



SFA Design Group, LLC

STRUCTURAL | GEOTECHNICAL | SPECIAL INSPECTIONS
PORTLAND, OR | LIVERMORE, CA | SEATTLE, WA
503.641.8311 | www.sfadg.com

STRUCTURAL CALCULATIONS

Do Residence Deck Design

7805 SE 70th St, Mercer Island, WA 98040



EXPIRES: 12/24/22

LIMITATIONS

ENGINEER WAS RETAINED IN A LIMITED CAPACITY FOR THIS PROJECT. DESIGN IS BASED UPON INFORMATION PROVIDED BY THE CLIENT WHO IS SOLELY RESPONSIBLE FOR ACCURACY OF SAME. NO RESPONSIBILITY AND/OR LIABILITY IS ASSUMED BY, OR IS TO BE ASSIGNED TO THE ENGINEER FOR ITEMS BEYOND THAT SHOWN ON THESE SHEETS.

Project No. MFR21-047
October 26, 2021



| | |
|-------------------------------------|-----------|
| PROJECT NO. MFR21-047 | SHEET NO. |
| PROJECT Do Residence Deck Design | |
| DATE 10/26/2021 | |
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| BY KEM/JAM | |

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| | |
|--------------------------|-----------|
| PROJECT NO. MFR21-047 | SHEET NO. |
|--------------------------|-----------|

| | |
|--|--------------------|
| PROJECT Do Residence Deck Design | DATE 10/26/2021 |
| SUBJECT Push Pier Design Requirements | BY KEM/JAM |

Structural Narrative

The structural calculations and drawings enclosed are in reference to the design of the deck extension of the 2-story residence located in Mercer Island, WA as referenced on the coversheet.

General

| | |
|---|-----------------------|
| Building Department | City of Mercer Island |
| Building Code Conformance (Meets Or Exceeds Requirements) | |
| 2018 International Building Code (IBC) | |
| 2018 International Residential Code (IRC) | |

Dead Loads

| | |
|---------------------|----------|
| Roof Dead Load | 15.0 psf |
| Floor Dead Load | 11.0 psf |
| Wood Wall Dead Load | 12.0 psf |
| Deck Dead Load | 7.5 psf |

Live Loads

| | |
|-------------------------------|----------|
| Roof Snow Load | 25.0 psf |
| Deck Live Load | 60.0 psf |
| Floor Live Load (Residential) | 40.0 psf |

Soil Parameters

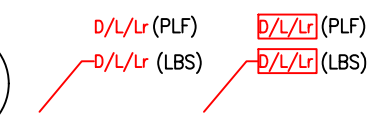
| | |
|---|---|
| Reference Standards | Conform to IBC Chapter 18 "Soils & Foundations". |
| Allowable Foundation Pressure (Assumed) | 1500 psf |
| Lateral Passive Pressure | 150 psf/ft |
| Coefficient of Sliding Friction | 0.30 |
| Footing Depth | Exterior perimeter footings shall bear not less than 18 inches below finish grade, or by the geotechnical engineer and the building official. |

Deflections

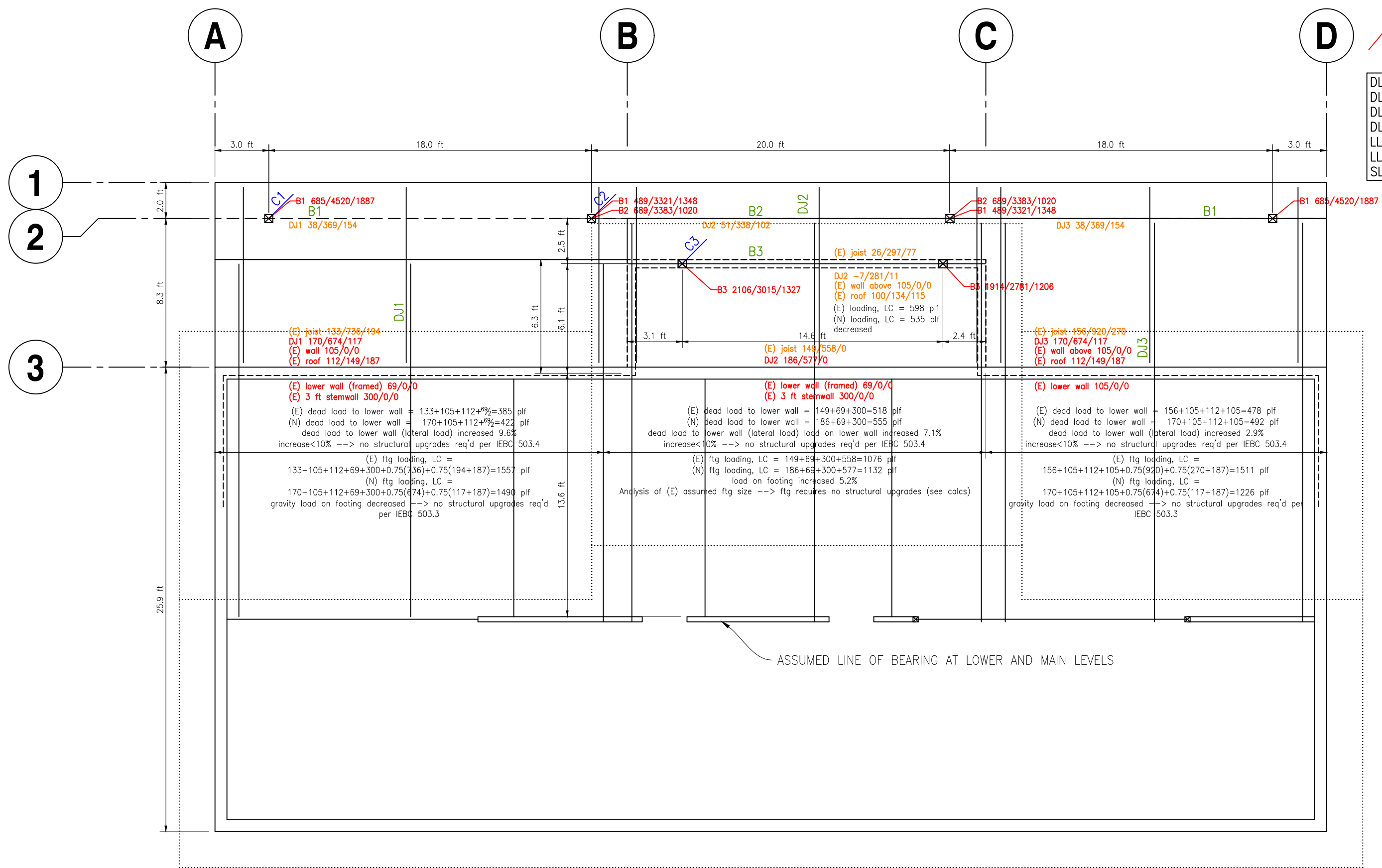
| | |
|-----------------------------|-------|
| Total Load Deflection Limit | L/240 |
| Live Load Deflection Limit | L/360 |

DO RESIDENCE DECK REMODEL
GRAVITY & DOWN LOADING
3/16" = 1'-0"

GRAVITY LOADS THIS LEVEL (BOXED LOADS ARE SUMMED LOADS):



| |
|-------------------|
| DL deck = 7.5 PSF |
| DL floor = 11 PSF |
| DL roof = 15 PSF |
| DL wall = 12 PSF |
| LL deck = 60 PSF |
| LL floor = 40 PSF |
| SL = 25 PSF |



ASSUMED LINE OF BEARING AT LOWER AND MAIN LEVELS

General Beam Analysis

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

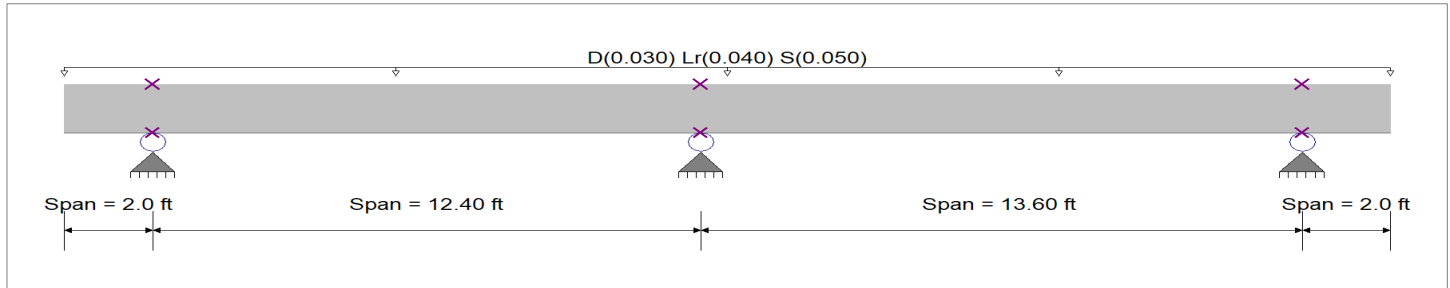
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DESCRIPTION: (E) roof at DJ1 & DJ3 calc to find reactions only

General Beam Properties

| | | | | | |
|-----------------|---------------|----------|--------|----------------------|---|
| Elastic Modulus | 29,000.0 ksi | | | | |
| Span #1 | Span Length = | 2.0 ft | Area = | 10.0 in ² | Moment of Inertia = 100.0 in ⁴ |
| Span #2 | Span Length = | 12.40 ft | Area = | 10.0 in ² | Moment of Inertia = 100.0 in ⁴ |
| Span #3 | Span Length = | 13.60 ft | Area = | 10.0 in ² | Moment of Inertia = 100.0 in ⁴ |
| Span #4 | Span Length = | 2.0 ft | Area = | 10.0 in ² | Moment of Inertia = 100.0 in ⁴ |



Applied Loads

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

Loads on all spans...

Uniform Load on ALL spans : D = 0.0150, Lr = 0.020, S = 0.0250 k/ft, Tributary Width = 2.0 ft

DESIGN SUMMARY

| | | | |
|-----------------------------------|------------|-----------------------------|-----------|
| Maximum Bending = | 1.621 k-ft | Maximum Shear = | 0.6514 k |
| Load Combination | +D+S | Load Combination | +D+S |
| Span # where maximum occurs | Span # 2 | Span # where maximum occurs | Span # 2 |
| Location of maximum on span | 12.400 ft | Location of maximum on span | 12.400 ft |
| Maximum Deflection | | | |
| Max Downward Transient Deflection | 0.000 in | | 0 |
| Max Upward Transient Deflection | 0.000 in | | 0 |
| Max Downward Total Deflection | 0.000 in | | 0 |
| Max Upward Total Deflection | 0.000 in | | 0 |

Overall Maximum Deflections

| Load Combination | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|------------------|------|---------------|------------------|------------------|---------------|------------------|
| | 1 | 0.0000 | 0.000 | | 0.0000 | 0.000 |
| | 2 | 0.0000 | 0.000 | | 0.0000 | 0.000 |
| | 3 | 0.0000 | 0.000 | | 0.0000 | 0.000 |
| | 4 | 0.0000 | 0.000 | | 0.0000 | 0.000 |

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 | Support 3 | Support 4 | Support 5 |
|------------------|-----------|-----------|-----------|-----------|-----------|
| Overall MAXimum | | 0.336 | 0.791 | 0.373 | |
| Overall MINimum | | | | | |
| D Only | | 0.202 | 0.474 | 0.224 | |
| Lr Only | | 0.269 | 0.633 | 0.298 | |
| S Only | | 0.336 | 0.791 | 0.373 | |

General Beam Analysis

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

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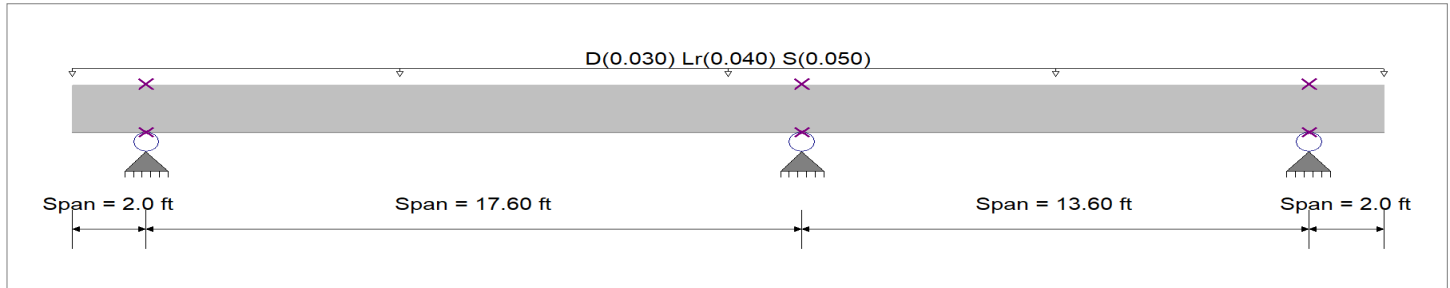
(c) ENERCALC INC 1983-2021

DESCRIPTION: (E) roof at DJ2

calc to find reactions only

General Beam Properties

| | | | | | |
|-----------------|---------------|----------|--------|----------------------|---|
| Elastic Modulus | 29,000.0 ksi | | | | |
| Span #1 | Span Length = | 2.0 ft | Area = | 10.0 in ² | Moment of Inertia = 100.0 in ⁴ |
| Span #2 | Span Length = | 17.60 ft | Area = | 10.0 in ² | Moment of Inertia = 100.0 in ⁴ |
| Span #3 | Span Length = | 13.60 ft | Area = | 10.0 in ² | Moment of Inertia = 100.0 in ⁴ |
| Span #4 | Span Length = | 2.0 ft | Area = | 10.0 in ² | Moment of Inertia = 100.0 in ⁴ |



Applied Loads

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

Loads on all spans...

Uniform Load on ALL spans : D = 0.0150, Lr = 0.020, S = 0.0250 k/ft, Tributary Width = 2.0 ft

DESIGN SUMMARY

| | | | |
|-----------------------------------|------------|-----------------------------|-----------|
| Maximum Bending = | 2.474 k-ft | Maximum Shear = | 0.8355 k |
| Load Combination | +D+S | Load Combination | +D+S |
| Span # where maximum occurs | Span # 2 | Span # where maximum occurs | Span # 2 |
| Location of maximum on span | 17.600 ft | Location of maximum on span | 17.600 ft |
| Maximum Deflection | | | |
| Max Downward Transient Deflection | 0.000 in | 0 | |
| Max Upward Transient Deflection | 0.000 in | 0 | |
| Max Downward Total Deflection | 0.000 in | 0 | |
| Max Upward Total Deflection | 0.000 in | 0 | |

Overall Maximum Deflections

| Load Combination | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|------------------|------|---------------|------------------|------------------|---------------|------------------|
| | 1 | 0.0000 | 0.000 | | 0.0000 | 0.000 |
| | 2 | 0.0000 | 0.000 | | 0.0000 | 0.000 |
| | 3 | 0.0000 | 0.000 | | 0.0000 | 0.000 |
| | 4 | 0.0000 | 0.000 | | 0.0000 | 0.000 |

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 | Support 3 | Support 4 | Support 5 |
|------------------|-----------|-----------|-----------|-----------|-----------|
| Overall MAXimum | | 0.458 | 0.968 | 0.334 | |
| Overall MINimum | | | | | |
| D Only | | 0.275 | 0.581 | 0.200 | |
| Lr Only | | 0.366 | 0.775 | 0.267 | |
| S Only | | 0.458 | 0.968 | 0.334 | |

General Beam Analysis

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

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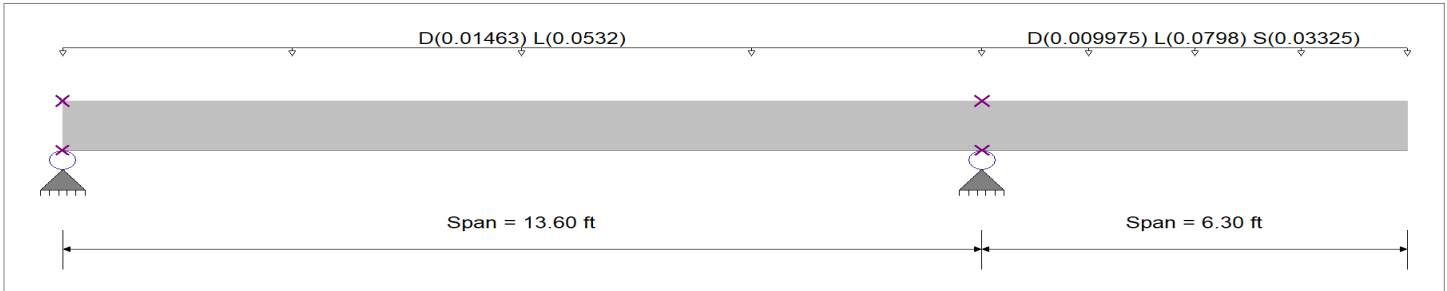
(c) ENERCALC INC 1983-2021

DESCRIPTION: (E) joist at DJ1

calc to find reactions only

General Beam Properties

| | | | | | |
|-----------------|---------------|----------|--------|----------|------------------------------|
| Elastic Modulus | 1,600.0 ksi | | | | |
| Span #1 | Span Length = | 13.60 ft | Area = | 1.0 in^2 | Moment of Inertia = 1.0 in^4 |
| Span #2 | Span Length = | 6.30 ft | Area = | 1.0 in^2 | Moment of Inertia = 1.0 in^4 |



Applied Loads

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

Load for Span Number 1

Uniform Load : D = 0.0110, L = 0.040 ksf, Tributary Width = 1.330 ft, (floor)

Load for Span Number 2

Uniform Load : D = 0.00750, L = 0.060, S = 0.0250 ksf, Tributary Width = 1.330 ft, (deck)

DESIGN SUMMARY

| | | | |
|---|------------|---|-----------|
| Maximum Bending = | 1.881 k-ft | Maximum Shear = | 0.5970 k |
| Load Combination: D+0.750L+0.750S+H, LL Comb Run (LL) | | Load Combination: D+0.750L+0.750S+H, LL Comb Run (*L) | |
| Span # where maximum occurs | Span # 1 | Span # where maximum occurs | Span # 1 |
| Location of maximum on span | 13.600 ft | Location of maximum on span | 13.600 ft |
| Maximum Deflection | | | |
| Max Downward Transient Deflection | 0.000 in | | 0 |
| Max Upward Transient Deflection | 0.000 in | | 0 |
| Max Downward Total Deflection | 0.000 in | | 0 |
| Max Upward Total Deflection | 0.000 in | | 0 |

Overall Maximum Deflections

| Load Combination | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|------------------|------|---------------|------------------|------------------|---------------|------------------|
| | 1 | 0.0000 | 0.000 | | 0.0000 | 0.000 |
| | 2 | 0.0000 | 0.000 | | 0.0000 | 0.000 |

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 | Support 3 |
|---------------------------|-----------|-----------|-----------|
| Overall MAXimum | 0.362 | 0.981 | |
| Overall MINimum | -0.049 | | |
| D Only | 0.085 | 0.177 | |
| Lr Only, LL Comb Run (*L) | | | |
| Lr Only, LL Comb Run (L*) | | | |
| Lr Only, LL Comb Run (LL) | | | |
| L Only, LL Comb Run (*L) | -0.116 | 0.619 | |
| L Only, LL Comb Run (L*) | 0.362 | 0.362 | |
| L Only, LL Comb Run (LL) | 0.245 | 0.981 | |
| S Only | -0.049 | 0.258 | |
| W Only | | | |
| E Only | | | |
| H Only | | | |

General Beam Analysis

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

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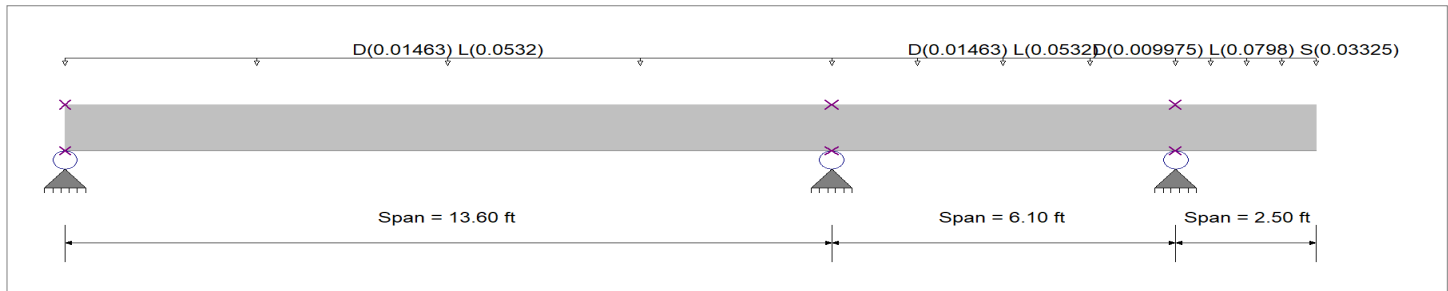
(c) ENERCALC INC 1983-2021

DESCRIPTION: (E) joist at DJ2

calc to find reactions only

General Beam Properties

| | | | | | | |
|-----------------|---------------|----------|--------|---------------------|---------------------|---------------------|
| Elastic Modulus | 1,600.0 ksi | | | | | |
| Span #1 | Span Length = | 13.60 ft | Area = | 1.0 in ² | Moment of Inertia = | 1.0 in ⁴ |
| Span #2 | Span Length = | 6.10 ft | Area = | 1.0 in ² | Moment of Inertia = | 1.0 in ⁴ |
| Span #3 | Span Length = | 2.50 ft | Area = | 1.0 in ² | Moment of Inertia = | 1.0 in ⁴ |



Applied Loads

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

Load for Span Number 1

Uniform Load : D = 0.0110, L = 0.040 ksf, Tributary Width = 1.330 ft, (floor)

Load for Span Number 2

Uniform Load : D = 0.0110, L = 0.040 ksf, Tributary Width = 1.330 ft, (floor)

Load for Span Number 3

Uniform Load : D = 0.00750, L = 0.060, S = 0.0250 ksf, Tributary Width = 1.330 ft, (deck)

DESIGN SUMMARY

| | | | |
|-----------------------------------|---------------------------|-----------------------------|---------------------------|
| Maximum Bending = | 1.176 k-ft | Maximum Shear = | 0.5477 k |
| Load Combination | +D+L+H, LL Comb Run (LL*) | Load Combination | +D+L+H, LL Comb Run (LL*) |
| Span # where maximum occurs | Span # 1 | Span # where maximum occurs | Span # 1 |
| Location of maximum on span | 13.600 ft | Location of maximum on span | 13.600 ft |
| Maximum Deflection | | | |
| Max Downward Transient Deflection | 0.000 in | | 0 |
| Max Upward Transient Deflection | 0.000 in | | 0 |
| Max Downward Total Deflection | 0.000 in | | 0 |
| Max Upward Total Deflection | 0.000 in | | 0 |

Overall Maximum Deflections

| Load Combination | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|------------------|------|---------------|------------------|------------------|---------------|------------------|
| | 1 | 0.0000 | 0.000 | | 0.0000 | 0.000 |
| | 2 | 0.0000 | 0.000 | | 0.0000 | 0.000 |
| | 3 | 0.0000 | 0.000 | | 0.0000 | 0.000 |

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 | Support 3 | Support 4 |
|----------------------------|-----------|-----------|-----------|-----------|
| Overall MAXimum | 0.302 | 0.744 | 0.396 | |
| Overall MINimum | -0.003 | -0.021 | -0.139 | |
| D Only | 0.081 | 0.198 | 0.034 | |
| Lr Only, LL Comb Run (**L) | | | | |
| Lr Only, LL Comb Run (*L*) | | | | |
| Lr Only, LL Comb Run (*LL) | | | | |
| Lr Only, LL Comb Run (L**) | | | | |
| Lr Only, LL Comb Run (L*L) | | | | |
| Lr Only, LL Comb Run (LL*) | | | | |
| Lr Only, LL Comb Run (LLL) | | | | |
| L Only, LL Comb Run (**L) | 0.003 | -0.050 | 0.247 | |
| L Only, LL Comb Run (*L*) | -0.006 | 0.180 | 0.150 | |
| L Only, LL Comb Run (*LL) | -0.003 | 0.130 | 0.396 | |
| L Only, LL Comb Run (L**) | 0.299 | 0.563 | -0.139 | |
| L Only, LL Comb Run (L*L) | 0.302 | 0.513 | 0.108 | |

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 24 SEP 2021, 5:19PM

General Beam Analysis

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

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DESCRIPTION: (E) joist at DJ2

calc to find reactions only

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 | Support 3 | Support 4 |
|---------------------------|-----------|-----------|-----------|-----------|
| L Only, LL Comb Run (LL*) | 0.294 | 0.744 | 0.010 | |
| L Only, LL Comb Run (LLL) | 0.297 | 0.694 | 0.257 | |
| S Only | 0.001 | -0.021 | 0.103 | |
| W Only | | | | |
| E Only | | | | |
| H Only | | | | |

General Beam Analysis

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

SFA ENGINEERING LLC

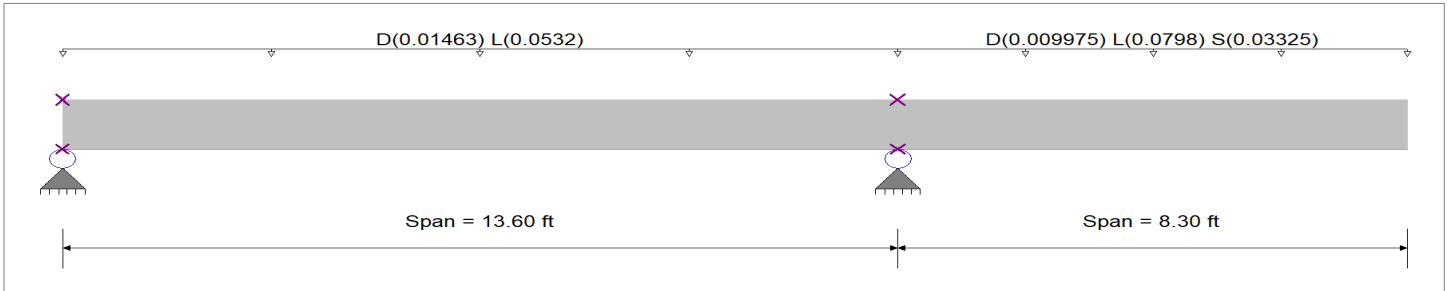
(c) ENERCALC INC 1983-2021

DESCRIPTION: (E) joist at DJ3

calc to find reactions only

General Beam Properties

| | | | | | |
|-----------------|---------------|----------|--------|----------|------------------------------|
| Elastic Modulus | 1,600.0 ksi | | | | |
| Span #1 | Span Length = | 13.60 ft | Area = | 1.0 in^2 | Moment of Inertia = 1.0 in^4 |
| Span #2 | Span Length = | 8.30 ft | Area = | 1.0 in^2 | Moment of Inertia = 1.0 in^4 |



Applied Loads

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

Load for Span Number 1

Uniform Load : D = 0.0110, L = 0.040 ksf, Tributary Width = 1.330 ft, (floor)

Load for Span Number 2

Uniform Load : D = 0.00750, L = 0.060, S = 0.0250 ksf, Tributary Width = 1.330 ft, (deck)

DESIGN SUMMARY

| | | | |
|--|------------|--|-----------|
| Maximum Bending = | 3.264 k-ft | Maximum Shear = | 0.7865 k |
| Load Combination: 1.0D+0.75L+0.75S+H, LL Comb Run (LL) | | Load Combination: 1.0D+0.75L+0.75S+H, LL Comb Run (LL) | |
| Span # where maximum occurs | Span # 1 | Span # where maximum occurs | Span # 1 |
| Location of maximum on span | 13.600 ft | Location of maximum on span | 13.600 ft |
| Maximum Deflection | | | |
| Max Downward Transient Deflection | 0.000 in | | 0 |
| Max Upward Transient Deflection | 0.000 in | | 0 |
| Max Downward Total Deflection | 0.000 in | | 0 |
| Max Upward Total Deflection | 0.000 in | | 0 |

Overall Maximum Deflections

| Load Combination | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|------------------|------|---------------|------------------|------------------|---------------|------------------|
| | 1 | 0.0000 | 0.000 | | 0.0000 | 0.000 |
| | 2 | 0.0000 | 0.000 | | 0.0000 | 0.000 |

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 | Support 3 |
|---------------------------|-----------|-----------|-----------|
| Overall MAXimum | 0.362 | 1.226 | |
| Overall MINimum | -0.084 | | |
| D Only | 0.074 | 0.208 | |
| Lr Only, LL Comb Run (*L) | | | |
| Lr Only, LL Comb Run (L*) | | | |
| Lr Only, LL Comb Run (LL) | | | |
| L Only, LL Comb Run (*L) | -0.202 | 0.864 | |
| L Only, LL Comb Run (L*) | 0.362 | 0.362 | |
| L Only, LL Comb Run (LL) | 0.160 | 1.226 | |
| S Only | -0.084 | 0.360 | |
| W Only | | | |
| E Only | | | |
| H Only | | | |

Wood Beam

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

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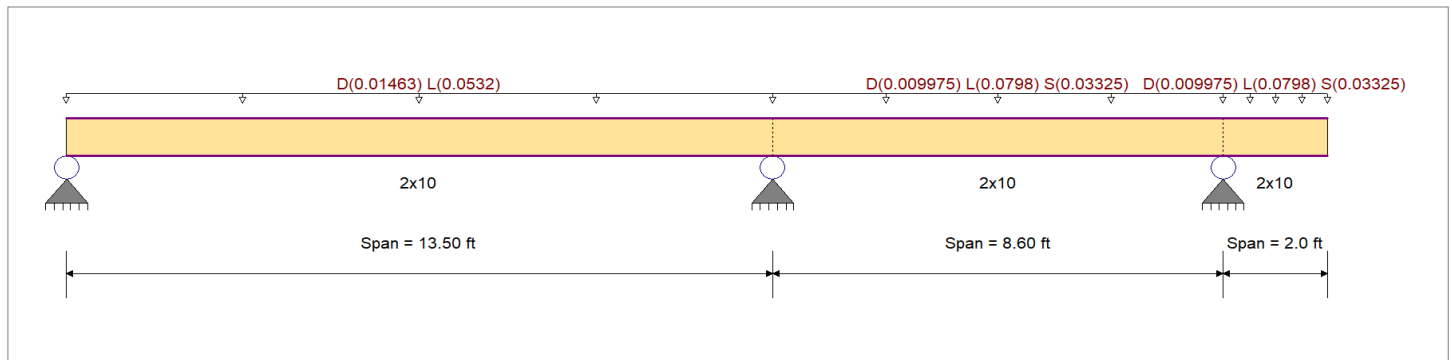
DESCRIPTION: DJ1 & DJ3

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
 Load Combination Set : ASCE 7-16

Material Properties

| | | | | | |
|------------------|---|-----------|-------------|---------------------------|------------|
| Analysis Method | Allowable Stress Design | Fb + | 900.0 psi | E : Modulus of Elasticity | |
| Load Combination | ASCE 7-16 | Fb - | 900.0 psi | Ebend- xx | 1,600.0ksi |
| Wood Species | Douglas Fir-Larch | Fc - Prll | 1,350.0 psi | Eminbend - xx | 580.0ksi |
| Wood Grade | No.2 | Fc - Perp | 625.0 psi | Fv | 180.0 psi |
| Beam Bracing | Beam is Fully Braced against lateral-torsional buckling | Ft | 575.0 psi | Density | 31.210pcf |



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 = 0.0110, L = 0.040 ksf, Tributary Width = 1.330 ft, (floor)

Load for Span Number 2

Uniform Load : D = 0.00750, L = 0.060, S = 0.0250 ksf, Tributary Width = 1.330 ft, (deck)

Load for Span Number 3

Uniform Load : D = 0.00750, L = 0.060, S = 0.0250 ksf, Tributary Width = 1.330 ft, (deck)

DESIGN SUMMARY

Design N.G.

| | | | | | | | |
|-------------------------------------|---------------------------|--------------|-------------------|-------------------------------------|---------------------------|--------------|---|
| Maximum Bending Stress Ratio | = | 0.846 | 1 | Maximum Shear Stress Ratio | = | 0.408 | 1 |
| Section used for this span | | 2x10 | | Section used for this span | | 2x10 | |
| fb: Actual | = | 737.44 psi | | fv: Actual | = | 57.01 psi | |
| Fb: Allowable | = | 871.20 psi | | Fv: Allowable | = | 139.68 psi | |
| Load Combination | +D+L+H, LL Comb Run (LL*) | | | Load Combination | +D+L+H, LL Comb Run (LL*) | | |
| Location of maximum on span | = | 0.000ft | | Location of maximum on span | = | 0.681 ft | |
| Span # where maximum occurs | = | Span # 2 | | Span # where maximum occurs | = | Span # 2 | |
| Maximum Deflection | | | | | | | |
| Max Downward Transient Deflection | 0.195 in | Ratio = | 246 < 360 | Span: 1 : L Only, LL Comb Run (L*L) | | | |
| Max Upward Transient Deflection | -0.053 in | Ratio = | 906 >= 360 | Span: 2 : L Only, LL Comb Run (L*L) | | | |
| Max Downward Total Deflection | 0.252 in | Ratio = | 190 < 240 | Span: 1 : +D+L+H, LL Comb Run (L*L) | | | |
| Max Upward Total Deflection | -0.060 in | Ratio = | 794 >= 240 | Span: 2 : +D+L+H, LL Comb Run (L*L) | | | |

Vertical Reactions

Support notation : Far left is #'

Values in KIPS

| Load Combination | Support 1 | Support 2 | Support 3 | Support 4 |
|---------------------------|-----------|-----------|-----------|-----------|
| Overall MAXimum | 0.307 | 0.898 | 0.492 | |
| Overall MINimum | -0.008 | 0.156 | 0.205 | |
| D Only | 0.098 | 0.227 | 0.051 | |
| L Only, LL Comb Run (**L) | 0.002 | -0.024 | 0.182 | |
| L Only, LL Comb Run (*L*) | -0.021 | 0.398 | 0.310 | |
| L Only, LL Comb Run (*LL) | -0.019 | 0.373 | 0.492 | |
| L Only, LL Comb Run (L**) | 0.304 | 0.500 | -0.086 | |
| L Only, LL Comb Run (L*L) | 0.307 | 0.476 | 0.096 | |
| L Only, LL Comb Run (LL*) | 0.283 | 0.898 | 0.224 | |

Enercalc has known bug;
 l/360 = 0.45" (span 1)
 l/240 = 0.675" (span 1)
 Deflection OK

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 24 SEP 2021, 5:59PM

Wood Beam

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

SFA ENGINEERING LLC

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DESCRIPTION: DJ1 & DJ3

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 | Support 3 | Support 4 |
|---------------------------|-----------|-----------|-----------|-----------|
| L Only, LL Comb Run (LLL) | 0.285 | 0.873 | 0.405 | |
| S Only | -0.008 | 0.156 | 0.205 | |
| H Only | | | | |

Wood Beam

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

SFA ENGINEERING LLC

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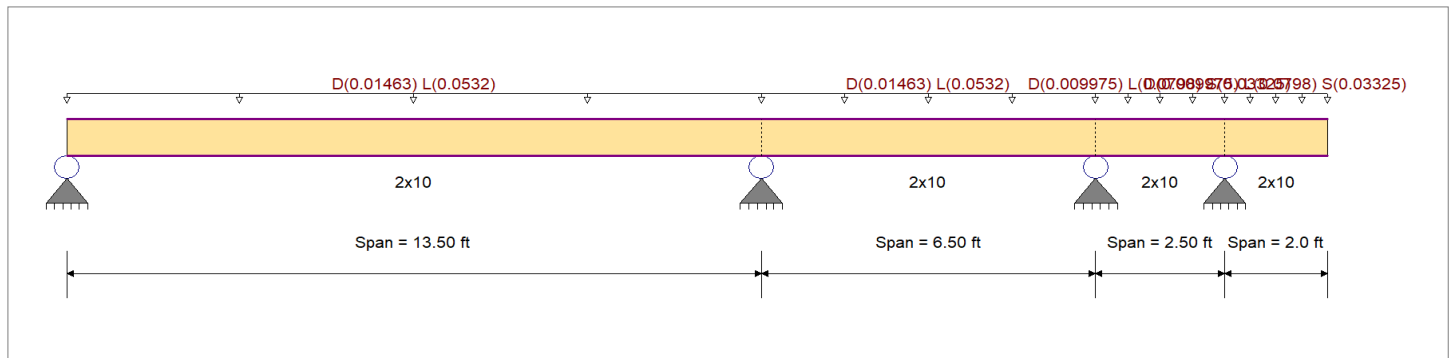
DESCRIPTION: DJ2

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
 Load Combination Set : ASCE 7-16

Material Properties

| | | | |
|--|-----------|-------------|-----------------------------------|
| Analysis Method : Allowable Stress Design | Fb + | 850.0 psi | E : Modulus of Elasticity |
| Load Combination: ASCE 7-16 | Fb - | 850.0 psi | Ebend- xx |
| | Fc - Prll | 1,300.0 psi | Eminbend - xx |
| Wood Species Hem-Fir | Fc - Perp | 405.0 psi | |
| Wood Grade No.2 | Fv | 150.0 psi | |
| | Ft | 525.0 psi | Density |
| Beam Bracing Beam is Fully Braced against lateral-torsional buckling | | | Repetitive Member Stress Increase |



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 = 0.0110, L = 0.040 ksf, Tributary Width = 1.330 ft, (floor)

Load for Span Number 2

Uniform Load : D = 0.0110, L = 0.040 ksf, Tributary Width = 1.330 ft, (floor)

Load for Span Number 3

Uniform Load : D = 0.00750, L = 0.060, S = 0.0250 ksf, Tributary Width = 1.330 ft, (deck)

Load for Span Number 4

Uniform Load : D = 0.00750, L = 0.060, S = 0.0250 ksf, Tributary Width = 1.330 ft, (deck)

DESIGN SUMMARY

Design N.G.

| | | | | | |
|-------------------------------------|-----------|----------------------------|--------------------------------------|---|----------------------------|
| Maximum Bending Stress Ratio | = | 0.733 < 1 | Maximum Shear Stress Ratio | = | 0.482 < 1 |
| Section used for this span | | 2x10 | Section used for this span | | 2x10 |
| fb: Actual | = | 693.56 psi | fv: Actual | = | 56.08 psi |
| Fb: Allowable | = | 946.22 psi | Fv: Allowable | = | 116.40 psi |
| Load Combination | | +D+L+H, LL Comb Run (LL*L) | Load Combination | | +D+L+H, LL Comb Run (LL*L) |
| Location of maximum on span | = | 0.000 ft | Location of maximum on span | = | 0.684 ft |
| Span # where maximum occurs | = | Span # 2 | Span # where maximum occurs | = | Span # 2 |
| Maximum Deflection | | | | | |
| Max Downward Transient Deflection | 0.214 in | Ratio = 140 < 360 | Span: 1 : L Only, LL Comb Run (L*L*) | | |
| Max Upward Transient Deflection | -0.027 in | Ratio = 1111 >= 360 | Span: 2 : L Only, LL Comb Run (L*L*) | | |
| Max Downward Total Deflection | 0.279 in | Ratio = 107 < 240 | Span: 1 : +D+L+H, LL Comb Run (L*L*) | | |
| Max Upward Total Deflection | -0.033 in | Ratio = 919 >= 240 | Span: 2 : +D+L+H, LL Comb Run (L*L*) | | |

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 | Support 3 | Support 4 | Support 5 |
|----------------------------|-----------|-----------|-----------|-----------|-----------|
| Overall MAXimum | 0.295 | 0.769 | -0.385 | 0.451 | |
| Overall MINimum | -0.000 | 0.000 | -0.197 | 0.136 | |
| D Only | 0.094 | 0.248 | -0.009 | 0.068 | |
| L Only, LL Comb Run (**L) | -0.000 | 0.004 | -0.077 | 0.233 | |
| L Only, LL Comb Run (**L*) | 0.000 | -0.004 | 0.110 | 0.092 | |
| L Only, LL Comb Run (**LL) | -0.000 | 0.001 | 0.033 | 0.325 | |
| L Only, LL Comb Run (*L**) | -0.005 | 0.159 | 0.263 | -0.072 | |

Enercalc has known bug;
 l/360 = 0.45" (span 1)
 l/240 = 0.675" (span 1)
 Deflection OK

Project Title:
 Engineer:
 Project ID:
 Project Descr:

Printed: 24 SEP 2021, 5:23PM

Wood Beam

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

SFA ENGINEERING LLC

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DESCRIPTION: DJ2

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 | Support 3 | Support 4 | Support 5 |
|----------------------------|-----------|-----------|-----------|-----------|-----------|
| L Only, LL Comb Run (*L*L) | -0.005 | 0.164 | 0.186 | 0.161 | |
| L Only, LL Comb Run (*LL*) | -0.004 | 0.156 | 0.374 | 0.020 | |
| L Only, LL Comb Run (*LLL) | -0.005 | 0.160 | 0.296 | 0.253 | |
| L Only, LL Comb Run (L***) | 0.295 | 0.605 | -0.308 | 0.126 | |
| L Only, LL Comb Run (L**L) | 0.294 | 0.610 | -0.385 | 0.358 | |
| L Only, LL Comb Run (L*L*) | 0.295 | 0.602 | -0.197 | 0.218 | |
| L Only, LL Comb Run (L*LL) | 0.295 | 0.606 | -0.275 | 0.451 | |
| L Only, LL Comb Run (LL**) | 0.290 | 0.765 | -0.044 | 0.053 | |
| L Only, LL Comb Run (LL*L) | 0.290 | 0.769 | -0.122 | 0.286 | |
| L Only, LL Comb Run (LLL*) | 0.290 | 0.761 | 0.066 | 0.146 | |
| L Only, LL Comb Run (LLLL) | 0.290 | 0.766 | -0.011 | 0.379 | |
| S Only | -0.000 | 0.000 | 0.014 | 0.136 | |
| H Only | | | | | |

Wood Beam

Project File: ENERCALC Data Files

LIC# : KW-06005923, Build:20.21.8.14

SFA ENGINEERING LLC

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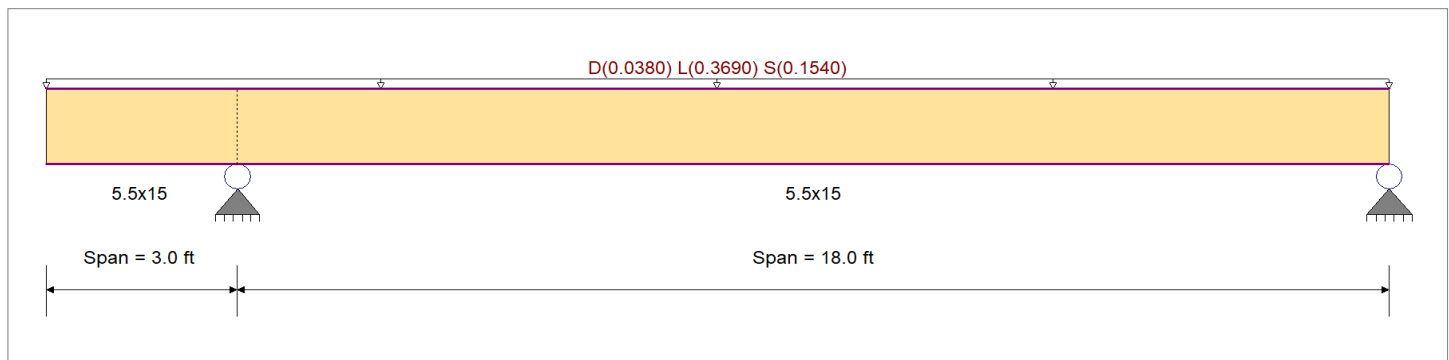
DESCRIPTION: B1

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
 Load Combination Set : ASCE 7-16

Material Properties

| | | | | |
|--|-----------|-------------|----------------------------------|------------|
| Analysis Method : Allowable Stress Design | Fb + | 2,400.0 psi | <i>E : Modulus of Elasticity</i> | |
| Load Combination: ASCE 7-16 | Fb - | 1,850.0 psi | Ebend- xx | 1,800.0ksi |
| Wood Species DF/DF | Fc - Prll | 1,650.0 psi | Eminbend - xx | 950.0ksi |
| Wood Grade 24F - V4 | Fc - Perp | 650.0 psi | Ebend- yy | 1,600.0ksi |
| Beam Bracing Beam is Fully Braced against lateral-torsional buckling | Fv | 265.0 psi | Eminbend - yy | 850.0ksi |
| | Ft | 1,100.0 psi | Density | 31.210pcf |



Applied Loads

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

Beam self weight calculated and added to loads
 Loads on all spans...

Uniform Load on ALL spans : D = 0.0380, L = 0.3690, S = 0.1540 k/ft

DESIGN SUMMARY

Design N.G.

| | | | | | |
|-------------------------------------|--------------------------|-------------------|------------------------------------|--------------------------|------------------|
| Maximum Bending Stress Ratio | = | 0.525 1 | Maximum Shear Stress Ratio | = | 0.268 : 1 |
| Section used for this span | | 5.5x15 | Section used for this span | | 5.5x15 |
| fb: Actual | = | 993.87 psi | fv: Actual | = | 62.14 psi |
| Fb: Allowable | = | 1,893.38 psi | Fv: Allowable | = | 231.88 psi |
| Load Combination | +D+L+H, LL Comb Run (*L) | | Load Combination | +D+L+H, LL Comb Run (LL) | |
| Location of maximum on span | = | 9.050ft | Location of maximum on span | = | 3.000 ft |
| Span # where maximum occurs | = | Span # 2 | Span # where maximum occurs | = | Span # 1 |
| Maximum Deflection | | | | | |
| Max Downward Transient Deflection | 0.379 in | Ratio = 569 >=360 | Span: 2 : L Only, LL Comb Run (*L) | | |
| Max Upward Transient Deflection | -0.200 in | Ratio = 358 <360 | Span: 1 : L Only, LL Comb Run (*L) | | |
| Max Downward Total Deflection | 0.433 in | Ratio = 499 >=240 | Span: 2 : +D+L+H, LL Comb Run (*L) | | |
| Max Upward Total Deflection | -0.227 in | Ratio = 316 >=240 | Span: 1 : +D+L+H, LL Comb Run (*L) | | |

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 | Support 3 |
|--------------------------|-----------|-----------|-----------|
| Overall MAXimum | | 4.520 | 3.321 |
| Overall MINimum | | 1.887 | 1.348 |
| D Only | | 0.685 | 0.489 |
| L Only, LL Comb Run (*L) | | 3.321 | 3.321 |
| L Only, LL Comb Run (L*) | | 1.199 | -0.092 |
| L Only, LL Comb Run (LL) | | 4.520 | 3.229 |
| S Only | | 1.887 | 1.348 |
| H Only | | | |

Upward deflection limit
 = l/180 = 0.20" (span 1)
 Deflection OK

Wood Beam

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

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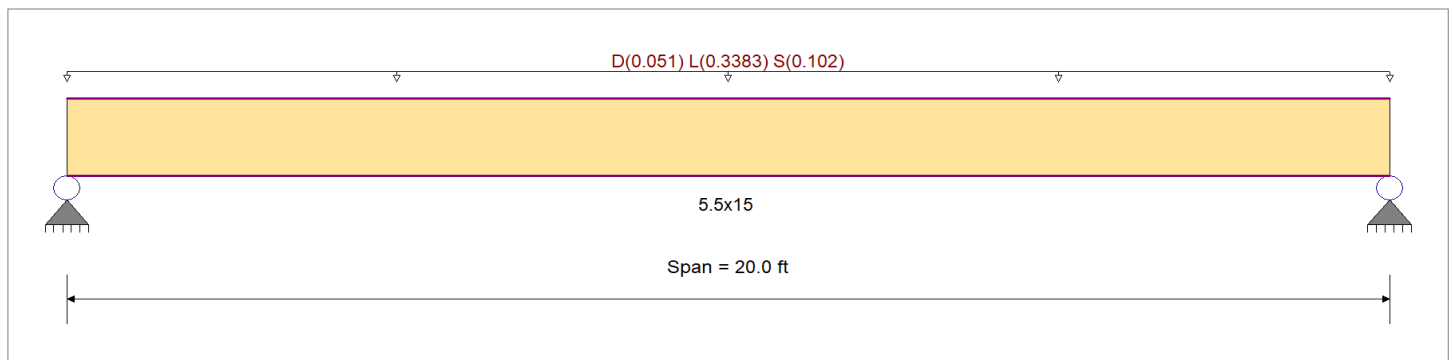
DESCRIPTION: B2

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
 Load Combination Set : ASCE 7-16

Material Properties

| | | | | |
|---|---|-------------|----------------------------------|-------------|
| Analysis Method : Allowable Stress Design | Fb + | 2,400.0 psi | <i>E : Modulus of Elasticity</i> | |
| Load Combination: ASCE 7-16 | Fb - | 1,850.0 psi | Ebend- xx | 1,800.0 ksi |
| | Fc - Prll | 1,650.0 psi | Eminbend - xx | 950.0 ksi |
| Wood Species DF/DF | Fc - Perp | 650.0 psi | Ebend- yy | 1,600.0 ksi |
| Wood Grade 24F - V4 | Fv | 265.0 psi | Eminbend - yy | 850.0 ksi |
| | Ft | 1,100.0 psi | Density | 31.210 pcf |
| Beam Bracing | Beam is Fully Braced against lateral-torsional buckling | | | |



Applied Loads

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

Beam self weight calculated and added to loads

Uniform Load : D = 0.0510, L = 0.3383, S = 0.1020 , Tributary Width = 1.0 ft, (DJ2)

DESIGN SUMMARY

Design OK

| | | | | | |
|-------------------------------------|----------|----------------|-----------------------------------|------------------|------------------|
| Maximum Bending Stress Ratio | = | 0.632 1 | Maximum Shear Stress Ratio | = | 0.280 : 1 |
| Section used for this span | | 5.5x15 | Section used for this span | | 5.5x15 |
| fb: Actual | = | 1,184.53 psi | fv: Actual | = | 64.85 psi |
| Fb: Allowable | = | 1,873.54 psi | Fv: Allowable | = | 231.88 psi |
| Load Combination | | +D+L+H | Load Combination | | +D+L+H |
| Location of maximum on span | = | 10.000ft | 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 | 0.528 in | Ratio = | 454 >=360 | Span: 1 : L Only | |
| Max Upward Transient Deflection | 0 in | Ratio = | 0 <360 | n/a | |
| Max Downward Total Deflection | 0.636 in | Ratio = | 377 >=240 | Span: 1 : +D+L+H | |
| Max Upward Total Deflection | 0 in | Ratio = | 0 <240 | n/a | |

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 |
|------------------|-----------|-----------|
| Overall MAXimum | 3.383 | 3.383 |
| Overall MINimum | 1.020 | 1.020 |
| D Only | 0.689 | 0.689 |
| L Only | 3.383 | 3.383 |
| S Only | 1.020 | 1.020 |
| H Only | | |

General Beam Analysis

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

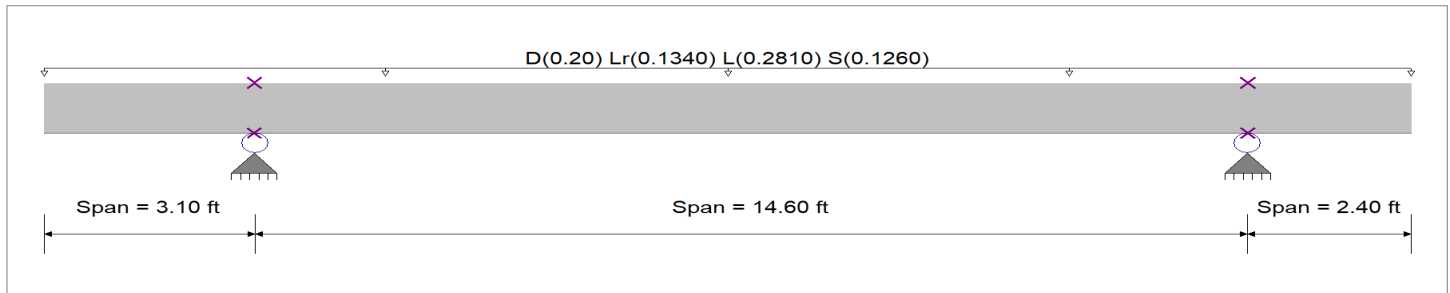
SFA ENGINEERING LLC

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DESCRIPTION: B3 (E) 6x12; calc to find reactions only

General Beam Properties

| | | | | | |
|-----------------|---------------|----------|--------|------------------------|--|
| Elastic Modulus | 1,600.0 ksi | | | | |
| Span #1 | Span Length = | 3.10 ft | Area = | 61.875 in ² | Moment of Inertia = 652.60 in ⁴ |
| Span #2 | Span Length = | 14.60 ft | Area = | 61.875 in ² | Moment of Inertia = 652.60 in ⁴ |
| Span #3 | Span Length = | 2.40 ft | Area = | 61.875 in ² | Moment of Inertia = 652.60 in ⁴ |



Applied Loads

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

Loads on all spans...

Uniform Load on ALL spans : D = 0.20, Lr = 0.1340, L = 0.2810, S = 0.1260 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

| | | | |
|---|-------------|---|----------|
| Maximum Bending = | 12.854 k-ft | Maximum Shear = | 3.861 k |
| Load Combination: D+0.75Lr+0.75L+H, LL Comb Run (*L*) | | Load Combination: D+0.75Lr+0.75L+H, LL Comb Run (LL*) | |
| Span # where maximum occurs | Span # 2 | Span # where maximum occurs | Span # 1 |
| Location of maximum on span | 7.392 ft | Location of maximum on span | 3.100 ft |
| Maximum Deflection | | | |
| Max Downward Transient Deflection | 0.000 in | 0 | |
| Max Upward Transient Deflection | 0.000 in | 0 | |
| Max Downward Total Deflection | 0.000 in | 0 | |
| Max Upward Total Deflection | 0.000 in | 0 | |

Overall Maximum Deflections

| Load Combination | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|------------------|------|---------------|------------------|------------------|---------------|------------------|
| | 1 | 0.0000 | 0.000 | | 0.0000 | 0.000 |
| | 2 | 0.0000 | 0.000 | | 0.0000 | 0.000 |
| | 3 | 0.0000 | 0.000 | | 0.0000 | 0.000 |

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

| Load Combination | Support 1 | Support 2 | Support 3 | Support 4 |
|----------------------------|-----------|-----------|-----------|-----------|
| Overall MAXimum | | 3.015 | 2.781 | |
| Overall MINimum | | -0.055 | -0.092 | |
| D Only | | 2.106 | 1.914 | |
| Lr Only, LL Comb Run (**L) | | -0.026 | 0.348 | |
| Lr Only, LL Comb Run (*L*) | | 0.978 | 0.978 | |
| Lr Only, LL Comb Run (*LL) | | 0.952 | 1.326 | |
| Lr Only, LL Comb Run (L**) | | 0.460 | -0.044 | |
| Lr Only, LL Comb Run (L*L) | | 0.433 | 0.304 | |
| Lr Only, LL Comb Run (LL*) | | 1.438 | 0.934 | |
| Lr Only, LL Comb Run (LLL) | | 1.411 | 1.282 | |
| L Only, LL Comb Run (**L) | | -0.055 | 0.730 | |
| L Only, LL Comb Run (*L*) | | 2.051 | 2.051 | |
| L Only, LL Comb Run (*LL) | | 1.996 | 2.781 | |
| L Only, LL Comb Run (L**) | | 0.964 | -0.092 | |
| L Only, LL Comb Run (L*L) | | 0.908 | 0.637 | |
| L Only, LL Comb Run (LL*) | | 3.015 | 1.959 | |
| L Only, LL Comb Run (LLL) | | 2.959 | 2.689 | |
| S Only | | 1.327 | 1.206 | |
| W Only | | | | |
| E Only | | | | |
| H Only | | | | |

Wood Column

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

SFA ENGINEERING LLC

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DESCRIPTION: C1

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
 Load Combinations Used : ASCE 7-16

General Information

| | | | | | |
|---|-------------------------|-------------|------------|-----------------------------------|-----------------------|
| Analysis Method | Allowable Stress Design | | | Wood Section Name | 6x6 |
| End Fixities | Top & Bottom Pinned | | | Wood Grading/Manuf. | Graded Lumber |
| Overall Column Height | 9 ft | | | Wood Member Type | Sawn |
| <i>(Used for non-slender calculations)</i> | | | | | |
| Wood Species | Hem-Fir | | | Exact Width | 5.50 in |
| Wood Grade | No.2 | | | Exact Depth | 5.50 in |
| Fb + | 575.0 psi | Fv | 140.0 psi | Area | 30.250 in^2 |
| Fb - | 575.0 psi | Ft | 375.0 psi | lx | 76.255 in^4 |
| Fc - Prll | 575.0 psi | Density | 26.840 pcf | ly | 76.255 in^4 |
| Fc - Perp | 405.0 psi | | | Incising Factors : | |
| E : Modulus of Elasticity . . . | x-x Bending | y-y Bending | Axial | for Bending | 0.80 |
| | Basic | 1,100.0 | 1,100.0 | for Elastic Modulus | 0.95 |
| | Minimum | 400.0 | 400.0 | | |
| | | | | Allow Stress Modification Factors | |
| | | | | Cf or Cv for Bending | 1.0 |
| | | | | Cf or Cv for Compression | 1.0 |
| | | | | Cf or Cv for Tension | 1.0 |
| | | | | Cm : Wet Use Factor | 1.0 |
| | | | | Ct : Temperature Fact | 1.0 |
| | | | | Cfu : Flat Use Factor | 1.0 |
| | | | | Kf : Built-up columns | 1.0 <i>NDS 15.3.2</i> |
| | | | | Use Cr : Repetitive ? | No |
| Brace condition for deflection (buckling) along columns : | | | | | |
| X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 9' | | | | | |
| Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 9' | | | | | |

Applied Loads

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

Column self weight included : 50.744 lbs * Dead Load Factor

AXIAL LOADS . . .

B1: Axial Load at 9.0 ft, Xecc = 1.0 in, D = 0.6850, L = 4.520, S = 1.887 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio = **0.7365 : 1**
 Load Combination +D+L
 Governing NDS Formula Comp + Myy, NDS Eq. 3.9-3
 Location of max.above base 8.940 ft
 At maximum location values are .
 Applied Axial 5.256 k
 Applied Mx 0.0 k-ft
 Applied My -0.4308 k-ft
 Fc : Allowable 364.269 psi

Maximum SERVICE Lateral Load Reactions . .
 Top along Y-Y 0.0 k Bottom along Y-Y 0.0 k
 Top along X-X 0.04185 k Bottom along X-X 0.04185 k

Maximum SERVICE Load Lateral Deflections . . .
 Along Y-Y 0.0 in at 0.0 ft above base
 for load combination : n/a
 Along X-X -0.04930 in at 5.255 ft above base
 for load combination : +D+L

PASS Maximum Shear Stress Ratio = **0.02134 : 1**
 Load Combination +D+L
 Location of max.above base 9.0 ft
 Applied Design Shear 2.390 psi
 Allowable Shear 112.0 psi

Other Factors used to calculate allowable stresses . . .
Bending Compression Tension

Load Combination Results

| Load Combination | C _D | C _P | Maximum Axial + Bending Stress Ratios | | | Maximum Shear Ratios | | |
|------------------|----------------|----------------|---------------------------------------|--------|----------|----------------------|--------|----------|
| | | | Stress Ratio | Status | Location | Stress Ratio | Status | Location |
| D Only | 0.900 | 0.886 | 0.07287 | PASS | 0.0 ft | 0.003120 | PASS | 9.0 ft |
| +D+L | 1.000 | 0.870 | 0.7365 | PASS | 8.940 ft | 0.02134 | PASS | 9.0 ft |
| +D+S | 1.150 | 0.846 | 0.2392 | PASS | 8.940 ft | 0.009168 | PASS | 9.0 ft |
| +D+0.750L | 1.250 | 0.829 | 0.4012 | PASS | 8.940 ft | 0.01336 | PASS | 9.0 ft |
| +D+0.750L+0.750S | 1.150 | 0.846 | 0.6760 | PASS | 8.940 ft | 0.01957 | PASS | 9.0 ft |
| +0.60D | 1.600 | 0.767 | 0.02840 | PASS | 0.0 ft | 0.001053 | PASS | 9.0 ft |

Maximum Reactions

Note: Only non-zero reactions are listed.

| Load Combination | X-X Axis Reaction k | | Y-Y Axis Reaction k | | Axial Reaction k | My - End Moments k-ft | | Mx - End Moments k-ft | |
|------------------|---------------------|-------|---------------------|-------|------------------|-----------------------|-------|-----------------------|-------|
| | @ Base | @ Top | @ Base | @ Top | | @ Base | @ Top | @ Base | @ Top |
| D Only | -0.006 | 0.006 | | | 0.736 | | | | |

Wood Column

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

SFA ENGINEERING LLC

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DESCRIPTION: C1

Maximum Reactions

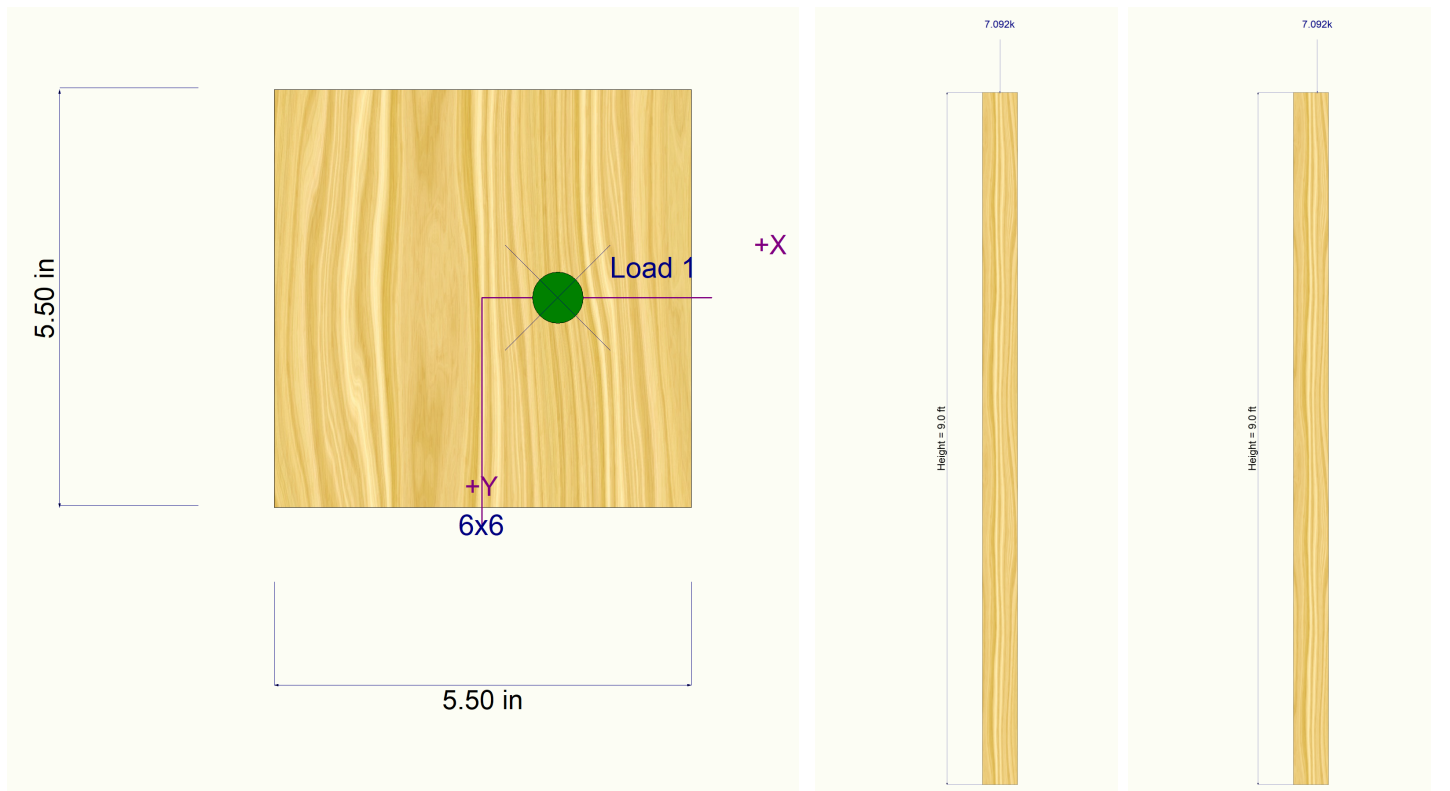
Note: Only non-zero reactions are listed.

| Load Combination | X-X Axis Reaction k | | Y-Y Axis Reaction k | | Axial Reaction @ Base | My - End Moments k-ft | | Mx - End Moments k-ft | |
|------------------|---------------------|-------|---------------------|-------|-----------------------|-----------------------|-------|-----------------------|-------|
| | @ Base | @ Top | @ Base | @ Top | | @ Base | @ Top | @ Base | @ Top |
| L Only | -0.042 | 0.042 | | | 4.520 | | | | |
| S Only | -0.017 | 0.017 | | | 1.887 | | | | |

Maximum Deflections for Load Combinations

| Load Combination | Max. X-X Deflection | Distance | Max. Y-Y Deflection | Distance |
|------------------|---------------------|----------|---------------------|----------|
| +D+L | -0.0493 in | 5.255ft | 0.000 in | 0.000 ft |
| L Only | -0.0428 in | 5.255ft | 0.000 in | 0.000 ft |
| S Only | -0.0179 in | 5.255ft | 0.000 in | 0.000 ft |

Sketches



Wood Column

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

SFA ENGINEERING LLC

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DESCRIPTION: C2

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
 Load Combinations Used : ASCE 7-16

General Information

| | | | | | |
|---|-------------------------|-------------|------------|-----------------------------------|-----------------------|
| Analysis Method | Allowable Stress Design | | | Wood Section Name | 6x6 |
| End Fixities | Top & Bottom Pinned | | | Wood Grading/Manuf. | Graded Lumber |
| Overall Column Height | 9 ft | | | Wood Member Type | Sawn |
| <i>(Used for non-slender calculations)</i> | | | | | |
| Wood Species | Hem Fir | | | Exact Width | 5.50 in |
| Wood Grade | No.2 | | | Exact Depth | 5.50 in |
| Fb + | 575.0 psi | Fv | 140.0 psi | Area | 30.250 in^2 |
| Fb - | 575.0 psi | Ft | 375.0 psi | Ix | 76.255 in^4 |
| Fc - Prll | 575.0 psi | Density | 26.840 pcf | Iy | 76.255 in^4 |
| Fc - Perp | 405.0 psi | | | Incising Factors : | |
| E : Modulus of Elasticity . . . | x-x Bending | y-y Bending | Axial | for Bending | 0.80 |
| | Basic | 1,100.0 | 1,100.0 | for Elastic Modulus | 0.95 |
| | Minimum | 400.0 | 400.0 | | |
| | | | | Allow Stress Modification Factors | |
| | | | | Cf or Cv for Bending | 1.0 |
| | | | | Cf or Cv for Compression | 1.0 |
| | | | | Cf or Cv for Tension | 1.0 |
| | | | | Cm : Wet Use Factor | 1.0 |
| | | | | Ct : Temperature Fact | 1.0 |
| | | | | Cfu : Flat Use Factor | 1.0 |
| | | | | Kf : Built-up columns | 1.0 <i>NDS 15.3.2</i> |
| | | | | Use Cr : Repetitive ? | No |
| Brace condition for deflection (buckling) along columns : | | | | | |
| X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 9' | | | | | |
| Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 9' | | | | | |

Applied Loads

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

Column self weight included : 50.744 lbs * Dead Load Factor

AXIAL LOADS . . .

B1: Axial Load at 9.0 ft, D = 0.4890, L = 3.321, S = 1.348 k

B2: Axial Load at 9.0 ft, D = 0.6890, L = 3.383, S = 1.020 k

DESIGN SUMMARY

Bending & Shear Check Results

| | | | |
|---|-----------------------|---|-----------------------------|
| PASS Max. Axial+Bending Stress Ratio = | 0.7199 : 1 | Maximum SERVICE Lateral Load Reactions . . | |
| Load Combination | +D+L | Top along Y-Y | 0.0 k |
| Governing NDS Formula | Comp Only, f_c/F_c' | Bottom along Y-Y | 0.0 k |
| Location of max.above base | 0.0 ft | Top along X-X | 0.0 k |
| At maximum location values are . . | | Bottom along X-X | 0.0 k |
| Applied Axial | 7.933 k | Maximum SERVICE Load Lateral Deflections . . . | |
| Applied Mx | 0.0 k-ft | Along Y-Y | 0.0 in at 0.0 ft above base |
| Applied My | 0.0 k-ft | for load combination : | n/a |
| Fc : Allowable | 364.269 psi | Along X-X | 0.0 in at 0.0 ft above base |
| | | for load combination : | n/a |
| PASS Maximum Shear Stress Ratio = | 0.0 : 1 | Other Factors used to calculate allowable stresses . . . | |
| Load Combination | +0.60D | <u>Bending</u> | <u>Compression</u> |
| Location of max.above base | 9.0 ft | <u>Tension</u> | |
| Applied Design Shear | 0.0 psi | | |
| Allowable Shear | 179.20 psi | | |

Load Combination Results

| Load Combination | C _D | C _P | Maximum Axial + Bending Stress Ratios | | | Maximum Shear Ratios | | |
|------------------|----------------|----------------|---------------------------------------|--------|----------|----------------------|--------|----------|
| | | | Stress Ratio | Status | Location | Stress Ratio | Status | Location |
| D Only | 0.900 | 0.886 | 0.1217 | PASS | 0.0 ft | 0.0 | PASS | 9.0 ft |
| +D+L | 1.000 | 0.870 | 0.7199 | PASS | 0.0 ft | 0.0 | PASS | 9.0 ft |
| +D+S | 1.150 | 0.846 | 0.2921 | PASS | 0.0 ft | 0.0 | PASS | 9.0 ft |
| +D+0.750L | 1.250 | 0.829 | 0.4771 | PASS | 0.0 ft | 0.0 | PASS | 9.0 ft |
| +D+0.750L+0.750S | 1.150 | 0.846 | 0.6524 | PASS | 0.0 ft | 0.0 | PASS | 9.0 ft |
| +0.60D | 1.600 | 0.767 | 0.04743 | PASS | 0.0 ft | 0.0 | PASS | 9.0 ft |

Wood Column

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

SFA ENGINEERING LLC

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DESCRIPTION: C2

Maximum Reactions

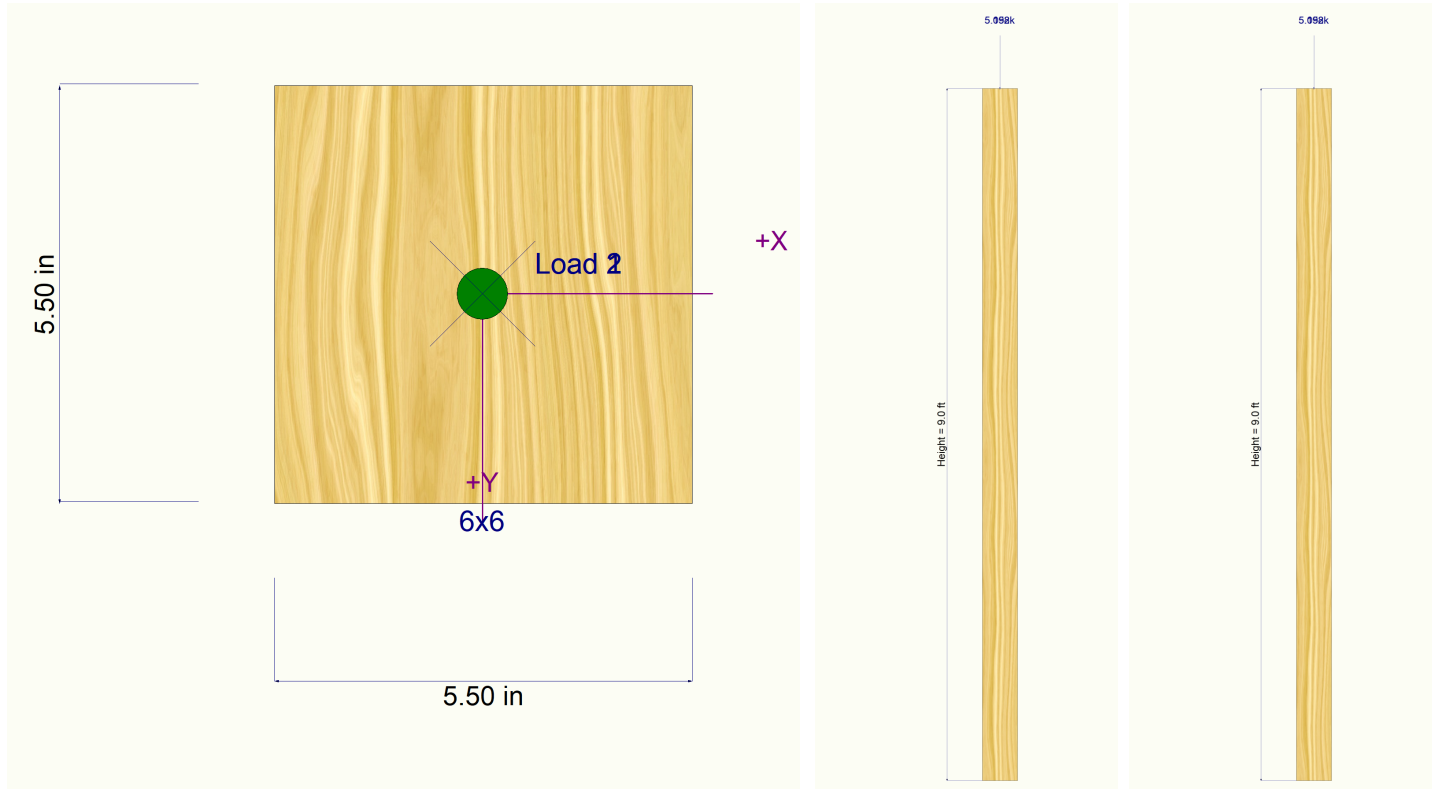
Note: Only non-zero reactions are listed.

| Load Combination | X-X Axis Reaction k | | Y-Y Axis Reaction k | | Axial Reaction | My - End Moments k-ft | | Mx - End Moments k-ft | |
|------------------|---------------------|-------|---------------------|-------|----------------|-----------------------|-------|-----------------------|-------|
| | @ Base | @ Top | @ Base | @ Top | @ Base | @ Base | @ Top | @ Base | @ Top |
| D Only | | | | | 1.229 | | | | |
| L Only | | | | | 6.704 | | | | |
| S Only | | | | | 2.368 | | | | |

Maximum Deflections for Load Combinations

| Load Combination | Max. X-X Deflection | | Max. Y-Y Deflection | |
|------------------|---------------------|---------|---------------------|----------|
| | Distance | | Distance | |
| +D+L | 0.0000 in | 0.000ft | 0.000 in | 0.000 ft |
| L Only | 0.0000 in | 0.000ft | 0.000 in | 0.000 ft |
| S Only | 0.0000 in | 0.000ft | 0.000 in | 0.000 ft |

Sketches



Wood Column

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

SFA ENGINEERING LLC

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DESCRIPTION: C3

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
 Load Combinations Used : ASCE 7-16

General Information

| | | | | | |
|---|-------------------------|-------------|------------|-----------------------------------|-----------------------|
| Analysis Method | Allowable Stress Design | | | Wood Section Name | 6x6 |
| End Fixities | Top & Bottom Pinned | | | Wood Grading/Manuf. | Graded Lumber |
| Overall Column Height | 9 ft | | | Wood Member Type | Sawn |
| <i>(Used for non-slender calculations)</i> | | | | | |
| Wood Species | Hem-Fir | | | Exact Width | 5.50 in |
| Wood Grade | No.2 | | | Exact Depth | 5.50 in |
| Fb + | 675.0 psi | Fv | 140.0 psi | Area | 30.250 in^2 |
| Fb - | 675.0 psi | Ft | 350.0 psi | Ix | 76.255 in^4 |
| Fc - Prll | 500.0 psi | Density | 26.840 pcf | Iy | 76.255 in^4 |
| Fc - Perp | 405.0 psi | | | Incising Factors : | |
| E : Modulus of Elasticity . . . | x-x Bending | y-y Bending | Axial | for Bending | 0.80 |
| | Basic | 1,100.0 | 1,100.0 | for Elastic Modulus | 0.95 |
| | Minimum | 400.0 | 400.0 | | |
| | | | | Allow Stress Modification Factors | |
| | | | | Cf or Cv for Bending | 1.0 |
| | | | | Cf or Cv for Compression | 1.0 |
| | | | | Cf or Cv for Tension | 1.0 |
| | | | | Cm : Wet Use Factor | 1.0 |
| | | | | Ct : Temperature Fact | 1.0 |
| | | | | Cfu : Flat Use Factor | 1.0 |
| | | | | Kf : Built-up columns | 1.0 <i>NDS 15.3.2</i> |
| | | | | Use Cr : Repetitive ? | No |
| Brace condition for deflection (buckling) along columns : | | | | | |
| X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 9' | | | | | |
| Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 9' | | | | | |

Applied Loads

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

Column self weight included : 50.744 lbs * Dead Load Factor

AXIAL LOADS . . .

(E) BM: Axial Load at 9.0 ft, Xecc = 1.0 in, D = 2.106, L = 3.015, S = 1.327 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio = **0.7030 : 1**
 Load Combination +D+L
 Governing NDS Formula Comp + Myy, NDS Eq. 3.9-3
 Location of max.above base 8.940 ft
 At maximum location values are .
 Applied Axial 5.172 k
 Applied Mx 0.0 k-ft
 Applied My -0.4239 k-ft
 Fc : Allowable 324.220 psi

Maximum SERVICE Lateral Load Reactions . .
 Top along Y-Y 0.0 k Bottom along Y-Y 0.0 k
 Top along X-X 0.02792 k Bottom along X-X 0.02792 k

Maximum SERVICE Load Lateral Deflections . . .
 Along Y-Y 0.0 in at 0.0 ft above base
 for load combination : n/a
 Along X-X -0.04850 in at 5.255 ft above base
 for load combination : +D+L

PASS Maximum Shear Stress Ratio = **0.02099 : 1**
 Load Combination +D+L
 Location of max.above base 9.0 ft
 Applied Design Shear 2.351 psi
 Allowable Shear 112.0 psi

Other Factors used to calculate allowable stresses . . .
Bending Compression Tension

Load Combination Results

| Load Combination | C _D | C _P | Maximum Axial + Bending Stress Ratios | | | Maximum Shear Ratios | | |
|------------------|----------------|----------------|---------------------------------------|--------|----------|----------------------|--------|----------|
| | | | Stress Ratio | Status | Location | Stress Ratio | Status | Location |
| D Only | 0.900 | 0.904 | 0.2408 | PASS | 0.0 ft | 0.009593 | PASS | 9.0 ft |
| +D+L | 1.000 | 0.891 | 0.7030 | PASS | 8.940 ft | 0.02099 | PASS | 9.0 ft |
| +D+S | 1.150 | 0.870 | 0.3289 | PASS | 8.940 ft | 0.01224 | PASS | 9.0 ft |
| +D+0.750L | 1.250 | 0.856 | 0.4203 | PASS | 8.940 ft | 0.01432 | PASS | 9.0 ft |
| +D+0.750L+0.750S | 1.150 | 0.870 | 0.6328 | PASS | 8.940 ft | 0.01912 | PASS | 9.0 ft |
| +0.60D | 1.600 | 0.804 | 0.09135 | PASS | 0.0 ft | 0.003238 | PASS | 9.0 ft |

Maximum Reactions

Note: Only non-zero reactions are listed.

| Load Combination | X-X Axis Reaction k | | Y-Y Axis Reaction k | | Axial Reaction k | My - End Moments k-ft | | Mx - End Moments k-ft | |
|------------------|---------------------|-------|---------------------|-------|------------------|-----------------------|-------|-----------------------|-------|
| | @ Base | @ Top | @ Base | @ Top | | @ Base | @ Top | @ Base | @ Top |
| D Only | -0.020 | 0.020 | | | 2.157 | | | | |

Wood Column

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

SFA ENGINEERING LLC

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DESCRIPTION: C3

Maximum Reactions

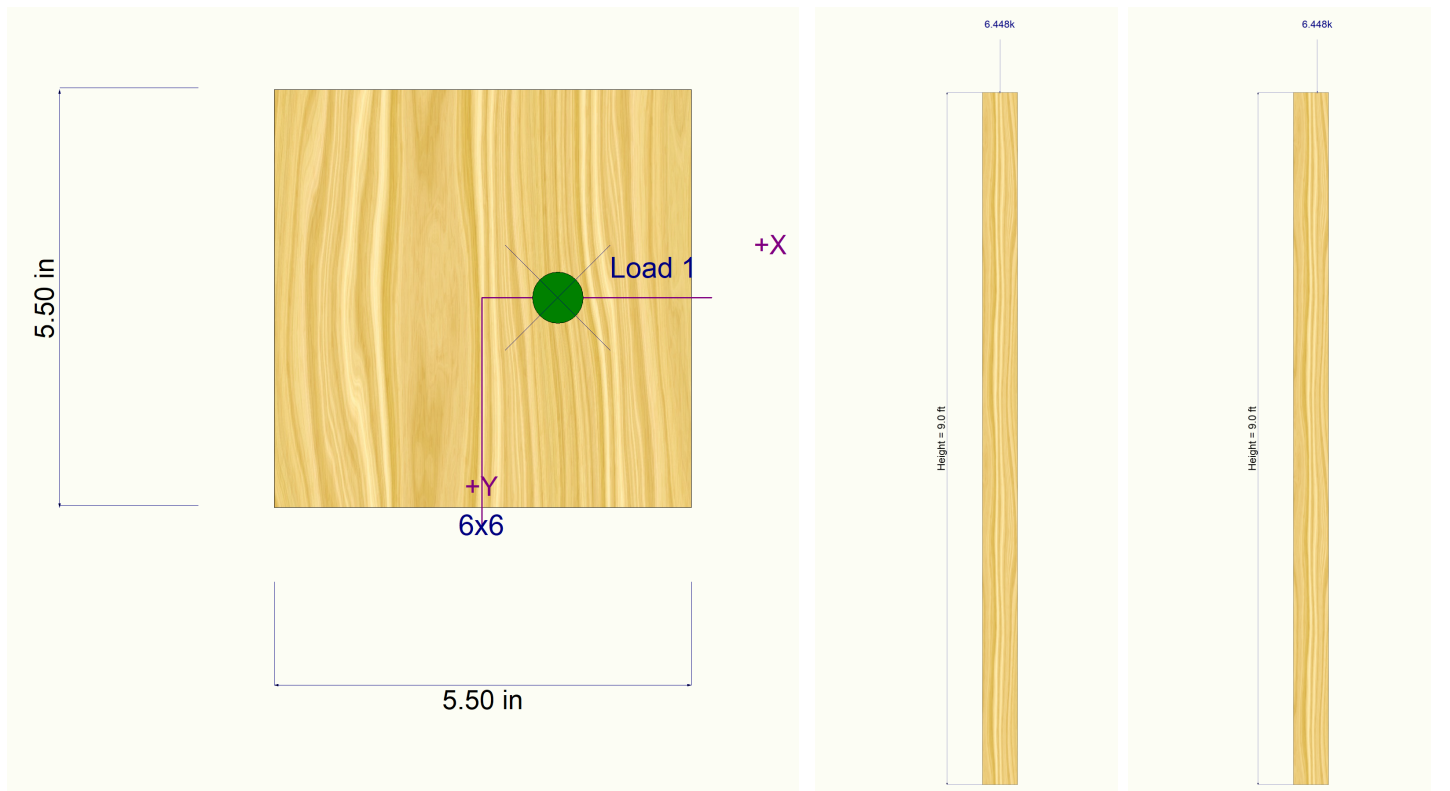
Note: Only non-zero reactions are listed.

| Load Combination | X-X Axis Reaction k | | Y-Y Axis Reaction k | | Axial Reaction @ Base | My - End Moments k-ft | | Mx - End Moments k-ft | |
|------------------|---------------------|-------|---------------------|-------|-----------------------|-----------------------|-------|-----------------------|-------|
| | @ Base | @ Top | @ Base | @ Top | | @ Base | @ Top | @ Base | @ Top |
| L Only | -0.028 | 0.028 | | | 3.015 | | | | |
| S Only | -0.012 | 0.012 | | | 1.327 | | | | |

Maximum Deflections for Load Combinations

| Load Combination | Max. X-X Deflection | Distance | Max. Y-Y Deflection | Distance |
|------------------|---------------------|----------|---------------------|----------|
| +D+L | -0.0485 in | 5.255ft | 0.000 in | 0.000 ft |
| L Only | -0.0286 in | 5.255ft | 0.000 in | 0.000 ft |
| S Only | -0.0126 in | 5.255ft | 0.000 in | 0.000 ft |

Sketches



Wall Footing

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

SFA ENGINEERING LLC

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DESCRIPTION: (E) cont footing at DJ2

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
 Load Combinations Used : ASCE 7-16

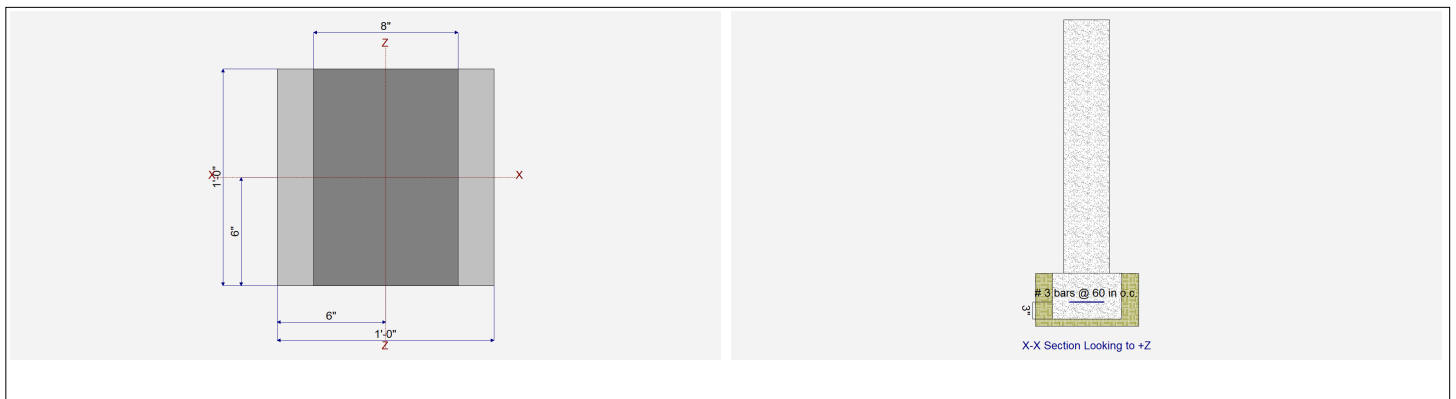
General Information

| | | | |
|-----------------------------------|---------------|--|-------------|
| Material Properties | | Soil Design Values | |
| f'_c : Concrete 28 day strength | = 2.50 ksi | Allowable Soil Bearing | = 1.50 ksf |
| f_y : Rebar Yield | = 60.0 ksi | Increase Bearing By Footing Weight | = No |
| E_c : Concrete Elastic Modulus | = 2,850.0 ksi | Soil Passive Resistance (for Sliding) | = 100.0 pcf |
| Concrete Density | = 145.0 pcf | Soil/Concrete Friction Coeff. | = 0.250 |
| ϕ Values Flexure | = 0.90 | Increases based on footing Depth | |
| Shear | = 0.750 | Reference Depth below Surface | = 1.50 ft |
| Analysis Settings | | Allow. Pressure Increase per foot of depth | = ksf |
| Min Steel % Bending Reinf. | = | when base footing is below | = ft |
| Min Allow % Temp Reinf. | = | Increases based on footing Width | |
| Min. Overturning Safety Factor | = 1.10 : 1 | Allow. Pressure Increase per foot of width | = ksf |
| Min. Sliding Safety Factor | = 1.10 : 1 | when footing is wider than | = ft |
| AutoCalc Footing Weight as DL : | Yes | Adjusted Allowable Bearing Pressure | |
| | | | = 1.50 ksf |

Dimensions

Reinforcing

| | | | | | |
|------------------------|----------|---|----------|----------------------|---------|
| Footing Width | = 1.0 ft | Footing Thickness | = 8.0 in | Bars along X-X Axis | |
| Wall Thickness | = 8.0 in | Rebar Centerline to Edge of Concrete... | | Bar spacing | = 60.00 |
| Wall center offset | | at Bottom of footing = | 3.0 in | Reinforcing Bar Size | = # 3 |
| from center of footing | = 0 in | | | | |



Applied Loads

| | D | Lr | L | S | W | E | H |
|-----------------|----------|-------------------------|--------|---|---|---|------|
| P : Column Load | = 0.5550 | | 0.5770 | | | | k |
| OB : Overburden | = 0.10 | | | | | | ksf |
| V-x | = | | | | | | k |
| M-zz | = | | | | | | k-ft |
| Vx applied | = | in above top of footing | | | | | |

Wall Footing

Project File: shi deck redo.ec6

LIC# : KW-06015057, Build:20.21.9.19

SFA ENGINEERING LLC

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DESCRIPTION: (E) cont footing at DJ2

DESIGN SUMMARY

Design OK

| Factor of Safety | Item | Applied | Capacity | Governing Load Combination | |
|------------------|------|-------------------|----------|----------------------------|----------------|
| PASS | n/a | Overturning - Z-Z | 0.0 k-ft | 0.0 k-ft | No Overturning |
| PASS | n/a | Sliding - X-X | 0.0 k | 0.0 k | No Sliding |
| PASS | n/a | Uplift | 0.0 k | 0.0 k | No Uplift |

| Utilization Ratio | Item | Applied | Capacity | Governing Load Combination | |
|-------------------|---------|------------------|---------------|----------------------------|--------------|
| PASS | 0.8413 | Soil Bearing | 1.262 ksf | 1.50 ksf | +D+L |
| PASS | 0.04576 | Z Flexure (+X) | 0.02254 k-ft | 0.4924 k-ft | +1.20D+1.60L |
| PASS | 0.01483 | Z Flexure (-X) | 0.007301 k-ft | 0.4924 k-ft | +0.90D |
| PASS | n/a | 1-way Shear (+X) | 0.0 psi | 75.0 psi | n/a |
| PASS | 0.0 | 1-way Shear (-X) | 0.0 psi | 0.0 psi | n/a |

Detailed Results

Soil Bearing

| Rotation Axis & Load Combination... | Gross Allowable | Xecc | Actual Soil Bearing Stress | | Actual / Allowable Ratio |
|-------------------------------------|-----------------|--------|----------------------------|------------|--------------------------|
| | | | -X | +X | |
| , D Only | 1.50 ksf | 0.0 in | 0.6850 ksf | 0.6850 ksf | 0.457 |
| , +D+L | 1.50 ksf | 0.0 in | 1.262 ksf | 1.262 ksf | 0.841 |
| , +D+0.750L | 1.50 ksf | 0.0 in | 1.118 ksf | 1.118 ksf | 0.745 |
| , +0.60D | 1.50 ksf | 0.0 in | 0.4110 ksf | 0.4110 ksf | 0.274 |

Overturning Stability

| Rotation Axis & Load Combination... | Overturning Moment | Resisting Moment | Stability Ratio | Status |
|-------------------------------------|--------------------|------------------|-----------------|--------|
| Footing Has NO Overturning | | | | |

Sliding Stability

| Force Application Axis Load Combination... | Sliding Force | Resisting Force | Sliding SafetyRatio | Status |
|--|---------------|-----------------|---------------------|--------|
| Footing Has NO Sliding | | | | |

Footing Flexure

| Flexure Axis & Load Combination | Mu k-ft | Which Side ? | Tension @ Bot. or Top ? | As Req'd in^2 | Gvrn. As in^2 | Actual As in^2 | Phi*Mn k-ft | Status |
|---------------------------------|----------|--------------|-------------------------|---------------|-----------------|----------------|-------------|--------|
| , +1.40D | 0.01136 | -X | Bottom | 0.0005 | Min for Bending | 0.022 | 0.4924 | OK |
| , +1.40D | 0.01136 | +X | Bottom | 0.0005 | Min for Bending | 0.022 | 0.4924 | OK |
| , +1.20D+1.60L | 0.02254 | -X | Bottom | 0.001 | Min for Bending | 0.022 | 0.4924 | OK |
| , +1.20D+1.60L | 0.02254 | +X | Bottom | 0.001 | Min for Bending | 0.022 | 0.4924 | OK |
| , +1.20D+L | 0.01774 | -X | Bottom | 0.0008 | Min for Bending | 0.022 | 0.4924 | OK |
| , +1.20D+L | 0.01774 | +X | Bottom | 0.0008 | Min for Bending | 0.022 | 0.4924 | OK |
| , +1.20D | 0.009734 | -X | Bottom | 0.0004 | Min for Bending | 0.022 | 0.4924 | OK |
| , +1.20D | 0.009734 | +X | Bottom | 0.0004 | Min for Bending | 0.022 | 0.4924 | OK |
| , +0.90D | 0.007301 | -X | Bottom | 0.0003 | Min for Bending | 0.022 | 0.4924 | OK |
| , +0.90D | 0.007301 | +X | Bottom | 0.0003 | Min for Bending | 0.022 | 0.4924 | OK |

One Way Shear

| Load Combination... | Vu @ -X | Vu @ +X | Vu:Max | Phi Vn | Vu / Phi*Vn | Status |
|---------------------|---------|---------|--------|--------|-------------|--------|
| +1.40D | 0 psi | 0 psi | 0 psi | 75 psi | 0 | OK |
| +1.20D+1.60L | 0 psi | 0 psi | 0 psi | 75 psi | 0 | OK |
| +1.20D+L | 0 psi | 0 psi | 0 psi | 75 psi | 0 | OK |
| +1.20D | 0 psi | 0 psi | 0 psi | 75 psi | 0 | OK |
| +0.90D | 0 psi | 0 psi | 0 psi | 75 psi | 0 | OK |



| | |
|-------------------------------------|-----------|
| PROJECT NO. MFR21-047 | SHEET NO. |
| PROJECT Do Residence Deck Design | |
| DATE 10/26/2021 | |
| SUBJECT Design Loads | |
| BY KEM/JAM | |

Worst Case Vertical Design Loads (Helical Piers at grid B/2)

| Load Type | Design Load | Depth | Area | Load | | |
|-------------------------|-------------|------------|-----------------------|----------|-----------------------------------|------------|
| 24"D x 18" Dia. Footing | (150 pcf) | (24.00 in) | 254.5 in ² | = 530 lb | Dead Load | 1.178 kips |
| | | | | | Floor Live Load | 6.704 kips |
| | | | | | Roof Snow Load | 2.368 kips |
| | | | | | Controlling ASD Load Combination: | |
| | | | | | D+0.75L+0.75S | |

| | |
|---|-------------------|
| Controlling ASD LC | 7.982 kips |
| Weight of Footing Above | 0.530 kips |
| Max Vertical Load to Worst Case Pier | 8.512 kips |



| | |
|--------------------------------------|--------------------|
| PROJECT Do Residence Deck Design | DATE 10/26/2021 |
| SUBJECT HP288 Helical Pier System | BY KEM/JAM |

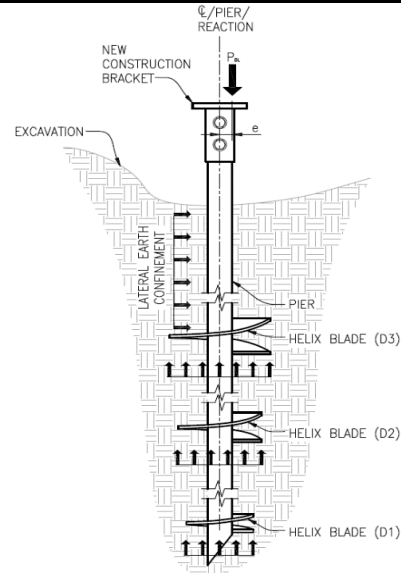
Design Input

Pier System Designation = **HP288**
 Pier Material = **Galvanized**
 Vertical Load to Pier, P_{TL} = **8.512 kips**
 Minimum Installation Depth, L = **8.000 ft**
 Unbraced Length, l = **4.000 ft**
 Eccentricity, e = **1.000 in**
 Friction Factor of Safety, FS = **2**
 Design Load (Vertical+Tieback), P_{DL} = **8.512 kips**
 Design Moment, M_{PierDL} = **8.512 kip-in**

Pier Property Input

Design Tube OD = 2.811 in
 Design Wall Thickness = 0.244 in
 k = 2.10
 r = 0.912 in
 A = 1.969 in²
 c = 1.406 in
 S = 1.164 in³
 Z = 1.614 in³
 I = 1.637 in⁴
 E = 29000 ksi
 F_y = 50 ksi

Note: Design thickness of pier and sleeve based on 93% of nominal thickness per AISC and the ICC-ES AC308 based on a corrosion loss rate of 50 years for zinc-coated steel



Note: Section above is a general representation of piercing system, refer to plan for layout and project specific details.

Pier Output Per AISC 325-11 Doubly and Singly Symmetric Members Subject To Flexure and Axial Force

| | | |
|--|-------------------------|----------------|
| kl/r = 110.56 | OK, <200 | §E2 |
| F_e = 23.407 ksi | | §(E3-4) |
| $4.71*(E/F_y)^{0.5}$ = 113.43 | | §E3 |
| F_{cr} = 20.449 ksi | | §(E3-2 & E3-3) |
| P_n = 40.3 kips | | §(E3-1) |
| Safety Factor for Compression, Ω_c = 1.67 | | |
| Allowable Axial Compressive Strength, P_n/Ω_c = 24.1 kips | | §E1 |
| Actual Axial Compressive Demand, P_r = 8.512 kips | | |
| D/t_{Pier} = 11.5 | OK, <.45E/F_y | §F8 |
| M_p = 80.7 kip-in | | §(F8-1) |
| Safety Factor for Flexure, Ω_b = 1.67 | | |
| Allowable Flexural Strength, M_n/Ω_b = 48.3 kip-in | | §F1 |
| Actual Flexural Demand, M_r = 8.5 kip-in | | |
| Combined Axial & Flexure Check = 0.51 | OK | §(H1-1a & 1b) |

Helix Properties and Capacity

| | | | |
|----------------------------|------------|--|-----------------------|
| $F_{yh} =$ | 50 ksi | | |
| $F_{bh} = 0.75 * F_{yh} =$ | 37.500 ksi | | |
| $D_1 =$ | 10 in | $A_1 = p * D_1^2 / 4 =$ | 78.5 in ² |
| $t_1 =$ | 0.375 in | $S_1 = 1 * t_1^2 / 6 =$ | 0.023 in ³ |
| $Q_1 = A_1 * w_1 =$ | 38.4 kips | $w_1 =$ | 0.489 ksi |
| $D_2 =$ | 12 in | $A_2 = p * D_2^2 / 4 - p * (\text{Tube OD})^2 / 4 =$ | 106.9 in ² |
| $t_2 =$ | 0.375 in | $S_2 = 1 * t_2^2 / 6 =$ | 0.023 in ³ |
| $Q_2 = A_2 * w_2 =$ | 40.9 kips | $w_2 =$ | 0.383 ksi |
| $D_3 =$ | 0 in | $A_3 = p * D_3^2 / 4 - p * (\text{Tube OD})^2 / 4 =$ | 0.0 in ² |
| $t_3 =$ | 0.000 in | $S_3 = 1 * t_3^2 / 6 =$ | 0.000 in ³ |
| $Q_3 = A_3 * w_3 =$ | 0.0 kips | $w_3 =$ | 0.000 ksi |
| $\Sigma Q =$ | 79.3 kips | | OK |

Helix Weld to Pier Capacity

| | | |
|---------------------------------|------------------|----------------|
| E70 Electrodes = | 70 ksi | |
| Size of Fillet Both Sides = | 0.250 in | |
| Capacity of Fillet Both Sides = | 7.424 kli | |
| R1 = | 1.758 kli | Weld OK |
| R2 = | 1.758 kli | Weld OK |
| R3 = | 0.000 kli | |

Soil - Individual Bearing Method - Cohesive

| | | |
|--|---------------------|----|
| Factor of Safety = | 2.0 | |
| Blow Count, N = | 13 | |
| $\Sigma A_h = A_1 + A_2 + A_3 =$ | 1.3 ft ² | |
| Cohesion, c = | 1.625 ksf | |
| $N_c =$ | 9 | |
| $Q_u = \Sigma A_h (c N_c) =$ | 18.833 kips | |
| $Q_{a, \text{compression/tension}} = Q_u / FS =$ | 9.416 kips | OK |

Soil - Individual Bearing Method - Non-Cohesive

| | | |
|---|------------|----------------------------|
| Factor of Safety, FS = | 2.0 | |
| $\gamma =$ | 110 pcf | |
| $\phi =$ | 32° | |
| Depth of Helix, D1 = | 7.500 ft | |
| Depth of Helix, D2 = | 5.000 ft | |
| Depth of Helix, D3 = | 0.000 ft | |
| $q'_1 = \gamma * D_1 =$ | 825.0 psf | |
| $q'_2 = \gamma * D_2 =$ | 550.0 psf | |
| $q'_3 = \gamma * D_3 =$ | 0.0 psf | |
| $N_q = 1 + 0.56(12 * \phi)^{0.54} =$ | 20.04 | (for $\phi = 32^\circ$) |
| $Q_{1u} = A_1 (q'_1 N_q) =$ | 9.017 kips | |
| $Q_{2u} = A_2 (q'_2 N_q) =$ | 8.181 kips | |
| $Q_{3u} = A_3 (q'_3 N_q) =$ | 0.000 kips | |
| $Q_{a, \text{compression/tension}} = \Sigma Q_u / FS =$ | 8.599 kips | OK ◀ Non-Cohesive Controls |

Soil - Torque Correlation Method - Verification

| | | |
|--|----------------------|-----------|
| Factor of Safety, FS = | 2.0 | |
| Design Work Load, DL = | 8.512 kips | |
| Empirical Torque Correlation Factor, $K_t =$ | 9.0 ft ⁻¹ | |
| Final Installation Torque, T = | 1892 lb-ft | |
| Ultimate Pile Capacity, $Q_u =$ | 17.024 kips | |
| Allowable Pile Capacity, $Q_a =$ | 8.512 kips | OK |

Results

Max Load To Pier = Design Load = 8512 lb
2.875 in Diameter Pier with 0.276 in Thick Wall
0.375" Thick 10/12" Helix With 0.25" Fillet Welds Each Side of Helix to Pier
Minimum 8'-0" Installation Depth And Minimum 3000 lb-ft Installation Torque



| | |
|--------------------------------------|--------------------|
| PROJECT NO. MFR21-047 | SHEET NO. |
| PROJECT Do Residence Deck Remodel | DATE 10/26/2021 |
| SUBJECT Face Mount Guardrail Calc | BY KEM |

Guardrail Design Criteria

| | | |
|---|-------------------|-------------------|
| Post spacing, $s =$ | 48 in o.c. | |
| Height of handrail point load, $h_h =$ | 36 in | |
| Height of decking, $h_d =$ | 0.75 in | |
| Height of rim/beam, $h_s =$ | 9.25 in | Joist closer than |
| Thickness of rim/beam, $t =$ | 1.5 in | 3" from end of |
| Lumber species = | HF | rim/beam? |
| Thickness of joist = | 2x | Yes |
| Type of Simpson holdown = | DTT2Z | |
| Holdown fasteners = | (8) SDS 1/4x1-1/2 | |
| Top edge distance to anchor, $h_t =$ | 1.625 in | |
| Bottom edge distance to anchor, $h_b =$ | 1.625 in | |
| Tension allowed, $T_{allowed} =$ | 1800 lb | |

Wood Post Design Criteria

| | | |
|-----------------------------|---------|---------------------------|
| Post width, $b =$ | 3.5 in | |
| Post depth, $d =$ | 3.5 in | |
| Post bending, $F_b =$ | 850 psi | [NDS Supplement Table 4A] |
| Size Factor, $C_F =$ | 1.5 | [NDS Supplement Table 4A] |
| Wet Service Factor, $C_M =$ | 0.85 | [NDS Supplement Table 4A] |
| Incising Factor, $C_F =$ | 0.8 | [NDS Table 4.3.8] |
| Duration Factor, $C_D =$ | 1.6 | [NDS Sec. B1.2 (10 min)] |

Wood Post Calcs

| | | |
|------------------------------------|-----------------------|----|
| Guardrail section modulus, $S_x =$ | 7.146 in ³ | |
| Moment applied, $M_{applied} =$ | 7675 in-lb | |
| Moment allowed, $M_{allowed} =$ | 9913 in-lb | OK |

Anchor Calcs

| | | |
|---|---------|----------------|
| Point load applied, $P =$ | 200 lb | [IBC 1607.8.1] |
| Tension applied to top bolt, $T_t =$ | 1672 lb | |
| Tension applied to bottom bolt, $T_b =$ | 1164 lb | OK |

Thru-Bolt Washer Calcs

| | | |
|------------------------------------|----------------------|----------------------|
| Bolt diameter = | 1/2 in | |
| Area of Bearing under washer = | 5.69 in ² | |
| Diameter of washer = | 2.75 in | |
| Washer bearing, $F_{c_{perp}} =$ | 405 psi | [NDS Supp. Table 4A] |
| Wet Service Factor, $C_M =$ | 0.67 | [NDS Supp. Table 4A] |
| Tension Allowed, $T_t_{allowed} =$ | 1755 lb | OK |
| Tension Allowed, $T_b_{allowed} =$ | 1544 lb | OK |

Bottom washer closer than 3" from bottom of guardrail post?
Yes

