# CHEFORNAK WATER AND SEWER PROJECT

# PUMP HOUSE 1 DESIGN

# DESIGN NOTEBOOK

CHEFORNAK WATER AND SEWER PROJECT

PUMP HOUSE 1 DESIGN

# STRUCTURAL CALCULATIONS

# Oien Associates, Inc.

Structural Engineering & Inspection – Construction Management Services 694-0507


May 11, 2015

Paul Weisner
CE2 Engineers
PO Box 232946
Anchorage, AK 99523 sent via email

RE: Chefornak Pumphouse and Water Tank
Piling Loading

Paul;

This is to confirm that the maximum load to pile is at the water tank. The maximum loading including the in service loading plus snow load is 30 kips per pile maximum (actual loading is 27 kips, 1 kip = 1000 lbs).

The 6" diameter standard pipe piling is more than adequate for this loading. I ran a design analysis on this with a 7' length, as the pile is 3' out of the ground and the point of fixity of the pile is most likely 4' below ground, so the unbraced length would be 7'.

The pile is only 25% stressed, so there is an additional factor of safety of 4 times the allowable stress for this pile.

Find supporting calculations. If you have any questions regarding this, please contact me.

Sincerely,

Benjamin C. Oien, P.E.
AK License CE-9141, SE-14183

STATE OF ALASKA
49TH
BENJAMIN C. OIEN
SE-14183
5/11/15
REGISTERED PROFESSIONAL ENGINEER


16922 Hanson Dr, Eagle River, Alaska 99577 email: boien@gci.net 907/694-0507 – Fax 694-0508

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Project Title:
Engineer:
Project Descr:

Project ID:

Printed: 11 MAY 2015, 4:52PM

# Steel Column

File = C:\Users\Ben\DOCUME~1\ENERCA~1\42754C~1.BKU
ENERCALC, INC. 1983-2015, Build:6.15.1.19, Ver:6.15.1.19

Lic. # : KW-06004715 Licensee : OEIN ASSOCIATES

Description : PILE CALC

### *Code References*

Calculations per AISC 360-05, IBC 2009, CBC 2010, ASCE 7-05
Load Combinations Used : ASCE 7-10

### General Information

Steel Section Name : **Pipe6 Std**
Analysis Method : Allowable Strength
Steel Stress Grade
Fy : Steel Yield 42.0 ksi
E : Elastic Bending Modulus 29,000.0 ksi
Load Combination : ASCE 7-10

Overall Column Height 7.0 ft
Top & Bottom Fixity Top & Bottom Pinned
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for X-X Axis buckling = 7.0 ft, K = 1.0
Y-Y (depth) axis :
Unbraced Length for Y-Y Axis buckling = 3 ft, K = 1.0

### Applied Loads

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

Column self weight included : 133.587 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 7.0 ft, D = 4.0, L = 26.0 k

### *DESIGN SUMMARY*

### Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio = **0.250** : 1
Load Combination +D+L+H
Location of max.above base 0.0 ft
At maximum location values are . . .
Pa : Axial 30.134 k
Pn / Omega : Allowable 120.511 k
Ma-x : Applied 0.0 k-ft
Mn-x / Omega : Allowable 22.216 k-ft
Ma-y : Applied 0.0 k-ft
Mn-y / Omega : Allowable 22.216 k-ft

PASS Maximum Shear Stress Ratio = **0.0** : 1
Load Combination
Location of max.above base 0.0 ft
At maximum location values are . . .
Va : Applied 0.0 k
Vn / Omega : Allowable 0.0 k

**Maximum SERVICE Load Reactions . .**
Top along X-X 0.0 k
Bottom along X-X 0.0 k
Top along Y-Y 0.0 k
Bottom along Y-Y 0.0 k

**Maximum SERVICE Load Deflections . . .**
Along Y-Y 0.0 in at 0.0 ft above base
for load combination :
Along X-X 0.0 in at 0.0 ft above base
for load combination :

### Load Combination Results

| Load Combination | Maximum Axial + Bending Stress Ratios: Stress Ratio | Status | Location | Maximum Shear Ratios: Stress Ratio | Status | Location |
|---|---|---|---|---|---|---|
| +D+H | 0.034 | PASS | 0.00 ft | 0.000 | PASS | 0.00 ft |
| +D+L+H | 0.250 | PASS | 0.00 ft | 0.000 | PASS | 0.00 ft |
| +D+Lr+H | 0.034 | PASS | 0.00 ft | 0.000 | PASS | 0.00 ft |
| +D+S+H | 0.034 | PASS | 0.00 ft | 0.000 | PASS | 0.00 ft |
| +D+0.750Lr+0.750L+H | 0.196 | PASS | 0.00 ft | 0.000 | PASS | 0.00 ft |
| +D+0.750L+0.750S+H | 0.196 | PASS | 0.00 ft | 0.000 | PASS | 0.00 ft |
| +D+0.60W+H | 0.034 | PASS | 0.00 ft | 0.000 | PASS | 0.00 ft |
| +D+0.70E+H | 0.034 | PASS | 0.00 ft | 0.000 | PASS | 0.00 ft |
| +D+0.750Lr+0.750L+0.450W+H | 0.196 | PASS | 0.00 ft | 0.000 | PASS | 0.00 ft |
| +D+0.750L+0.750S+0.450W+H | 0.196 | PASS | 0.00 ft | 0.000 | PASS | 0.00 ft |
| +D+0.750L+0.750S+0.5250E+H | 0.196 | PASS | 0.00 ft | 0.000 | PASS | 0.00 ft |
| +0.60D+0.60W+0.60H | 0.021 | PASS | 0.00 ft | 0.000 | PASS | 0.00 ft |
| +0.60D+0.70E+0.60H | 0.021 | PASS | 0.00 ft | 0.000 | PASS | 0.00 ft |

### Maximum Reactions

Note: Only non-zero reactions are listed.

| Load Combination | X-X Axis Reaction @ Base | X-X Axis Reaction @ Top | Y-Y Axis Reaction @ Base | Y-Y Axis Reaction @ Top | Axial Reaction @ Base |
|---|---|---|---|---|---|
| +D+H | | k | | k | 4.134 k |

# Steel Column

File = C:\Users\Ben\DOCUME~1\ENERCA~1\42754C~1.BKU
ENERCALC, INC. 1983-2015, Build:6.15.1.19, Ver:6.15.1.19
Lic. # : KW-06004715
Licensee : OEIN ASSOCIATES

Description : PILE CALC

## Maximum Reactions

Note: Only non-zero reactions are listed.

| Load Combination | X-X Axis Reaction @ Base | X-X Axis Reaction @ Top | Y-Y Axis Reaction @ Base | Y-Y Axis Reaction @ Top | Axial Reaction @ Base |
|---|---|---|---|---|---|
| +D+L+H | k | k | k | k | 30.134 k |
| +D+Lr+H | k | k | k | k | 4.134 k |
| +D+S+H | k | k | k | k | 4.134 k |
| +D+0.750Lr+0.750L+H | k | k | k | k | 23.634 k |
| +D+0.750L+0.750S+H | k | k | k | k | 23.634 k |
| +D+0.60W+H | k | k | k | k | 4.134 k |
| +D+0.70E+H | k | k | k | k | 4.134 k |
| +D+0.750Lr+0.750L+0.450W+H | k | k | k | k | 23.634 k |
| +D+0.750L+0.750S+0.450W+H | k | k | k | k | 23.634 k |
| +D+0.750L+0.750S+0.5250E+H | k | k | k | k | 23.634 k |
| +0.60D+0.60W+0.60H | k | k | k | k | 2.480 k |
| +0.60D+0.70E+0.60H | k | k | k | k | 2.480 k |
| D Only | k | k | k | k | 4.134 k |
| Lr Only | k | k | k | k | k |
| L Only | k | k | k | k | 26.000 k |
| S Only | k | k | k | k | k |
| W Only | k | k | k | k | k |
| E Only | k | k | k | k | k |
| H Only | k | k | k | k | k |

## Maximum Deflections for Load Combinations

| Load Combination | Max. X-X Deflection | | Distance | | Max. Y-Y Deflection | | Distance | |
|---|---|---|---|---|---|---|---|---|
| +D+H | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| +D+L+H | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| +D+Lr+H | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| +D+S+H | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| +D+0.750Lr+0.750L+H | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| +D+0.750L+0.750S+H | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| +D+0.60W+H | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| +D+0.70E+H | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| +D+0.750Lr+0.750L+0.450W+H | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| +D+0.750L+0.750S+0.450W+H | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| +D+0.750L+0.750S+0.5250E+H | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| +0.60D+0.60W+0.60H | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| +0.60D+0.70E+0.60H | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| D Only | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| Lr Only | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| L Only | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| S Only | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| W Only | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| E Only | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |
| H Only | 0.0000 | in | 0.000 | ft | 0.000 | in | 0.000 | ft |

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# Steel Column

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Lic. # : KW-06004715

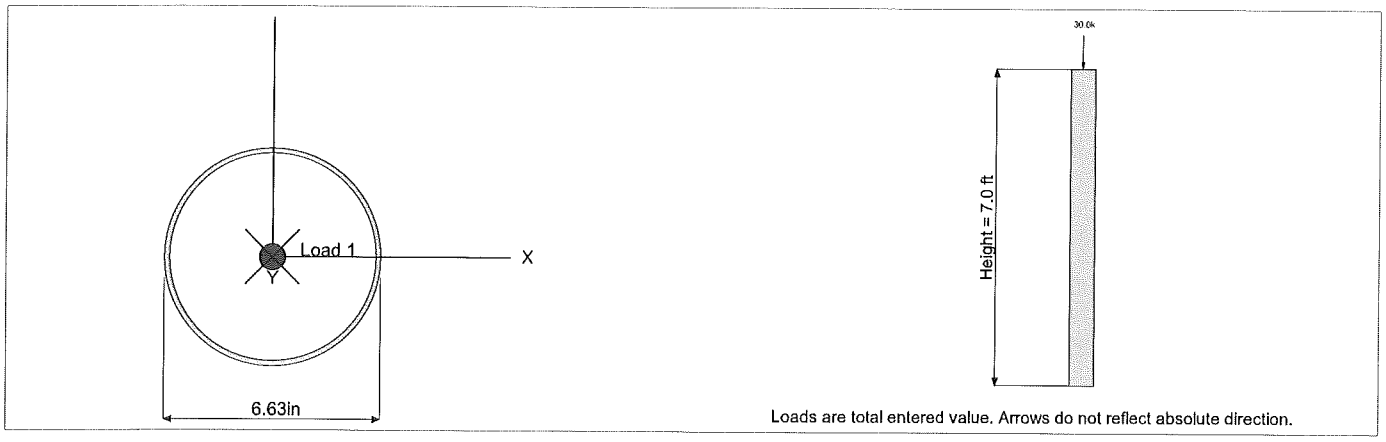
Licensee : OEIN ASSOCIATES

Description : PILE CALC

## Steel Section Properties : Pipe6 Std

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Depth | = | 6.625 in | I xx | = | 26.50 in^4 | J | = | 52.900 in^4 |
| | | | S xx | = | 7.99 in^3 | | | |
| Diameter | = | 6.625 in | R xx | = | 2.250 in | | | |
| Wall Thick | = | 0.280 in | Zx | = | 10.600 in^3 | | | |
| Area | = | 5.220 in^2 | I yy | = | 26.500 in^4 | | | |
| Weight | = | 19.084 plf | S yy | = | 7.990 in^3 | | | |
| | | | R yy | = | 2.250 in | | | |

Ycg = 0.000 in



# STRUCTURAL CALCULATIONS
# PUMPHOUSES

## 35% SUBMISSION

## CHEFORNAK, ALASKA

for

## CE2 ENGINEERS

Qien Associates, Inc.
Construction Management Engineering Inspections
16922 Hanson Drive
Eagle River, AK 99577
Phone: (907) 694-2587
Fax: (907) 694-2508
email: bolen@gci.net

STRUCTURAL CALCULATIONS
September 17, 2014

PROJECT NO 42754

# OIEN ASSOCIATES, INC.

16922 Hanson Drive, Eagle River, Alaska 99577 Ph: 694-0507 Fax: 694-0508


| | | | |
|---|---|---|---|
| **Structural Calculations** | | **Date:** | **9/18/2014** |
| **Project** | **CHEFORNAK PUMPHOUSES** | **Project No.** | **42754** |

NEW ONE STORY STRUCTURE IN CHEFORNAK
WIND = 130, EXP C
SNOW = 50 (GROUND), USE 40 ROOF SNOW
SEISMIC PER IBC

**NO SNOW DRIFT, NO LOWER ROOF OR FLOOR SECTIONS**

ROOF BEAM
L = 23, W=12'
**5 1/8" X 18" GLB** **ATTACHED**

ROOF RAFTERS
SPAN = 14'
**USE 14" BCI'S FOR R-38 AND VENTING** **ATTACHED**

FLOOR BEAM
L = 9.33', WIDHT = 12', USE LL = 500 PSF
**5 1/8" X 15" GLB** **ATTACHED**

FLOOR JOIST
L = 12', 1 = 1.33, LL = 500
**14" BCI/60'S @ 16" O.C.** **ATTACHED**

THESE ARE PRELIMINARY, WE ARE NOT SURE OF THE
TANK SIZE AND WATER HEIGHT YET

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# Wood Beam

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ENERCALC, INC. 1983-2014, Build:6.14.1.28, Ver:6.14.7.31

Lic. # : KW-06004715 Licensee : OEIN ASSOCIATES

Description : ridge beam

## CODE REFERENCES

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-05
Load Combination Set : ASCE 7-05

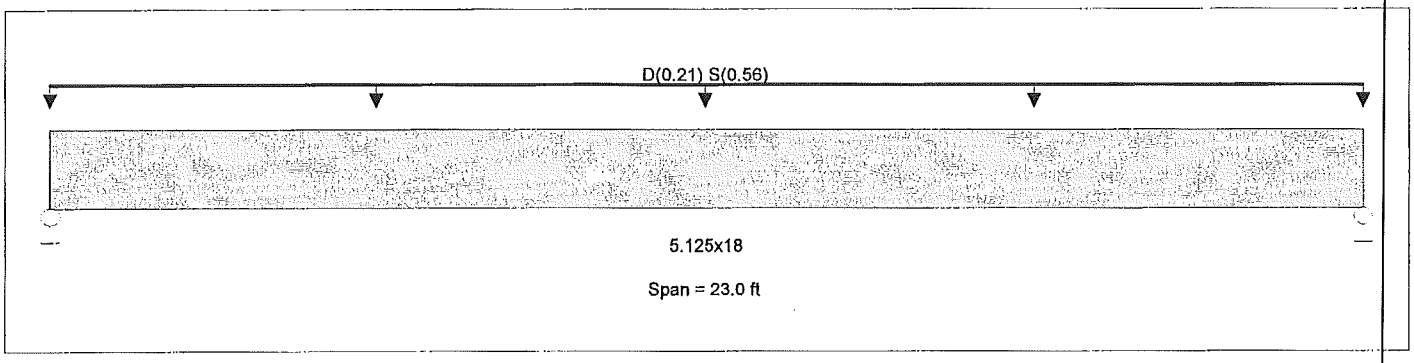
## Material Properties

Analysis Method : Allowable Stress Design
Load Combination ASCE 7-05

Wood Species : DF/DF
Wood Grade : 24F - V4

Beam Bracing : Beam is Fully Braced against lateral-torsion buckling

| | | | |
|---|---|---|---|
| Fb - Tension | 2400 psi | *E : Modulus of Elasticity* | |
| Fb - Compr | 1850 psi | Ebend- xx | 1800 ksi |
| Fc - Prll | 1650 psi | Eminbend - xx | 930 ksi |
| Fc - Perp | 650 psi | Ebend- yy | 1600 ksi |
| Fv | 265 psi | Eminbend - yy | 830 ksi |
| Ft | 1100 psi | Density | 32.21 pcf |




## Applied Loads

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

Uniform Load : D = 0.0150, S = 0.040 ksf, Tributary Width = 14.0 ft

## DESIGN SUMMARY

**Design N.G.**

| | | | | | |
|---|---|---|---|---|---|
| Maximum Bending Stress Ratio | = | 0.967: 1 | Maximum Shear Stress Ratio | = | 0.476 : 1 |
| Section used for this span | | 5.125x18 | Section used for this span | | 5.125x18 |
| fb : Actual | = | 2,207.75 psi | fv : Actual | = | 126.12 psi |
| FB : Allowable | = | 2,283.76 psi | Fv : Allowable | = | 265.00 psi |
| Load Combination | | +D+S+H | Load Combination | | +D+S+H |
| Location of maximum on span | = | 11.500 ft | Location of maximum on span | = | 0.000 ft |
| Span # where maximum occurs | = | Span # 1 | Span # where maximum occurs | = | Span # 1 |

Maximum Deflection

| | | | |
|---|---|---|---|
| Max Downward L+Lr+S Deflection | 0.791 in | Ratio = | 348 <360 |
| Max Upward L+Lr+S Deflection | 0.000 in | Ratio = | 0 <360 |
| Max Downward Total Deflection | 1.088 in | Ratio = | 253 |
| Max Upward Total Deflection | 0.000 in | Ratio = | 0 <180 |

## Maximum Forces & Stresses for Load Combinations

| Load Combination | | Max Stress Ratios | | | | | | | | | Moment Values | | | Shear Values | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Segment Length | Span # | M | V | $C_d$ | $C_{F/V}$ | $C_i$ | $C_r$ | $C_m$ | $C_t$ | $C_L$ | M | fb | F'b | V | fv | F'v |
| D Only | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.264 | 0.130 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 13.89 | 602.11 | 2283.76 | 2.12 | 34.40 | 265.00 |
| +D+L+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.264 | 0.130 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 13.89 | 602.11 | 2283.76 | 2.12 | 34.40 | 265.00 |
| +D+Lr+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.264 | 0.130 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 13.89 | 602.11 | 2283.76 | 2.12 | 34.40 | 265.00 |
| +D+S+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.967 | 0.476 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 50.92 | 2,207.75 | 2283.76 | 7.76 | 126.12 | 265.00 |
| +D+0.750Lr+0.750L+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.264 | 0.130 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 13.89 | 602.11 | 2283.76 | 2.12 | 34.40 | 265.00 |
| +D+0.750L+0.750S+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.791 | 0.389 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 41.66 | 1,806.34 | 2283.76 | 6.35 | 103.19 | 265.00 |

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ENERCALC, INC. 1983-2014, Build:6.14.1.28, Ver:6.14.7.31

# Wood Beam

Lic. # : KW-06004715 Licensee : OEIN ASSOCIATES

Description : ridge beam

| Load Combination / Segment Length | Span # | Max Stress Ratios M | V | $C_d$ | $C_{F/V}$ | $C_i$ | $C_r$ | $C_m$ | $C_t$ | $C_L$ | Moment Values M | fb | F'b | Shear Values V | fv | F'v |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| +D+W+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.264 | 0.130 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 13.89 | 602.11 | 2283.76 | 2.12 | 34.40 | 265.00 |
| +D+0.70E+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.264 | 0.130 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 13.89 | 602.11 | 2283.76 | 2.12 | 34.40 | 265.00 |
| +D+0.750Lr+0.750L+0.750W+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.264 | 0.130 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 13.89 | 602.11 | 2283.76 | 2.12 | 34.40 | 265.00 |
| +D+0.750L+0.750S+0.750W+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.791 | 0.389 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 41.66 | 1,806.34 | 2283.76 | 6.35 | 103.19 | 265.00 |
| +D+0.750Lr+0.750L+0.5250E+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.264 | 0.130 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 13.89 | 602.11 | 2283.76 | 2.12 | 34.40 | 265.00 |
| +D+0.750L+0.750S+0.5250E+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.791 | 0.389 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 41.66 | 1,806.34 | 2283.76 | 6.35 | 103.19 | 265.00 |
| +0.60D+W+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.158 | 0.078 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 8.33 | 361.27 | 2283.76 | 1.27 | 20.64 | 265.00 |
| +0.60D+0.70E+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.158 | 0.078 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 8.33 | 361.27 | 2283.76 | 1.27 | 20.64 | 265.00 |

## Overall Maximum Deflections - Unfactored Loads

| Load Combination | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|---|---|---|---|---|---|---|
| D+S | 1 | 1.0877 | 11.584 | | 0.0000 | 0.000 |

## Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

| Load Combination | Support 1 | Support 2 |
|---|---|---|
| Overall MAXimum | 8.855 | 8.855 |
| Overall MINimum | 2.415 | 2.415 |
| D Only | 2.415 | 2.415 |
| S Only | 6.440 | 6.440 |
| D+S | 8.855 | 8.855 |

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# Wood Beam

Lic. # : KW-06004715 Licensee : OEIN ASSOCIATES

Description : ridge beam ph 2

## CODE REFERENCES

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-05
Load Combination Set : ASCE 7-05

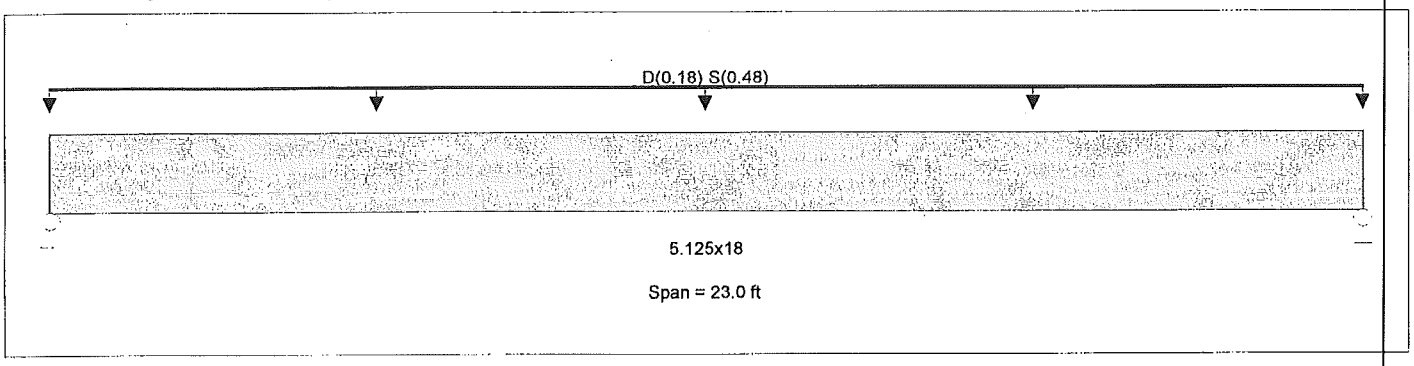
## Material Properties

Analysis Method : Allowable Stress Design
Load Combination ASCE 7-05

Wood Species : DF/DF
Wood Grade : 24F - V4

Beam Bracing : Beam is Fully Braced against lateral-torsion buckling

| | | | |
|---|---|---|---|
| Fb - Tension | 2,400.0 psi | *E : Modulus of Elasticity* | |
| Fb - Compr | 1,850.0 psi | Ebend- xx | 1,800.0 ksi |
| Fc - Prll | 1,650.0 psi | Eminbend - xx | 930.0 ksi |
| Fc - Perp | 650.0 psi | Ebend- yy | 1,600.0 ksi |
| Fv | 265.0 psi | Eminbend - yy | 830.0 ksi |
| Ft | 1,100.0 psi | Density | 32.210 pcf |




## Applied Loads

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

Uniform Load : D = 0.0150, S = 0.040 ksf, Tributary Width = 12.0 ft

## DESIGN SUMMARY

**Design OK**

| | | | | | |
|---|---|---|---|---|---|
| Maximum Bending Stress Ratio | = | 0.829 : 1 | Maximum Shear Stress Ratio | = | 0.408 : 1 |
| Section used for this span | | 5.125x18 | Section used for this span | | 5.125x18 |
| fb : Actual | = | 1,892.36 psi | fv : Actual | = | 108.10 psi |
| FB : Allowable | = | 2,283.76 psi | Fv : Allowable | = | 265.00 psi |
| Load Combination | | +D+S+H | Load Combination | | +D+S+H |
| Location of maximum on span | = | 11.500 ft | Location of maximum on span | = | 0.000 ft |
| Span # where maximum occurs | = | Span # 1 | Span # where maximum occurs | = | Span # 1 |

Maximum Deflection

| | | | |
|---|---|---|---|
| Max Downward L+Lr+S Deflection | 0.678 in | Ratio = | 407 |
| Max Upward L+Lr+S Deflection | 0.000 in | Ratio = | 0 <360 |
| Max Downward Total Deflection | 0.932 in | Ratio = | 296 |
| Max Upward Total Deflection | 0.000 in | Ratio = | 0 <180 |

## Maximum Forces & Stresses for Load Combinations

| Load Combination | | Max Stress Ratios | | | | | | | | | Moment Values | | | Shear Values | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Segment Length | Span # | M | V | $C_d$ | $C_{F/V}$ | $C_l$ | $C_r$ | $C_m$ | $C_t$ | $C_L$ | M | fb | F'b | V | fv | F'v |
| D Only | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.226 | 0.111 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 11.90 | 516.10 | 2283.76 | 1.81 | 29.48 | 265.00 |
| +D+L+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.226 | 0.111 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 11.90 | 516.10 | 2283.76 | 1.81 | 29.48 | 265.00 |
| +D+Lr+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.226 | 0.111 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 11.90 | 516.10 | 2283.76 | 1.81 | 29.48 | 265.00 |
| +D+S+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.829 | 0.408 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 43.64 | 1,892.36 | 2283.76 | 6.65 | 108.10 | 265.00 |
| +D+0.750Lr+0.750L+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.226 | 0.111 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 11.90 | 516.10 | 2283.76 | 1.81 | 29.48 | 265.00 |
| +D+0.750L+0.750S+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.678 | 0.334 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 35.71 | 1,548.29 | 2283.76 | 5.44 | 88.45 | 265.00 |

Title Block Line 1
You can change this area using the "Settings" menu item and then using the "Printing & Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project Descr:

Project ID:

Printed: 12 SEP 2014, 10:25AM
File = c:\Users\Ben\DOCUME~1\ENERCA~1\42754C~1.EC6
ENERCALC, INC. 1983-2014, Build:6.14.1.28, Ver:6.14.7.31

# Wood Beam

Lic. # : KW-06004715 Licensee : OEIN ASSOCIATES

Description : ridge beam ph 2

| Load Combination / Segment Length | Span # | Max Stress Ratios M | V | $C_d$ | $C_{F/V}$ | $C_i$ | $C_r$ | $C_m$ | $C_t$ | $C_L$ | Moment Values M | fb | F'b | Shear Values V | fv | F'v |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| +D+W+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.226 | 0.111 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 11.90 | 516.10 | 2283.76 | 1.81 | 29.48 | 265.00 |
| +D+0.70E+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.226 | 0.111 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 11.90 | 516.10 | 2283.76 | 1.81 | 29.48 | 265.00 |
| +D+0.750Lr+0.750L+0.750W+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.226 | 0.111 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 11.90 | 516.10 | 2283.76 | 1.81 | 29.48 | 265.00 |
| +D+0.750L+0.750S+0.750W+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.678 | 0.334 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 35.71 | 1,548.29 | 2283.76 | 5.44 | 88.45 | 265.00 |
| +D+0.750Lr+0.750L+0.5250E+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.226 | 0.111 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 11.90 | 516.10 | 2283.76 | 1.81 | 29.48 | 265.00 |
| +D+0.750L+0.750S+0.5250E+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.678 | 0.334 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 35.71 | 1,548.29 | 2283.76 | 5.44 | 88.45 | 265.00 |
| +0.60D+W+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.136 | 0.067 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 7.14 | 309.66 | 2283.76 | 1.09 | 17.69 | 265.00 |
| +0.60D+0.70E+H | | | | | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 23.0 ft | 1 | 0.136 | 0.067 | 1.00 | 0.952 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 7.14 | 309.66 | 2283.76 | 1.09 | 17.69 | 265.00 |

## Overall Maximum Deflections - Unfactored Loads

| Load Combination | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|---|---|---|---|---|---|---|
| D+S | 1 | 0.9323 | 11.584 | | 0.0000 | 0.000 |

## Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

| Load Combination | Support 1 | Support 2 |
|---|---|---|
| Overall MAXimum | 7.590 | 7.590 |
| Overall MINimum | 2.070 | 2.070 |
| D Only | 2.070 | 2.070 |
| S Only | 5.520 | 5.520 |
| D+S | 7.590 | 7.590 |

Title Block Line 1
You can change this area using the "Settings" menu item and then using the "Printing & Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project Descr:

Project ID:

Printed: 18 SEP 2014, 2:26PM
File = c:\Users\Ben\DOCUME~1\ENERCA~1\42754C~1.EC6
ENERCALC, INC. 1983-2014, Build:6.14.1.28, Ver:6.14.7.31

# Wood Beam

Lic. # : KW-06004715 Licensee : OEIN ASSOCIATES

Description : FLOOR BEAM PH 1

## CODE REFERENCES

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-05
Load Combination Set : ASCE 7-05

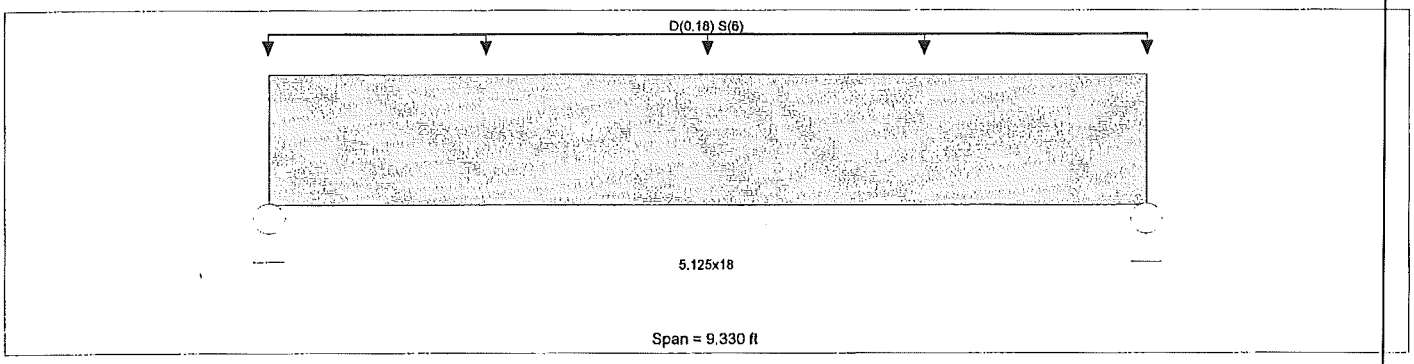
## Material Properties

Analysis Method : Load Resistance Factor D
Load Combination ASCE 7-05

Wood Species : DF/DF
Wood Grade : 24F - V4

Beam Bracing : Beam is Fully Braced against lateral-torsion buckling

| | | | |
|---|---|---|---|
| Fb - Tension | 2,400.0 psi | *E : Modulus of Elasticity* | |
| Fb - Compr | 1,850.0 psi | Ebend- xx | 1,800.0 ksi |
| Fc - Prll | 1,650.0 psi | Eminbend - xx | 930.0 ksi |
| Fc - Perp | 650.0 psi | Ebend- yy | 1,600.0 ksi |
| Fv | 265.0 psi | Eminbend - yy | 830.0 ksi |
| Ft | 1,100.0 psi | Density | 32.210 pcf |




## Applied Loads

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

Uniform Load : D = 0.0150, S = 0.50 ksf, Tributary Width = 12.0 ft

## DESIGN SUMMARY

**Design OK**

| | | | | | |
|---|---|---|---|---|---|
| Maximum Bending Stress Ratio | = | 0.893 : 1 | Maximum Shear Stress Ratio | = | 0.883 : 1 |
| Section used for this span | | 5.125x18 | Section used for this span | | 5.125x18 |
| fb : Actual | = | 4,631.28 psi | fv : Actual | = | 505.44 psi |
| FB : Allowable | = | 5,184.00 psi | Fv : Allowable | = | 572.40 psi |
| Load Combination | | +1.20D+0.50L+1.60S | Load Combination | | +1.20D+0.50L+1.60S |
| Location of maximum on span | = | 4.665 ft | Location of maximum on span | = | 7.832 ft |
| Span # where maximum occurs | = | Span # 1 | Span # where maximum occurs | = | Span # 1 |

Maximum Deflection

| | | | |
|---|---|---|---|
| Max Downward L+Lr+S Deflection | 0.230 in | Ratio = | 487 |
| Max Upward L+Lr+S Deflection | 0.000 in | Ratio = | 0 <360 |
| Max Downward Total Deflection | 0.236 in | Ratio = | 473 |
| Max Upward Total Deflection | 0.000 in | Ratio = | 0 <180 |

## Maximum Forces & Stresses for Load Combinations

| Load Combination | | Max Stress Ratios | | | | | | | | | Moment Values | | | Shear Values | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Segment Length | Span # | M | V | λ | $C_{F/V}$ | $C_i$ | $C_r$ | $C_m$ | $C_t$ | $C_L$ | Mu | fb | Fb | Vu | fv | Fv |
| +1.40D | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 9.330 ft | 1 | 0.023 | 0.023 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 2.74 | 118.90 | 5184.00 | 0.80 | 12.98 | 572.40 |
| +1.20D+0.50Lr+1.60L+1.60H | | | | | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 9.330 ft | 1 | 0.020 | 0.019 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 2.35 | 101.91 | 5184.00 | 0.68 | 11.12 | 572.40 |
| +1.20D+1.60L+0.50S+1.60H | | | | | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 9.330 ft | 1 | 0.293 | 0.289 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 34.99 | 1,517.34 | 5184.00 | 10.18 | 165.60 | 572.40 |
| +1.20D+1.60Lr+0.50L | | | | | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 9.330 ft | 1 | 0.020 | 0.019 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 2.35 | 101.91 | 5184.00 | 0.68 | 11.12 | 572.40 |
| +1.20D+1.60Lr+0.80W | | | | | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 9.330 ft | 1 | 0.020 | 0.019 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 2.35 | 101.91 | 5184.00 | 0.68 | 11.12 | 572.40 |
| +1.20D+0.50L+1.60S | | | | | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 9.330 ft | 1 | 0.893 | 0.883 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 106.81 | 4,631.28 | 5184.00 | 31.08 | 505.44 | 572.40 |

Title Block Line 1
You can change this area using the "Settings" menu item and then using the "Printing & Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project Descr:

Project ID:

Printed: 18 SEP 2014, 2:26PM

# Wood Beam

File = c:\Users\Ben\DOCUME~1\ENERCA~1\42754C~1.EC6
ENERCALC, INC. 1983-2014, Build:6.14.1.28, Ver:6.14.7.31

Lic. # : KW-06004715 Licensee : OEIN ASSOCIATES

Description : FLOOR BEAM PH 1

| Load Combination / Segment Length | Span # | Max Stress Ratios M | V | λ | $C_{F/V}$ | $C_i$ | $C_r$ | $C_m$ | $C_t$ | $C_L$ | Moment Values Mu | fb | Fb | Shear Values Vu | fv | Fv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| +1.20D+1.60S+0.80W | | | | | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 9.330 ft | 1 | 0.893 | 0.883 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 106.81 | 4,631.28 | 5184.00 | 31.08 | 505.44 | 572.40 |
| +1.20D+0.50Lr+0.50L+1.60W | | | | | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 9.330 ft | 1 | 0.020 | 0.019 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 2.35 | 101.91 | 5184.00 | 0.68 | 11.12 | 572.40 |
| +1.20D+0.50L+0.50S+1.60W | | | | | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 9.330 ft | 1 | 0.293 | 0.289 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 34.99 | 1,517.34 | 5184.00 | 10.18 | 165.60 | 572.40 |
| +1.20D+0.50L+0.20S+E | | | | | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 9.330 ft | 1 | 0.129 | 0.127 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 15.41 | 668.08 | 5184.00 | 4.48 | 72.91 | 572.40 |
| +0.90D+1.60W+1.60H | | | | | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 9.330 ft | 1 | 0.015 | 0.015 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.76 | 76.43 | 5184.00 | 0.51 | 8.34 | 572.40 |
| +0.90D+E+1.60H | | | | | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Length = 9.330 ft | 1 | 0.015 | 0.015 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.76 | 76.43 | 5184.00 | 0.51 | 8.34 | 572.40 |

## Overall Maximum Deflections - Unfactored Loads

| Load Combination | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|---|---|---|---|---|---|---|
| D+S | 1 | 0.2364 | 4.699 | | 0.0000 | 0.000 |

## Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

| Load Combination | Support 1 | Support 2 |
|---|---|---|
| Overall MAXimum | 28.830 | 28.830 |
| Overall MINimum | 0.840 | 0.840 |
| D Only | 0.840 | 0.840 |
| S Only | 27.990 | 27.990 |
| D+S | 28.830 | 28.830 |

Boise Cascade

# Single 14" BCI® 60-2.0 DF

**Joist\J01**

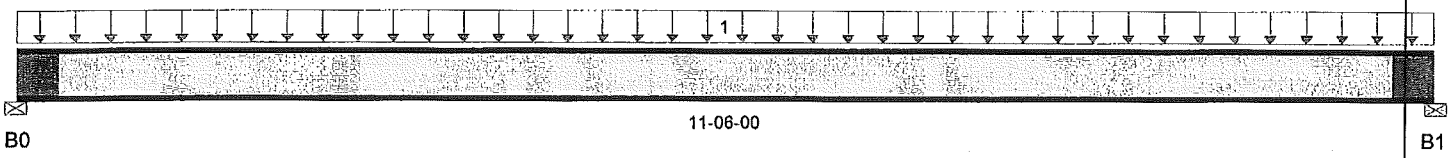
BC CALC® Design Report

Dry | 1 span | No cantilevers | 0/12 slope
16 OCS | Repetitive | Glued & nailed construction

Thursday, September 18, 2014

Build 3272
Job Name:
Address:
City, State, Zip: ,
Customer:
Code reports: ESR-1336

File Name: BC CALC Project
Description: Designs\J01
Specifier:
Designer:
Company:
Misc:




Total Horizontal Product Length = 11-06-00

## Reaction Summary (Down / Uplift) ( lbs )

| Bearing | Live | Dead | Snow | Wind | Roof Live |
|---|---|---|---|---|---|
| B0, 2-1/2" | 1,917 / 0 | 77 / 0 | | | |
| B1, 2-1/2" | 1,917 / 0 | 77 / 0 | | | |

## Load Summary

| Tag | Description | Load Type | Ref. | Start | End | Live 100% | Dead 90% | Snow 115% | Wind 160% | Roof Live 125% | OCS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Standard Load | Unf. Area (lb/ft^2) | L | 00-00-00 | 11-06-00 | 250 | 10 | | | | 16 |

## Controls Summary

| | Value | % Allowable | Duration | Case | Location |
|---|---|---|---|---|---|
| Pos. Moment | 5,444 ft-lbs | 73.2% | 100% | 1 | 05-09-00 |
| End Reaction | 1,993 lbs | 122.7% | 100% | 1 | 00-00-00 |
| End Shear | 1,921 lbs | 99.8% | 100% | 1 | 00-02-08 |
| Total Load Defl. | L/597 (0.225") | 40.2% | n/a | 1 | 05-09-00 |
| Live Load Defl. | L/621 (0.217") | 77.3% | n/a | 2 | 05-09-00 |
| Max Defl. | 0.225" | 22.5% | n/a | 1 | 05-09-00 |
| Vibration | 11' 1" | 51% | 100% | | 00-00-00 |
| Span / Depth | 9.6 | n/a | n/a | 0 | 00-00-00 |

## Bearing Supports

| | | Dim. (L x W) | Value | % Allow Support | % Allow Member | Material |
|---|---|---|---|---|---|---|
| B0 | Wall/Plate | 2-1/2" x 2-5/16" | 1,993 lbs | 53% | 122.7% | Glulam 24F-V4 |
| B1 | Wall/Plate | 2-1/2" x 2-5/16" | 1,993 lbs | 53% | 122.7% | Glulam 24F-V4 |

## Vibration Summary

Subfloor: 23/32" OSB, Glue + Nail
Gypsum Ceiling: 5/8"
Strapping: None
Bracing: None

## Cautions

Member has insufficient End Reaction resistance to carry loads.
Member has insufficient Bearing resistance to carry loads At B0.
Member has insufficient Bearing resistance to carry loads At B1.
Web stiffeners required at bearing B0.
Web stiffeners required at bearing B1.

## Notes

Build 3272
Job Name:
Address:
City, State, Zip: ,
Customer:
Code reports: ESR-1336

File Name: BC CALC Project
Description: Designs\J01
Specifier:
Designer:
Company:
Misc:

Design meets Code minimum (L/240) Total load deflection criteria.
Design meets User specified (L/480) Live load deflection criteria.
Design meets arbitrary (1") Maximum total load deflection criteria.
Minimum bearing length for B0 is 3-1/2".
Minimum bearing length for B1 is 3-1/2".
Calculations assume Member is Fully Braced.
Composite EI value based on 23/32" thick OSB sheathing glued and nailed to member .
Design based on Dry Service Condition.
Deflections less than 1/8" were ignored in the results.

## Disclosure

Completeness and accuracy of input must be verified by anyone who would rely on output as evidence of suitability for particular application. Output here based on building code-accepted design properties and analysis methods. Installation of BOISE engineered wood products must be in accordance with current Installation Guide and applicable building codes. To obtain Installation Guide or ask questions, please call (800)232-0788 before installation.\n\nBC CALC®, BC FRAMER® ,AJS™, ALLJOIST® , BC RIM BOARD™, BCI® , BOISE GLULAM™, SIMPLE FRAMING SYSTEM® , VERSA-LAM®, VERSA-RIM PLUS® , VERSA-RIM®, VERSA-STRAND®, VERSA-STUD® are trademarks of Boise Cascade Wood Products L.L.C.

CHEFORNAK WATER AND SEWER PROJECT

PUMP HOUSE 1 DESIGN

# MECHANICAL DESIGN CONSIDERATIONS

Chefornak Pump House #1 Preliminary Mechanical System Evaluation March 10, 2015

By: Frederick H Belz PE

Preliminary Floor Plans are for a 20 x 28 building with 8 foot high walls and a hot roof with a 4:12 pitch.

**Heat Loss Calculations** OAT of -45F IAT of +65 F 110 F TD

Heat loss calculations are 14,645 BTUH for the building shell with 3/4 air change infiltration factor.
An additional heat load for 75 CFM for breathing air of 8910 BTUH was added.
An additional heat load of 150 MBH was added for back up for the village water loop heating.
An additional heat load of 4 MBH was added for the well top heating and supply line to pumphouse
The total calculated load is 178 MBH.

**Heating System Selection**

Heat generation systems in Alaska include Geothermal, Wood Boilers, Natural Gas hydronic, Natural gas forced air, oil fired hydronic, electric resistance heat, water to air heat pumps, and air to air heat pumps.
For this application an oil fired hydronic system was chosen due to the high cost of local electricity, and the absence of moderate air temperatures or moderate or high ground water temperatures at the locality.

**Heating System Components**

Oil fired boilers, using 50/50 propylene glycol as a heat transfer fluid, were chosen for heat generation. Due to the high wind in the area plus cold temperatures medium efficiency boilers were chosen. The boilers will be fitted with a ducted combustion air system to the burners. This eliminates the need for a combustion air fan and controls, plus minimizes the heat loss due to an open combustion air system into the room. It is planned to use roof chimneys with high wind tops, and high wall intake combustion air intakes using long snouted hoods located near the building corners.

Weil McLain Ultra 87 % AFUE boilers were chosen fitted with ducted combustion air to the burner.

Circulation Pumps planned are variable speed high efficiency type.

**Ventilation System for the Building**

A ventilation system using a centrifugal inline fan will provide 75 CFM of outside air to the building during occupied periods. The air supply to the fan is equipped with a long snout hood and a motorized intake damper. The relief air from the building is equipped with a motorized damper and a long snout hood. An occupancy sensor and a timer will control the fan and damper motors. The air intake and exhaust hoods will be located near the corners of the building to minimize pressure problems.

CHEFORNAK WATER AND SEWER PROJECT

PUMP HOUSE 1 DESIGN

# WATER DISTRIBUTION LOOP CALCULATIONS

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| loop lngth | 10800 | ft | | | | | | | | | | | | | |
| Pipe size | 3 in SDR 11 HDPE | | | | | | | | | | | | | | |
| Pipe ID | 2.86 | "ID | | | | | | | | | | | | | |
| C factor | 140 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| GPM | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 |
| Sys head ft | 0 | 1.4 | 5.0 | 10.6 | 18.2 | 27.5 | 38.7 | 51.5 | 66.0 | 82.2 | 100.0 | 119.4 | 140.3 | 162.8 | 186.9 |
| Fluid velocity fps | 0 | 0.25 | 0.50 | 0.75 | 1.00 | 1.25 | 1.49 | 1.74 | 1.99 | 2.24 | 2.49 | 2.74 | 2.99 | 3.24 | 3.49 |

Loop Head Loss

Chefornak Water Distribution Loop –

Equivalent Length, 10,800 LF 3" SDR 11 HDPE PIPE, 2.86" ID

C-FACTOR 140

USE Hazen-Williams FORMULA TO DETERMINE SYSTEM HEAD LOSS AT VARIOUS FLOW RATES. THE ONES WE ARE INTERESTED IN WOULD BE BETWEEN 1' AND 2'/SEC, OR 20 TO 40 GPM

FORMULA: $\Delta H = 452 \frac{L}{100} \times \left( \frac{Q^{1.86}}{C^{1.86} \, ID^{4.86}} \right) \times 2.31$ ADAPTED FROM DRISCOPIPE MANUAL

L = Equivalent Length in Feet of Water

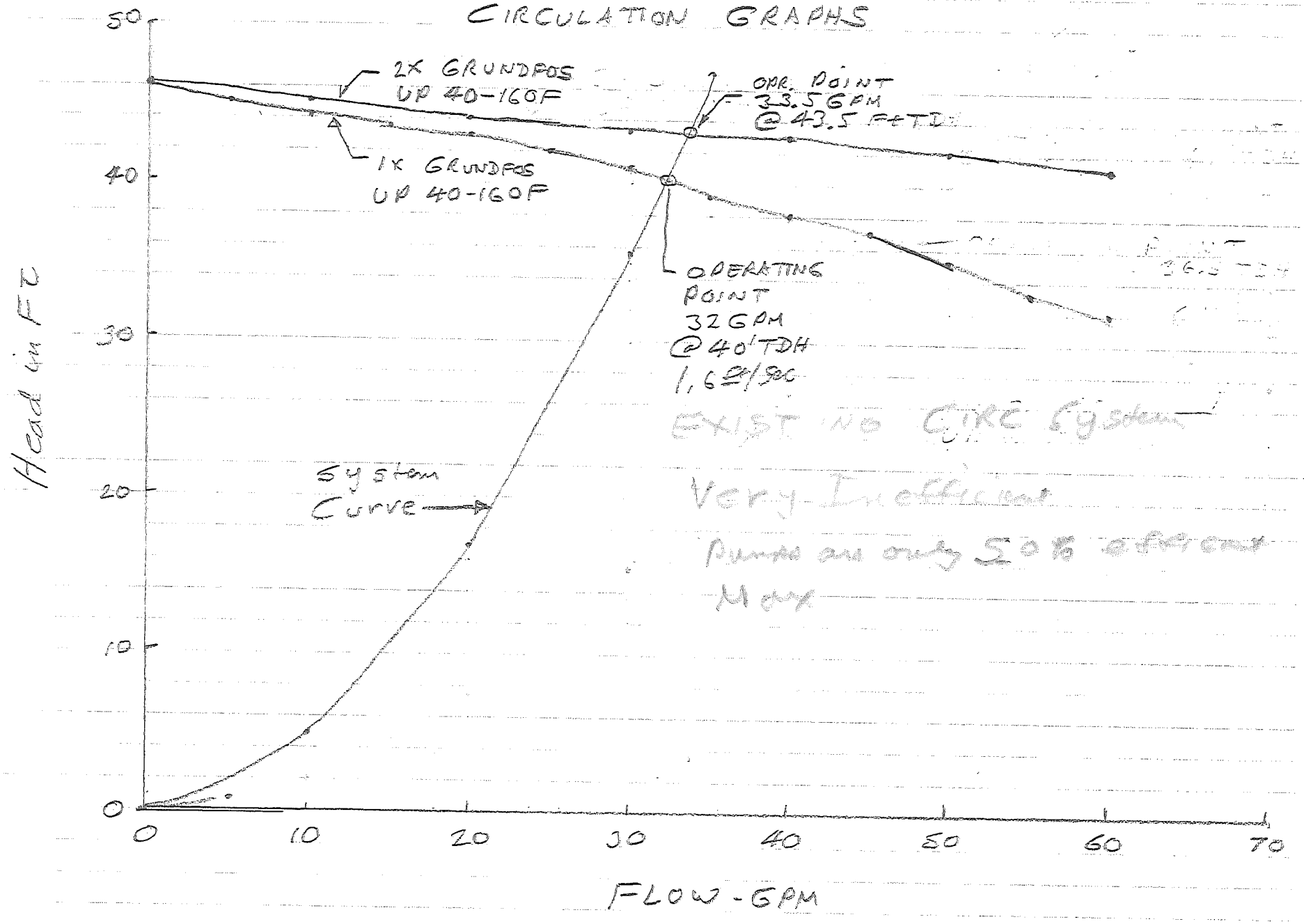
Q = GPM

C = C-Factor

ID = INSIDE DIA in INCHES

THE GOAL IS TO CIRCULATE WATER THROUGH THE DISTRIBUTION LOOP IN THE 8×15 ARCTIC PIPE AND ARCTIC BOXES AT THE MINIMUM FT/SEC TO KEEP THE LOOP RETURN TEMPERATURE FROM DROPPING TO LOW FROM 55°F OUT TO 40-45F

# CHEFORNAK WATER DIST. LOOP
## CIRCULATION GRAPHS




EXIST NO CIRC System

Very Inefficient

Pumps are only 50% efficient

May

PUMPS CP-1A or CP-1B WERE SIZED TO PROVIDE BETWEEN 1 FPS AND 2 FPS. or 20 to 40 GPM. THE PUMP SPEED WOULD VARY BETWEEN 30 HZ AND 60 HZ. A 1750 RPM MOTOR OPERATING AT 30 HZ ON THE PUMP WOULD USE ONLY 0.13 HP. AT 40 GPM (60 HZ) THE PUMP would use 1.0 HP. SE Detail 1, Sheet C4.1 FOR THE PUMP CURVE.

CP-1A or 1B would vary Speed on Loop Return Temperature Through the VFD CONTROL.

# WATER DISTRIBUTION LOOP HEAT LOSS

THE DUCT HOUSING THE LOOP IS 5000 FT LONG WITH 8x15 ARCTIC PIPE INSULATION IS FOAM WITH A K-FACTOR OF 0.02 BTU·FT/°F FOR 8x15 ARCTIC PIPE DUCT

$$q = \frac{2\pi K L (T_i - T_o)}{\ln\left(\frac{D_o}{D_i}\right)}$$

where K = BTU/ft/(ft² °F)
L = Length in Ft.
T = °F
$D_o$ = Outside dia in
$D_i$ = Inside dia in

$$q = \frac{2\pi\, 0.02 \times 5000 (50-(-50))}{\ln\left(\frac{15}{8.625}\right)} = 113{,}540 \text{ BTU/HR}$$

Add 25% For Junction Boxes = 28,385

Total Loss 141,930 BTU/HR

Pipe Line Losses are about 23 BTU/ft of ARCTIC PIPE

ASSUME A 15°F TEMP DROP OF WATER IN THE WORST CASE of -50F OUTSIDE AIR TEMP

The volume of Water Needed in an Hour to maintain the Loop Would Be

$$141{,}930 \text{ BTU/hr} = V_W \times \frac{8.34 \text{ BTU}}{\text{Gal}} \times 15°F\ \Delta T$$

$$V_W \text{ in gal} = \frac{141{,}930}{8.34 \times 15} = 1134 \text{ Gal/hr or } 20 \text{ GPM}$$

at Low temp we would look for a safe ΔT of 10°F

$$V_W = \frac{141{,}930}{8.34 \times 10} = 1702 \frac{\text{gal}}{\text{hr}} \text{ or } 28 \text{ gpm}$$

We Know that we are in the right ball park,
So we will set Loop outgoing Temp to be 55°F
AND RUN THE PUMPS TO MAINTAIN A RETURN
TEMPERATURE OF 45°F into the Loop Heat
Exchanger.

CHEFORNAK WATER AND SEWER PROJECT

PUMP HOUSE 1 DESIGN

# WATER SYSTEM DEMAND AND PRESSURIZATION CALCULATIONS

# WATER SYSTEM DEMAND AND PRESSURIZATION:

1. 2034 Water Consumption

| | | |
|---|---|---|
| WATERING POINTS | 1000 GPD | APPROX 25PCD |
| CLINIC | 1000 GPD | |
| School | 3000 GPD | |
| Washteria | 3000 GPD | |
| | 8000 GPD | |

2. Ave Flow Ave 5.6 GPM
   PEAK FLOW 5xAve 27.8 GPM

3. Water Storage 5000 GAL

4. Pump sizing @ 50 psi
   2 ea PUMPS @ 15 gpm ea constant Pressure w/VFDs.

   Pick 1750 RPM Multistage Pumps, 70% eff

5. Washteria will have its own 22,000 GAL TANK so peaks in water consumption will be will be isolated from well pump AND PUMP HOUSE 1.

6. Well Pump WP-1. Need 3" ϕ pump because of 4" well casing.

   Size Pump for 10 GPM @ 165' TDH. DRAWDOWN will be Much Less, so use speed Pot Control to throttle down speed to minimum to deliver about 9 GPM or Less to Prevent salt upconing in well. This will take some adjustments to optimize.