | -27.4 | -17.9 | -19.1 | -13.7 |
| 20 | 31.6 | -8.3 | 21.1 | -4.6 | -27.4 | -19.1 | -19.1 | -14.5 |
| 25 | 28.6 | 4.6 | 20.7 | 4.7 | -12.7 | -17.3 | -9.2 | -13.9 |
| 30 | 25.7 | 17.6 | 20.4 | 14 | 9.9 | -15.6 | 8.6 | -13.4 |

| 150 | Design Wind Pressures | | | | | | | |
|-----|-----------------------|-------|------|------|-------|-------|-------|-------|
| | A | B | C | D | E | F | G | H |
| 15 | 44.8 | -14.9 | 29.8 | -8.5 | -42.9 | -28 | -29.8 | -21.4 |
| 20 | 49.4 | -13 | 32.9 | -7.2 | -42.9 | -29.8 | -29.8 | -22.6 |
| 25 | 44.8 | 7.2 | 32.4 | 7.4 | -19.9 | -27.1 | -14.4 | -21.8 |
| 30 | 40.1 | 27.4 | 31.9 | 22 | 15.4 | -24.4 | 13.4 | -20.9 |

| | | | | | | | | |
|-----|-------|--------|-------|-------|--------|--------|--------|--------|
| 110 | 24.10 | -8.00 | 16.00 | -4.60 | -23.10 | -15.10 | -16.00 | -11.50 |
| 120 | 28.70 | -9.50 | 19.10 | -5.40 | -27.40 | -17.90 | -19.10 | -13.70 |
| 150 | 44.80 | -14.90 | 29.80 | -8.50 | -42.90 | -28.00 | -29.80 | -21.40 |

Applic. Press. For 120 mph gust

| | | | | | | | | |
|-------|-------|-------|-------|-------|--------|--------|--------|--------|
| | 28.70 | -9.50 | 19.10 | -5.40 | -27.40 | -17.90 | -19.10 | -13.70 |
| Ps'=' | 22.47 | -7.44 | 14.96 | -4.23 | -21.45 | -14.02 | -14.96 | -10.73 |

Calc'd Zone Areas (sf)

| | A | B | C | D | E | F | G | H |
|--------------|-----|----|-----|-----|-----|-----|-----|-----|
| Transverse | 192 | 84 | 768 | 336 | 240 | 240 | 960 | 960 |
| Longitudinal | 128 | - | 524 | - | 240 | 240 | 960 | 960 |

Calc'd Zone Loads (lbs)

| | A | B | C | D | E | F | G | H |
|--------------|------|------|-------|-------|-------|-------|--------|--------|
| Transverse | 4315 | -625 | 11486 | -1421 | -5149 | -3364 | -14357 | -10298 |
| Longitudinal | 2876 | - | 7837 | - | -5149 | -3364 | -14357 | -10298 |

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BEAM #1, ROOF PERLINS

| INPUT | | LOADING | | | LOAD DIST. | | DEFLECTION LIMITS | |
|---------------------------|------|--------------------|----|---|---------------|--------|-------------------|--|
| <u>BEAM PARAMETERS</u> | | LL | DL | | FROM LEFT | LL, L/ | 240 | |
| BEAM TABLE NO. | 2 | W (PLF) | 60 | 6 | FROM LEFT | TL, L/ | 180 | |
| QUANTITY | 1 | W FROM LEFT (LBS) | 0 | 0 | WA, RIGHT WC, | | | |
| SPAN (FT) | 11.5 | W FROM RIGHT (LBS) | 0 | 0 | TO START WB) | | | |
| <u>ADJUSTMENT FACTORS</u> | | W @ MID (LBS) | 0 | 0 | (FT.) | | | |
| CD | 1.00 | PL 1 (LBS) | 0 | 0 | 0.0 | | | |
| CM*CT*CI | 1.00 | PL 2 (LBS) | 0 | 0 | 0.0 | | | |
| CL | 1.00 | PL 3 (LBS) | 0 | 0 | 0.0 | | | |
| CF*CV | 1.00 | | | | | | | |
| CFU*CR | 1.15 | | | | | | | |

RESULTS

BEAM DESCRIPTION 1 | 2" x 6" DF#2 LAPPED

| <u>BEAM PROPERTIES</u> | | <u>REQ'D PROPERTIES</u> | | <u>PROPERTIES ADEQUATE*?</u> |
|-------------------------|---------|------------------------------------|-------|------------------------------|
| SX (IN ³) | 11.34 | SX (IN ³) | 8.93 | YES |
| AREA (IN ²) | 8.25 | AREA (IN ²) | 2.11 | YES |
| IX (IN ⁴) | 21 | | | |
| E' (PSI) | 1600000 | <u>CALC'D LOADS & STRESSES</u> | | |
| F' B (PSI) | 14.66 | MAX MOMENT (LB*FT) | 1,091 | |
| F' V (PSI) | 180 | REACTION L (LBS) | 380 | |
| | | REACTION R (LBS) | 380 | |
| <u>MAX. DEFLECTION</u> | | <u>CALC'D DEFLECTION</u> | | |
| LL (IN.) | 0.58 | LL (IN.) | 0.71 | |
| TL (IN.) | 0.77 | TL (IN.) | 0.78 | |

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Snow Load Calculations

Codes: 2012 IBC 1607, State Amendment, ASCE 7 10

Ground Snow Load, P_g

State Amendment R156-56-704

County: *Morgan County*

A : 4970 ft.
S : 63 psf/100 ft.
Po: 57 psf/100 ft.
Ao: 4.5 ft./1000

$$P_g = (Po^2 + s^2(A - Ao)^2)^{1/2}$$

$P_g = 64$ psf

Roof Snow Load, P_s (Sloped), P_f (Flat) ASCE 7

Slope: 18 degrees
 P_g : 64 psf
Ce: 0.9
Ct: 1.1
I: 0.8
Cs: 0.85

$$P_f = (0.7) * C_e * C_t * I * P_g$$

* $P_f = 36$ psf

$$P_s = (0.7) * C_e * C_t * I * P_g * C_s$$

* $P_s = 36$ psf

Design Roof Balanced Snow Load 36 psf

Unbalanced Snow Load

ASCE 7

Lu 20
Slope: ()/12 4
Density 22
hd 1.9
S 3.0

dist. from ridge= 9 ft
Windward= 11 psf
Leeward (add to P_s)= 25 psf

Beam / HDR Loading: 456 plf

Drift Snow Load

P_d = 43 psf
W= 8 ft.

Seismic DL

W_s = 7 psf

Project: **Roper Meyerhoffer**

Project No.:

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2x6 DF Wall Girts @ 24" o.c.

WALLS ARE CONSIDERED FLEXIBLE FOR DEFLECTION CALC CRITERIA

BEAM | 2X6 WALL GIRTS |

INPUT

BEAM PARAMETERS

BEAM TABLE NO. 2
QUANTITY 1
SPAN (FT) 11.5

LOADING

W (PLF) 19
W FROM LEFT (LBS) 0
W FROM RIGHT (LBS) 0
W @ MID (LBS) 0

LL

DL

LOAD DIST.

FROM LEFT
WA, RIGHT WC,
TO START WB)
(FT.)

DEFLECTION LIMITS

LL, L/ 120
TL, L/ 120

ADJUSTMENT FACTORS

CD 1.60
CM*CT*Ci 1.00
CL 1.00
CF*CV 1.00
CFU*CR 1.15

WIND

PL 1 (LBS) 0
PL 2 (LBS) 0
PL 3 (LBS) 0

0
0
0
0
0

0.0
0.0
0.0

W/ METAL SIDING

RESULTS

BEAM DESCRIPTION | 1 | 2" x 6" DF#2 FLAT |

BEAM PROPERTIES

SX (IN³) 2.06
AREA (IN²) 8.25
IX (IN⁴) 2
E' (PSI) 1600000
F' B (PSI) 2116
F' V (PSI) 288

REQ'D PROPERTIES

SX (IN³) 1.78
AREA (IN²) 0.38

PROPERTIES ADEQUATE*?

YES
YES

CALC'D LOADS & STRESSES

MAX MOMENT (LB*FT) 314
REACTION L (LBS) 109
REACTION R (LBS) 109

MAX. DEFLECTION

LL (IN.) 1.15
TL (IN.) 1.15

CALC'D DEFLECTION

LL (IN.) 3.03
TL (IN.) 3.03

PROJECT: Roper Meyerhoffer
 DESIGN: K.Price
 DATE: 6/16/2014

SHEET: _____ of _____

**Post Calculations W/ Bending
 2008 NDS**

| Input | Results | COLUMN | BUILDING POST |
|--------------------------|--|--------|---------------|
| Axial | | | |
| Fc= 925.00 psi | | | |
| Cd= 1.00 | | | |
| Cm= 1.00 | F'c= 740.00 psi | | |
| Ct= 1.00 | (Cd*Cm*Ct*Cf*Ci*Cp) | | |
| CF= 1.00 (built up col) | | | |
| Ci= 0.80 | Cp= 0.77 | | |
| | ((1+(Fce/Fc))/(2*C) - (((1+(Fce/Fc))/(2*C))^2 - ((Fce/Fc)/c))^0.5) | | |
| load= 7,920 lbs (max) | | | |
| Area= 48 in ² | Fce= 948 psi | | |
| | (Kce*E)/(Le/d) ² | | |
| Kce= 0.30 | | | |
| E'= 1,600,000 psi | 569 psi | | |
| L= 180.0 in | 165 psi | | |
| K= 1.0 in | | | |
| Le= 180.0 in | check OK | | |
| d= 8.00 in | | | |
| b= 6.00 in | | | |
| c= 0.80 | F'b= 1664 | | |
| | 759 | | |
| Bending | | | |
| Fb= 1300.00 psi | tress Ratio 0.64 | | |
| CD= 1.60 | check OK | | |
| CL= 1.00 | | | |
| Cv= 1.00 | | | |
| Cfu= 1.00 | | | |
| Cr= 1.00 | | | |
| Ci= 0.80 | | | |
| | 1.00 | | |
| load= 144 plf | | | |
| Sx= 64.0 in ³ | | | |

Provide **1 6x8 DF#1 Treated**
 Maximum Height: 15.0 ft
 Weak Axis Braced at 2.0 ft