QUANTUM
CONSULTING ENGINEERS

May 19, 2023


**STRUCTURAL CALCULATIONS**
(Permit Supplement)

**HEADRICK RESIDENCE**
8822 SE 62nd Street
Mercer Island, WA 98040

Quantum Job Number: 21271.01

*Prepared for:*
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Project Title:
Engineer:
Project ID:
Project Descr:

# Wood Beam

Project File: Headrick Rev 2.ec6

LIC# : KW-06016450, Build:20.23.04.05 QUANTUM CONSULTING ENGINEERS (c) ENERCALC INC 1983-2023

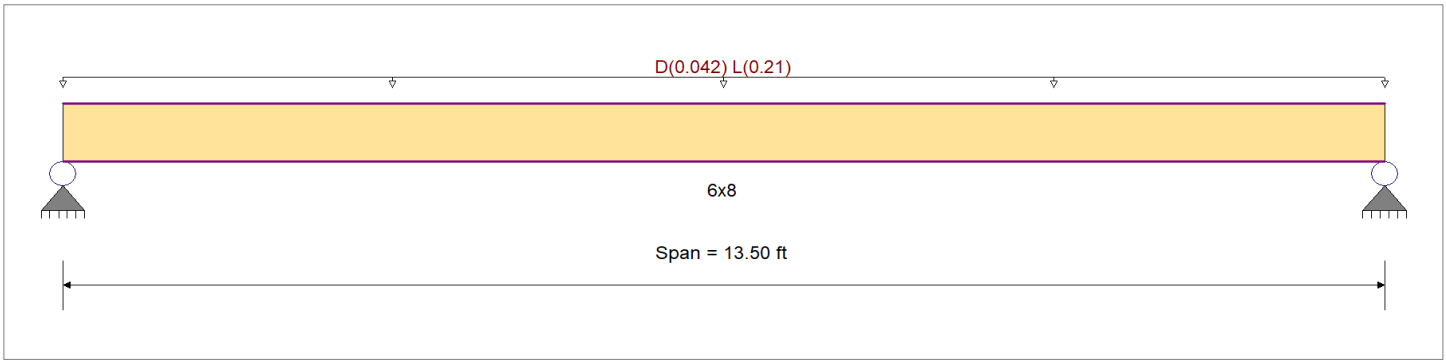
**DESCRIPTION:** L2J3 Rev 2 - Deck Joist

## CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
Load Combination Set : IBC 2015

## Material Properties

| | | | | | |
|---|---|---|---|---|---|
| Analysis Method : | Allowable Stress Design | Fb + | 1,600.0 psi | *E : Modulus of Elasticity* | |
| Load Combination | IBC 2015 | Fb - | 1,600.0 psi | Ebend- xx | 1,600.0 ksi |
| | | Fc - Prll | 1,100.0 psi | Eminbend - xx | 580.0 ksi |
| Wood Species : | Douglas Fir - Larch | Fc - Perp | 625.0 psi | | |
| Wood Grade : | Select structural | Fv | 170.0 psi | | |
| | | Ft | 950.0 psi | Density | 31.20 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 loading
Uniform Load : D = 0.0120, L = 0.060 ksf, Tributary Width = 3.50 ft, (Deck)

## DESIGN SUMMARY

**Design OK**

| | | | | | |
|---|---|---|---|---|---|
| Maximum Bending Stress Ratio | = | 0.865 : 1 | Maximum Shear Stress Ratio | = | 0.344 : 1 |
| Section used for this span | | 6x8 | Section used for this span | | 6x8 |
| fb: Actual | = | 1,383.44 psi | fv: Actual | = | 58.44 psi |
| F'b | = | 1,600.00 psi | F'v | = | 170.00 psi |
| Load Combination | | +D+L | Load Combination | | +D+L |
| Location of maximum on span | = | 6.750 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 | 0.510 in | Ratio = | 317 >=240 | Span: 1 : L Only |
| Max Upward Transient Deflection | 0 in | Ratio = | 0 <240 | n/a |
| Max Downward Total Deflection | 0.634 in | Ratio = | 255 >=180 | Span: 1 : +D+L |
| Max Upward Total Deflection | 0 in | Ratio = | 0 <180 | n/a |

## Maximum Forces & Stresses for Load Combinations

| Load Combination | | Max Stress Ratios | | | | | | | | | | Moment Values | | | Shear Values | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Segment Length | Span # | M | V | CD | CM | $C_t$ | CLx | $C_F$ | Cfu | $C_i$ | $C_r$ | M | fb | F'b | V | fv | F'v |
| D Only | | | | | | | | | | | | | | 0.0 | 0.00 | 0.0 | 0.0 |
| Length = 13.451 ft | 1 | 0.188 | 0.075 | 0.90 | 1.00 | 1.00 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 1.16 | 270.1 | 1,440.0 | 0.31 | 11.4 | 153.0 |
| Length = 0.04927 ft | 1 | 0.003 | 0.075 | 0.90 | 1.00 | 1.00 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 0.02 | 3.9 | 1,440.0 | 0.31 | 11.4 | 153.0 |
| +D+L | | | | | 1.00 | 1.00 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | | | 0.0 | 0.00 | 0.0 | 0.0 |
| Length = 13.451 ft | 1 | 0.865 | 0.344 | 1.00 | 1.00 | 1.00 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 5.94 | 1,383.4 | 1,600.0 | 1.61 | 58.4 | 170.0 |
| Length = 0.04927 ft | 1 | 0.013 | 0.344 | 1.00 | 1.00 | 1.00 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 0.09 | 20.1 | 1,600.0 | 1.61 | 58.4 | 170.0 |
| +D+0.750L | | | | | 1.00 | 1.00 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | | | 0.0 | 0.00 | 0.0 | 0.0 |
| Length = 13.451 ft | 1 | 0.553 | 0.220 | 1.25 | 1.00 | 1.00 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 4.75 | 1,105.1 | 2,000.0 | 1.28 | 46.7 | 212.5 |
| Length = 0.04927 ft | 1 | 0.008 | 0.220 | 1.25 | 1.00 | 1.00 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 0.07 | 16.1 | 2,000.0 | 1.28 | 46.7 | 212.5 |
| +0.60D | | | | | 1.00 | 1.00 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | | | 0.0 | 0.00 | 0.0 | 0.0 |

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**DESCRIPTION:** L2J3 Rev 2 - Deck Joist

## Maximum Forces & Stresses for Load Combinations

| Load Combination / Segment Length | Span # | Max Stress Ratios M | V | CD | CM | $C_t$ | CLx | $C_F$ | Cfu | $C_i$ | $C_r$ | Moment Values M | fb | F'b | Shear Values V | fv | F'v |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Length = 13.451 ft | 1 | 0.063 | 0.025 | 1.60 | 1.00 | 1.00 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 0.70 | 162.0 | 2,560.0 | 0.19 | 6.8 | 272.0 |
| Length = 0.04927 ft | 1 | 0.001 | 0.025 | 1.60 | 1.00 | 1.00 | 1.00 | 1.000 | 1.00 | 1.00 | 1.00 | 0.01 | 2.4 | 2,560.0 | 0.19 | 6.8 | 272.0 |

## Overall Maximum Deflections

| Load Combination | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|---|---|---|---|---|---|---|
| +D+L | 1 | 0.6340 | 6.799 | | 0.0000 | 0.000 |

## Vertical Reactions

Support notation : Far left is #1 Values in KIPS

| Load Combination | Support 1 | Support 2 |
|---|---|---|
| Max Upward from all Load Conditions | 1.761 | 1.761 |
| Max Upward from Load Combinations | 1.761 | 1.761 |
| Max Upward from Load Cases | 1.418 | 1.418 |
| D Only | 0.344 | 0.344 |
| +D+L | 1.761 | 1.761 |
| +D+0.750L | 1.407 | 1.407 |
| +0.60D | 0.206 | 0.206 |
| L Only | 1.418 | 1.418 |

| Second Level | | | |
|---|---|---|---|
| Member Name | Results | Current Solution | Comments |
| L2B3. - Deck Rev 2 | Passed | 1 piece(s) 6 3/4" x 15" 24F-V4 DF Glulam | |



| ForteWEB Software Operator | Job Notes |
|---|---|
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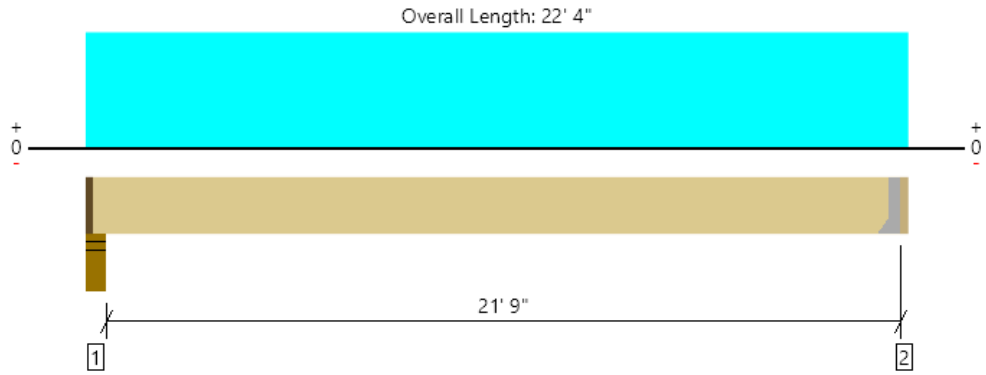
Second Level, L2B3. - Deck Rev 2

1 piece(s) 6 3/4" x 15" 24F-V4 DF Glulam




All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

| Design Results | Actual @ Location | Allowed | Result | LDF | Load: Combination (Pattern) |
|---|---|---|---|---|---|
| Member Reaction (lbs) | 5585 @ 22' 2" | 6581 (1.50") | Passed (85%) | -- | 1.0 D + 1.0 L (All Spans) |
| Shear (lbs) | 4947 @ 20' 11" | 17888 | Passed (28%) | 1.00 | 1.0 D + 1.0 L (All Spans) |
| Pos Moment (Ft-lbs) | 30542 @ 11' 2 3/4" | 47967 | Passed (64%) | 1.00 | 1.0 D + 1.0 L (All Spans) |
| Live Load Defl. (in) | 0.611 @ 11' 2 3/4" | 0.729 | Passed (L/430) | -- | 1.0 D + 1.0 L (All Spans) |
| Total Load Defl. (in) | 0.770 @ 11' 2 3/4" | 1.094 | Passed (L/341) | -- | 1.0 D + 1.0 L (All Spans) |

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume factor of 0.95 that was calculated using length L = 21' 10 1/2".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

| Supports | Bearing Length | | | Loads to Supports (lbs) | | | Accessories |
|---|---|---|---|---|---|---|---|
| | Total | Available | Required | Dead | Floor Live | Factored | |
| 1 - Stud wall - HF | 5.00" | 3.25" | 2.07" | 1182 | 4548 | 5730 | 1 3/4" Rim Board |
| 2 - Hanger on 15" HF beam | 2.00" | Hanger[1] | 1.50" | 1169 | 4497 | 5666 | See note [1] |

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

| Lateral Bracing | Bracing Intervals | Comments |
|---|---|---|
| Top Edge (Lu) | 22' o/c | |
| Bottom Edge (Lu) | 22' o/c | |

•Maximum allowable bracing intervals based on applied load.

| Connector: Simpson Strong-Tie | | | | | | |
|---|---|---|---|---|---|---|
| Support | Model | Seat Length | Top Fasteners | Face Fasteners | Member Fasteners | Accessories |
| 2 - Face Mount Hanger | HGUS6.88/12 | 4.00" | N/A | 56-10d | 20-10d | |

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

| Vertical Loads | Location (Side) | Tributary Width | Dead (0.90) | Floor Live (1.00) | Comments |
|---|---|---|---|---|---|
| 0 - Self Weight (PLF) | 1 3/4" to 22' 2" | N/A | 24.6 | -- | |
| 1 - Uniform (PSF) | 0 to 22' 4" (Front) | 6' 9" | 12.0 | 60.0 | Deck |

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

| ForteWEB Software Operator | Job Notes |
|---|---|
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