

Scan

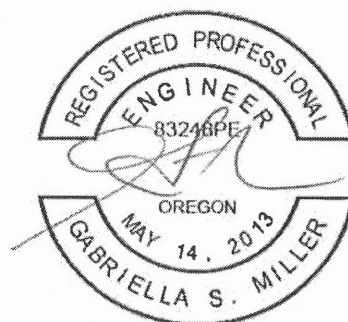
15-245987 DTS0100

Structural Calculations
for
Roof Fall Protection
HUB Apartments
3423 SE Hawthorne, Portland, Oregon
July 8, 2016

DESIGN CODE

2014 Oregon Structural Specialty Code

SUBMITTAL REVIEW	
☒ NO EXCEPTIONS TAKEN	☐ REVISE AND RESUBMIT
☐ MAKE CORRECTIONS NOTED	☐ SUBMIT SPECIFIED ITEM
CHECKING IS ONLY FOR GENERAL CONFORMANCE WITH THE DESIGN CONCEPT OF THE PROJECT AND GENERAL COMPLIANCE WITH THE INFORMATION IN THE CONTRACT DOCUMENTS. ANY ACTION SHOWN ABOVE, IS SUBJECT TO THE REQUIREMENTS OF THE PLANS AND SPECIFICATIONS. CONTRACTOR IS RESPONSIBLE FOR DIMENSIONS WHICH SHALL BE FABRICATED AND CORRELATED AT THE JOB SITE. FABRICATION PROCESSES AND TECHNIQUES OF CONSTRUCTION, COORDINATION OF THEIR WORK WITH THAT OF ALL OTHER TRADES, AND THE SATISFACTORY PERFORMANCE OF THEIR WORK.	
 HAYDEN ENGINEERS STRUCTURAL CIVIL	BY: CM DATE: 2/8/17 PHONE: (503) 968-9994 FAX: (503) 968-8444



EXPIRES: 12/31/2016

12/30/2018

SCOPE OF WORK

These calculations for roof tie off framing and stanchion

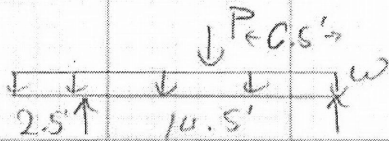


(503) 968-9994 p (503) 968-8444 f

	BY	JB	DATE	7.8.2016
	REV		DATE	
	JOB NO		16270	
	SHEET		OF	

ROOF FRAMING

NORTH - WEST RAFTERS

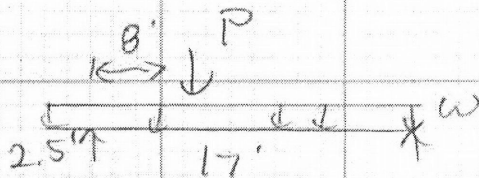


$$W = 1.33(150 + 250)$$

$$P = \frac{5000}{2} \left(\frac{1}{2} \right) \leftarrow \text{LOAD DURATION} = 1250 \text{ lb}$$

→ USE (2) $1\frac{3}{4}" \times 9\frac{1}{2}"$ LULS
@ EACH SIDE

SOUTH - WEST RAFTERS

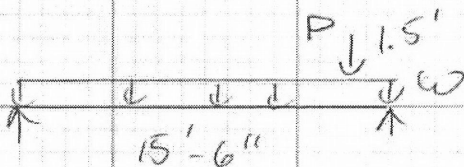


$$W = 1.33(100 + 250)$$

$$P = 1250 \text{ lb}$$

→ USE (2) $1\frac{3}{4}" \times 9\frac{1}{2}"$ LULS
@ EACH SIDE

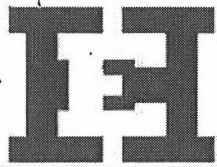
NORTH - EAST RAFTERS



$$P = 1250 \text{ lb}$$

$$W = 1.33(150 + 250)$$

USE (1) $1\frac{3}{4}" \times 9\frac{1}{2}"$ LULS
@ EACH SIDE



HAYDEN ENGINEERS

STRUCTURAL | CIVIL

Wood Beam

Lic. #: KW-06005543

Description: North West Rafters

File = Z:\projects\2016PR-1116270H-1116270H-1.EC6
ENERCALC, INC. 1983-2016, Build: 6.16.6.7, Ver: 6.16.6.30

Licensee: HAYDEN CONSULTING ENGINEERS

CODE REFERENCES

Calculations per NDS 2012, IBC 2012, CBC 2013, ASCE 7-10

Load Combination Set: ASCE 7-10

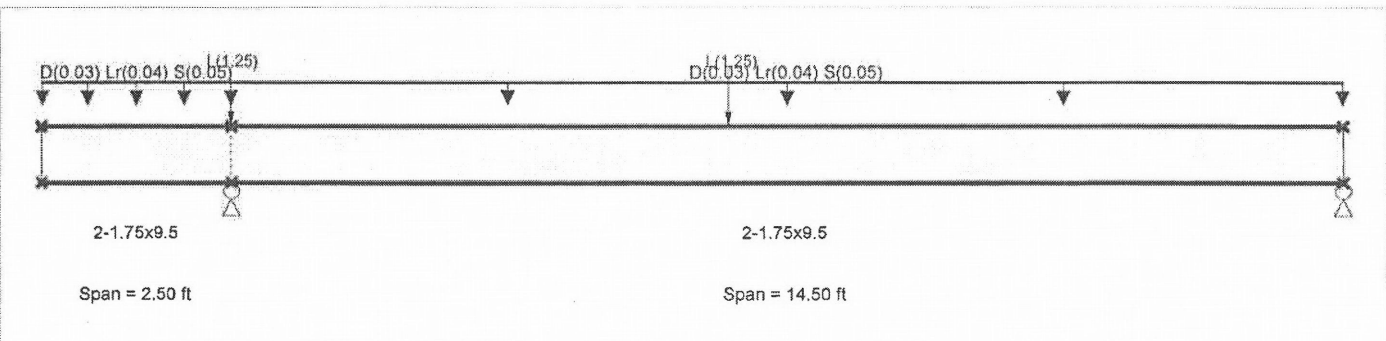
Material Properties

Analysis Method: Allowable Stress Design
Load Combination: ASCE 7-10

Wood Species: iLevel Truss Joist
Wood Grade: MicroLam LVL 1.9 E

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

Fb - Tension	2,600.0 psi	E : Modulus of Elasticity	
Fb - Compr	2,600.0 psi	Ebend-xx	1,900.0 ksi
Fc - Prll	2,510.0 psi	Eminbend-xx	965.71 ksi
Fc - Perp	750.0 psi		
Fv	285.0 psi		
Ft	1,555.0 psi	Density	42.0 pcf



Applied Loads

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

Beam self weight calculated and added to loads

Load for Span Number 1

Uniform Load: D = 0.0150, Lr = 0.020, S = 0.0250 ksf, Tributary Width = 2.0 ft

Point Load: L = 1.250 k @ 2.50 ft

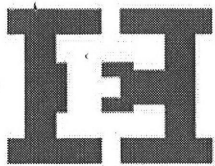
Load for Span Number 2

Uniform Load: D = 0.0150, Lr = 0.020, S = 0.0250 ksf, Tributary Width = 2.0 ft

Point Load: L = 1.250 k @ 6.50 ft

DESIGN SUMMARY

				Design OK			
Maximum Bending Stress Ratio	=	0.476	1	Maximum Shear Stress Ratio	=	0.151	1
Section used for this span	=	2-1.75x9.5		Section used for this span	=	2-1.75x9.5	
fb : Actual	=	1,238.21 psi		fv : Actual	=	43.18 psi	
FB : Allowable	=	2,600.00 psi		Fv : Allowable	=	285.00 psi	
Load Combination	=	+D+L+H		Load Combination	=	+D+L+H	
Location of maximum on span	=	6.480 ft		Location of maximum on span	=	2.500 ft	
Span # where maximum occurs	=	Span # 2		Span # where maximum occurs	=	Span # 1	
Maximum Deflection							
Max Downward Transient Deflection		0.287 in	Ratio = 605 >= 360				
Max Upward Transient Deflection		-0.153 in	Ratio = 392 >= 360				
Max Downward Total Deflection		0.367 in	Ratio = 474 >= 240				
Max Upward Total Deflection		-0.193 in	Ratio = 310 >= 240				



HAYDEN ENGINEERS

STRUCTURAL | CIVIL

Wood Beam

Lic. #: KW-06005543

Description: South West Rafters

File = Z:\projects\2016PR-1\16270H-1\16270H-1.EC6
ENERCALC, INC. 1983-2016, Build: 6.16.6.7, Ver: 6.16.6.30

Licensee: HAYDEN CONSULTING ENGINEERS

CODE REFERENCES

Calculations per NDS 2012, IBC 2012, CBC 2013, ASCE 7-10

Load Combination Set: ASCE 7-10

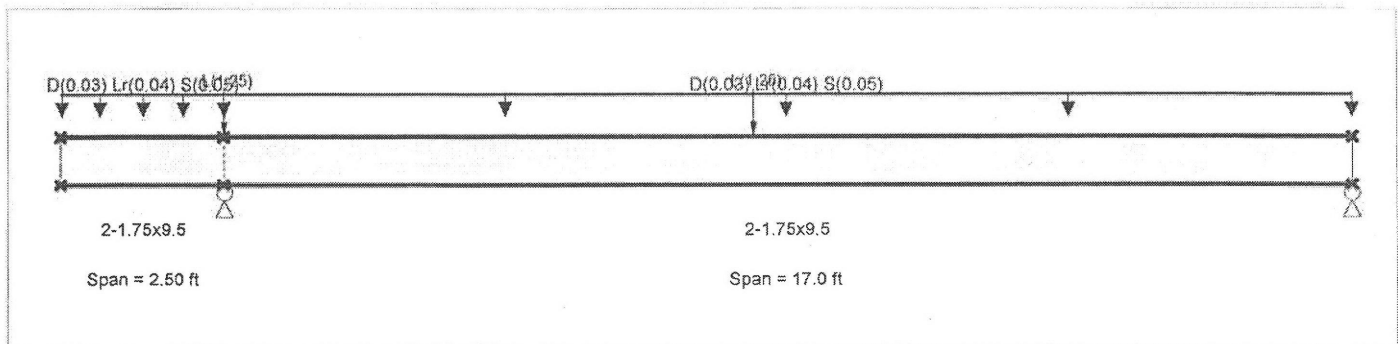
Material Properties

Analysis Method: Allowable Stress Design
Load Combination ASCE 7-10

Wood Species: Trus Joist
Wood Grade: MicroLam LVL 1.9 E

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

Fb - Tension	2600 psi	E : Modulus of Elasticity	
Fb - Compr	2600 psi	Ebend-xx	1900 ksi
Fc - Prll	2510 psi	Eminbend-xx	965.71 ksi
Fc - Perp	750 psi		
Fv	285 psi		
Ft	1555 psi	Density	42 pcf



Applied Loads

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

Beam self weight calculated and added to loads

Load for Span Number 1

Uniform Load: D = 0.0150, Lr = 0.020, S = 0.0250 ksf, Tributary Width = 2.0 ft

Point Load: L = 1.250 k @ 2.50 ft

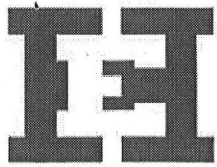
Load for Span Number 2

Uniform Load: D = 0.0150, Lr = 0.020, S = 0.0250 ksf, Tributary Width = 2.0 ft

Point Load: L = 1.250 k @ 8.0 ft

DESIGN SUMMARY

Maximum Bending Stress Ratio	=	0.582	1	Maximum Shear Stress Ratio	=	0.155	: 1
Section used for this span	=	2-1.75x9.5		Section used for this span	=	2-1.75x9.5	
fb : Actual	=	1,514.00 psi		fv : Actual	=	44.05 psi	
FB : Allowable	=	2,600.00 psi		Fv : Allowable	=	285.00 psi	
Load Combination	=	+D+L+H		Load Combination	=	+D+L+H	
Location of maximum on span	=	7.978 ft		Location of maximum on span	=	2.500 ft	
Span # where maximum occurs	=	Span # 2		Span # where maximum occurs	=	Span # 1	
Maximum Deflection							
Max Downward Transient Deflection		0.467 in	Ratio =	436	>=	240.	
Max Upward Transient Deflection		-0.209 in	Ratio =	286	>=	240.	
Max Downward Total Deflection		0.642 in	Ratio =	317	>=	180.	
Max Upward Total Deflection		-0.286 in	Ratio =	208	>=	180.	



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Wood Beam

Lic. #: KW-06005543

Description: North-East

File = Z:\projects\2016PR-1\16270H-1\16270H-1.EC6
ENERCALC, INC. 1983-2016, Build: 6.16.6.7, Ver: 6.16.6.30

Licensee: HAYDEN CONSULTING ENGINEERS

CODE REFERENCES

Calculations per NDS 2012, IBC 2012, CBC 2013, ASCE 7-10

Load Combination Set: ASCE 7-10

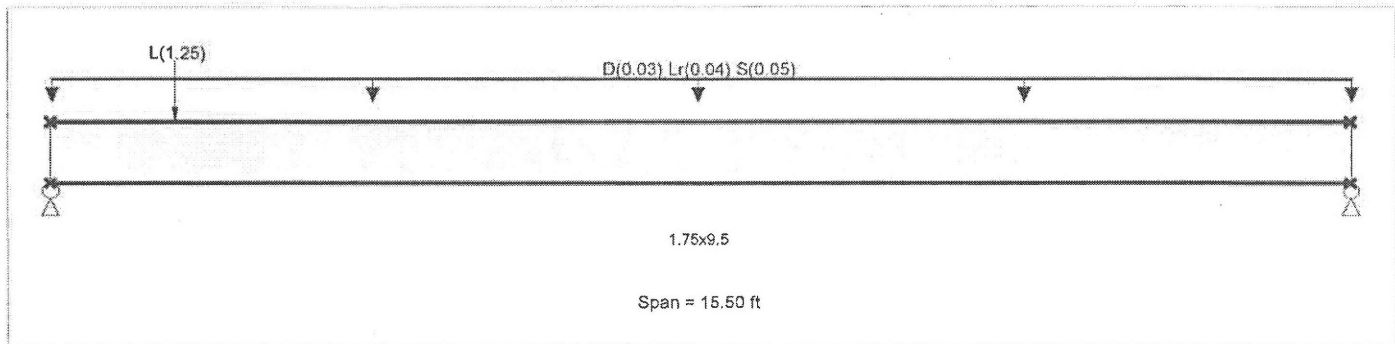
Material Properties

Analysis Method: Allowable Stress Design
Load Combination ASCE 7-10

Wood Species: Trus Joist
Wood Grade: MicroLam LVL 1.9 E

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

Fb - Tension	2,600.0 psi	E: Modulus of Elasticity	
Fb - Compr	2,600.0 psi	Ebend-xx	1,900.0 ksi
Fc - Prll	2,510.0 psi	Eminbend-xx	965.71 ksi
Fc - Perp	750.0 psi		
Fv	285.0 psi		
Ft	1,555.0 psi	Density	42.0 pcf



Applied Loads

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

Beam self weight calculated and added to loads

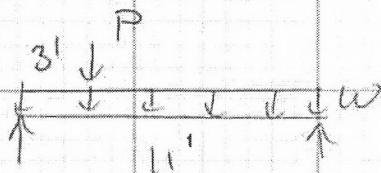
Uniform Load: D = 0.0150, Lr = 0.020, S = 0.0250 ksf, Tributary Width = 2.0 ft

Point Load: L = 1.250 k @ 1.50 ft

DESIGN SUMMARY

				Design OK			
Maximum Bending Stress Ratio	=	0.447	1	Maximum Shear Stress Ratio	=	0.435	1
Section used for this span	=	1.75x9.5		Section used for this span	=	1.75x9.5	
fb: Actual	=	1,336.97 psi		fv: Actual	=	123.92 psi	
FB: Allowable	=	2,990.00 psi		Fv: Allowable	=	285.00 psi	
Load Combination	=	+D+0.750L+0.750S+H		Load Combination	=	+D+L+H	
Location of maximum on span	=	6.505 ft		Location of maximum on span	=	0.000 ft	
Span # where maximum occurs	=	Span # 1		Span # where maximum occurs	=	Span # 1	
Maximum Deflection							
Max Downward Transient Deflection		0.275 in	Ratio = 676 >= 240.				
Max Upward Transient Deflection		0.000 in	Ratio = 0 < 240.0				
Max Downward Total Deflection		0.552 in	Ratio = 337 >= 180.				
Max Upward Total Deflection		0.000 in	Ratio = 0 < 180.0				

SOUTH-EAST

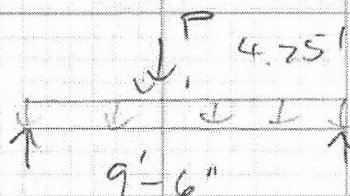


$$W = 1.33 (190 + 255)$$

$$P = 1250 \text{ L}$$

→ USE (1) $1\frac{3}{4}" \times 9\frac{1}{2}"$ LVL

BEAM @ GRID 1.75 AND 2.5

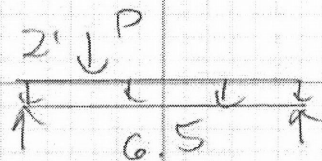


$$W = \frac{28}{2} (15 + 255)$$

$$P = 2500 \text{ LB}$$

USE $5\frac{1}{2}" \times 12"$ GL BEAM

BEAM @ SOUTH GRID 2.75



$$W = \frac{25}{2} (150 + 255)$$

$$P = 2500 \text{ LB}$$

USE (2) $1\frac{3}{4}" \times 9\frac{1}{2}"$ LVLs

Wood Beam

Lic. #: KW-06005543

Description: south-east

File = Z:\projects\2016PR-116270H-116270H-1.EC6
ENERCALC, INC. 1983-2016, Build: 5.16.6.7, Ver: 6.16.6.30

Licensee: HAYDEN CONSULTING ENGINEERS

CODE REFERENCES

Calculations per NDS 2012, IBC 2012, CBC 2013, ASCE 7-10

Load Combination Set: ASCE 7-10

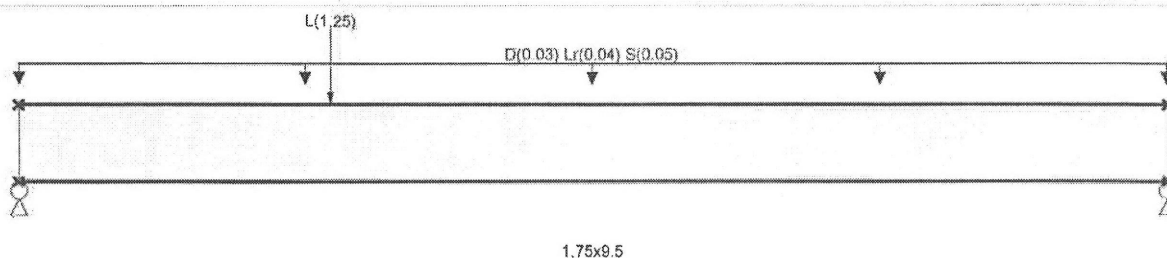
Material Properties

Analysis Method: Allowable Stress Design
Load Combination ASCE 7-10

Wood Species: Trus Joist
Wood Grade: MicroLam LVL 1.9 E

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

Fb - Tension	2,600.0 psi	E: Modulus of Elasticity	
Fb - Compr	2,600.0 psi	Ebend-xx	1,900.0 ksi
Fc - Prll	2,510.0 psi	Eminbend-xx	965.71 ksi
Fc - Perp	750.0 psi		
Fv	285.0 psi		
Ft	1,555.0 psi	Density	42.0 pcf



Span = 11.0 ft

Applied Loads

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

Beam self weight calculated and added to loads

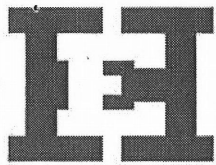
Uniform Load: D = 0.0150, Lr = 0.020, S = 0.0250 ksf, Tributary Width = 2.0 ft

Point Load: L = 1.250 k @ 3.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.551: 1	Maximum Shear Stress Ratio	=	0.340: 1
Section used for this span		1.75x9.5	Section used for this span		1.75x9.5
fb: Actual	=	1,432.67 psi	fv: Actual	=	96.92 psi
FB: Allowable	=	2,600.00 psi	Fv: Allowable	=	285.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	3.011 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection		0.190 in	Ratio =		695 >= 240.
Max Upward Transient Deflection		0.000 in	Ratio =		0 < 240.0
Max Downward Total Deflection		0.242 in	Ratio =		544 >= 180.
Max Upward Total Deflection		0.000 in	Ratio =		0 < 180.0



HAYDEN ENGINEERS

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Wood Beam

Lic. #: KW-06005543

Description: Beam @ grid 1.75

File = Z:\projects\2016PR-1116270H-1116270H-1.EC8
ENERCALC, INC. 1983-2016, Build:6.16.6.7, Ver:6.16.6.30

Licensee: HAYDEN CONSULTING ENGINEERS

CODE REFERENCES

Calculations per NDS 2012, IBC 2012, CBC 2013, ASCE 7-10

Load Combination Set: ASCE 7-10

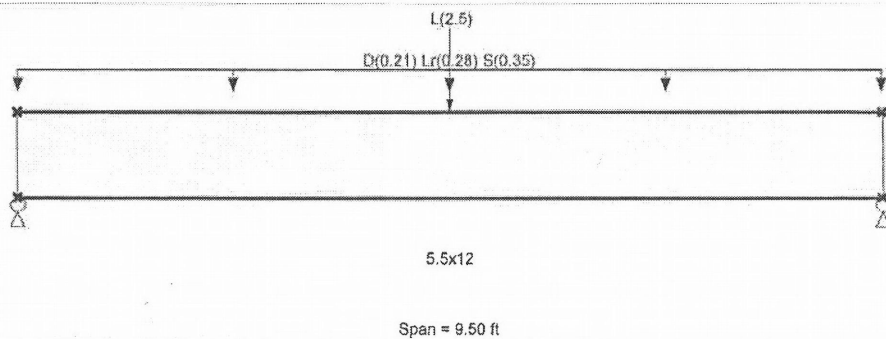
Material Properties

Analysis Method: Allowable Stress Design
Load Combination ASCE 7-10

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

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

Fb - Tension	2400 psi	E: Modulus of Elasticity	
Fb - Compr	1850 psi	Ebend-xx	1800 ksi
Fc - Prll	1650 psi	Eminbend-xx	950 ksi
Fc - Perp	650 psi	Ebend-yy	1600 ksi
Fv	265 psi	Eminbend-yy	850 ksi
Ft	1100 psi	Density	31.2 pcf



Applied Loads

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

Beam self weight calculated and added to loads

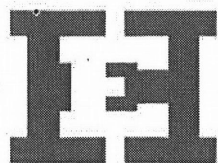
Uniform Load: D = 0.0150, Lr = 0.020, S = 0.0250 ksf, Tributary Width = 14.0 ft

Point Load: L = 2.50 k @ 4.750 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.328	1	Maximum Shear Stress Ratio	=	0.207	: 1
Section used for this span		5.5x12		Section used for this span		5.5x12	
fb: Actual	=	904.08	psi	fv: Actual	=	63.12	psi
FB: Allowable	=	2,760.00	psi	Fv: Allowable	=	304.75	psi
Load Combination	=	+D+0.750L+0.750S+H		Load Combination	=	+D+0.750L+0.750S+H	
Location of maximum on span	=	4.750	ft	Location of maximum on span	=	8.529	ft
Span # where maximum occurs	=	Span # 1		Span # where maximum occurs	=	Span # 1	
Maximum Deflection							
Max Downward Transient Deflection		0.054	in	Ratio =	2094	>=240.	
Max Upward Transient Deflection		0.000	in	Ratio =	0	<240.0	
Max Downward Total Deflection		0.104	in	Ratio =	1098	>=180.	
Max Upward Total Deflection		0.000	in	Ratio =	0	<180.0	



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STRUCTURAL | CIVIL

Wood Beam

Lic. #: KW-06005543

Description: Beam @ south 2.75

File = Z:\projects\2016PR-1\16270H-1\16270H-1.E06
ENERCALC, INC. 1983-2016, Build: 6.16.6.7, Ver: 6.16.6.30

Licensee: HAYDEN CONSULTING ENGINEERS

CODE REFERENCES

Calculations per NDS 2012, IBC 2012, CBC 2013, ASCE 7-10

Load Combination Set: ASCE 7-10

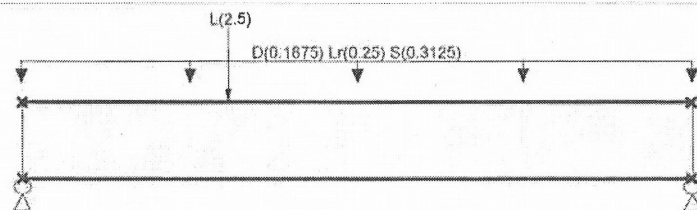
Material Properties

Analysis Method: Allowable Stress Design
Load Combination: ASCE 7-10

Wood Species: Trus Joist
Wood Grade: MicroLam LVL 1.9 E

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

Fb - Tension	2600 psi	E : Modulus of Elasticity	
Fb - Compr	2600 psi	Ebend-xx	1900 ksi
Fc - Prll	2510 psi	Eminbend-xx	965.71 ksi
Fc - Perp	750 psi		
Fv	285 psi		
Ft	1555 psi	Density	42 pcf



2-1.75x9.5

Span = 6.50 ft

Applied Loads

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

Beam self weight calculated and added to loads

Uniform Load: D = 0.0150, Lr = 0.020, S = 0.0250 ksf, Tributary Width = 12.50 ft

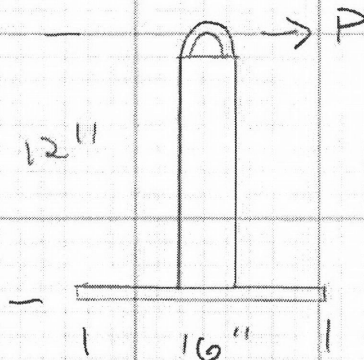
Point Load: L = 2.50 k @ 2.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.381 : 1	Maximum Shear Stress Ratio	=	0.351 : 1
Section used for this span	=	2-1.75x9.5	Section used for this span	=	2-1.75x9.5
fb : Actual	=	989.32 psi	fv : Actual	=	100.03 psi
FB : Allowable	=	2,600.00 psi	Fv : Allowable	=	285.00 psi
Load Combination	=	+D+L+H	Load Combination	=	+D+L+H
Location of maximum on span	=	2.016 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection		0.043 in Ratio =	1825 >= 240.		
Max Upward Transient Deflection		0.000 in Ratio =	0 < 240.0		
Max Downward Total Deflection		0.069 in Ratio =	1137 >= 180.		
Max Upward Total Deflection		0.000 in Ratio =	0 < 180.0		

GUARDIAN FALL PROTECTION S-SERIES (B-12)



$$P_0 = 5000 \text{ lb}$$

TOP HOOP

$$\text{DIA} = 1.625''$$

$$\text{AREA} = .307 \text{ in}^2$$

$$V = f_0 = \frac{P}{A} = 16306 \text{ psi}$$

$$F_y = 36 \text{ ksi}$$

$$F_u = .6(36) = 21.6 \text{ ksi}$$

$$21.6 > 16.3$$

LOOP OKAY



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HUB - ROOF TIE OFF

BY JB DATE 7/8/16

REV _____ DATE _____

JOB NO 10270

SHEET 9 OF _____

TOP LOOP WELD

$$t_w = .177 \text{ IN}$$

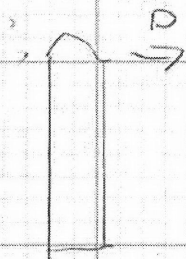
$$A_w = .445 \text{ IN}^2$$

$$P/A = 11235 \text{ PSI}$$

$$F_w = .6(70) = 42 \text{ KSI}$$

$$42 > 11.2 \rightarrow \text{OKAY}$$

STANCHION

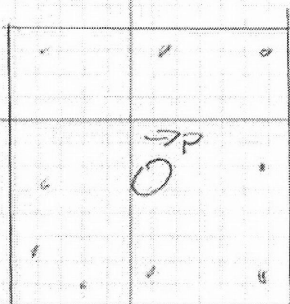


$$P = 5000 \text{ LB}$$

SEE CALL NEXT PAGE

3/2 STD PIPE OKAY

PLATE TO ROOF



BASED ON GAUGING LAYOUT

$$\text{SCREW GROUP } Z_x = 300 \text{ IN}$$

$$M = 5000(12) = 61250 \text{ IN-LB}$$

$$T_{\text{SCREW}} = \frac{61250}{300} = 204 \text{ LB}$$

$$T_{\text{PRY}} = 150 \text{ LB}$$

$$T_{\text{TOTAL}} = 354 \text{ LB}$$

PLATE COND. CONT.

$T_u = 580 \text{ lb}$ (#12 screw w/ 2" embed)

$580 \text{ lb} > 354 \text{ lb}$

→ USE (40) #12 x 3" SCREWS



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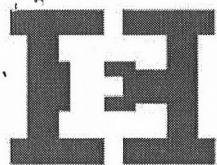
HOB ROOF TIE OFF

BY JB DATE 7/8/16

REV DATE

JOB NO 16270

SHEET 11 OF



HAYDEN ENGINEERS

STRUCTURAL | CIVIL

Steel Column

Lic. #: KW-06005543

Description: Stanchion Pipe

File = z:\projects\2016PR-1\16082S-1\16082S-1.EC6
ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Licensee: HAYDEN CONSULTING ENGINEERS

Code References

Calculations per AISC 360-10, IBC 2012, CBC 2013, ASCE 7-10

Load Combinations Used: ASCE 7-10

General Information

Steel Section Name: **Pipe3xS**
Analysis Method: Allowable Strength
Steel Stress Grade
Fy: Steel Yield 36.0 ksi
E: Elastic Bending Modulus 29,000.0 ksi

Overall Column Height 1.0 ft
Top & Bottom Fixity Top Free, Bottom Fixed
Brace condition for deflection (buckling) along columns:
X-X (width) axis:
Unbraced Length for X-X Axis buckling = 1.0 ft, K = 2.1
Y-Y (depth) axis:
Unbraced Length for Y-Y Axis buckling = 1.0 ft, K = 2.1

Applied Loads

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

Column self weight included: 10.30 lbs * Dead Load Factor

BENDING LOADS ...

Lat. Point Load at 1.0 ft creating Mx-x, L = 5.0 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio =
Load Combination

0.9566 : 1
+D+L+H

Location of max.above base

0.0 ft

At maximum location values are ...

Pa: Axial

0.01030 k

Pn / Omega: Allowable

59.457 k

Ma-x: Applied

-5.0 k-ft

Mn-x / Omega: Allowable

5.228 k-ft

Ma-y: Applied

0.0 k-ft

Mn-y / Omega: Allowable

5.228 k-ft

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 5.0 k

Maximum SERVICE Load Deflections ...

Along Y-Y 0.02671 in at 1.0ft above base
for load combination: +D+L+H

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

PASS Maximum Shear Stress Ratio =

0.2732 : 1

Load Combination

+D+L+H

Location of max.above base

0.0 ft

At maximum location values are ...

Va: Applied

5.0 k

Vn / Omega: Allowable

18.302 k

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