APEX
ENGINEERS, INC.

October 24, 2018

Kevin Higdon Construction
PO Box 847
Lee's Summit, MO 64063

Re: Permit #: PRRES20181851
        1531 SW Blackstone Pl
        Lee's Summit, MO 64082

Apex Engineers, Inc. has been asked to address comments from the city rough-in inspection for the house at the address above.

Provide engineers report on cut LVL in master bedroom.
- The (2) 1 ¾"x18" LVL has a tapered notch at each end. There is 9" of remaining member depth at the notch, measured at the bearing wall at each end of the beam. After computations, the (2) 1 ¾"x18" LVL adequately supports the design loads.

Our firm recommends approval of this structural issue. Please call if Apex Engineers, Inc. can be of further assistance.

LIMITATIONS
The scope of our services includes only those items specifically addressed herein. No attempt was made to design or check the design of any structural members other than those specifically addressed herein. All other items are outside the scope of this inspection; including but not limited to, any environmental assessment (such as, but not limited to mold, mildew, presence of hazardous or toxic materials in the soil, surface water, ground water, etc.).

In addition, the scope of our services does not include any evaluation of the building or site for job-site safety and/or hazardous conditions. All construction shall be performed in compliance with IRC and OSHA standards at all times. Our firm has not been retained to examine the site or building for any of these conditions. In addition, the contractor shall retain sole responsibility for the quality of work, for adhering to plans, specifications, appropriate codes, and, for repairing defects, deficiencies or omission, regardless of when they are found.

Best Regards,
Apex Engineers, Inc.

Joshua M. Jensen, E.I.T.
Project Engineer

Project Title:
Engineer:
Project ID:
Project Descr:

Wood Beam

SW Blackstone Place_Lot 1531 Napa Valley_LSMO\2018.10.24_Struct_Kevin Higdon Homes\Eng\beam calcs.ec6

Lic. # : KW-06005244	Licensee : APEX ENGINEERS INC

Description : LVL Over Master Bedroom

CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
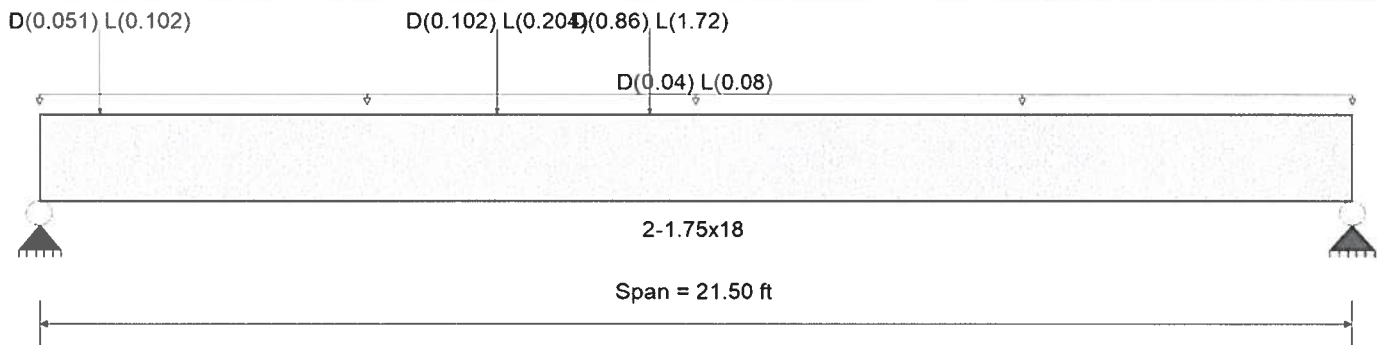Load Combination Set : IBC 2012

Material Properties

Analysis Method : Allowable Stress Design	Fb +	2600 psi
Load Combination IBC 2012	Fb -	2600 psi
	Fc - Prll	2510 psi
	Fc - Perp	750 psi
Wood Species : Trus Joist	Fv	285 psi
Wood Grade : MicroLam LVL 1.9 E	Ft	1555 psi

E : Modulus of Elasticity
Ebend- xx   1900 ksi
Eminbend - xx   965.71 ksi

Density   42 pcf

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

D(0.051) L(0.102)   D(0.102) L(0.204) D(0.86) L(1.72)

D(0.04) L(0.08)

2-1.75x18

Span = 21.50 ft

Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.0050, L = 0.010 ksf, Tributary Width = 8.0 ft, (Ceiling Load)

Point Load : D = 0.860, L = 1.720 k @ 10.0 ft, (Points Load From Ridge Above)

Point Load : D = 0.1020, L = 0.2040 k @ 7.50 ft, (Point Load From Roof Hip)

Point Load : D = 0.0510, L = 0.1020 k @ 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.562 1	Maximum Shear Stress Ratio	=	0.238 : 1	
Section used for this span		2-1.75x18	Section used for this span		2-1.75x18	
fb : Actual	=	1,461.48 psi	fv : Actual	=	67.94 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	=	9.965 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	0.331 in	Ratio =	778 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.525 in	Ratio =	491 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

(State of Missouri Professional Engineer seal: CLAYTON J HESS, NUMBER PE-2002000003)
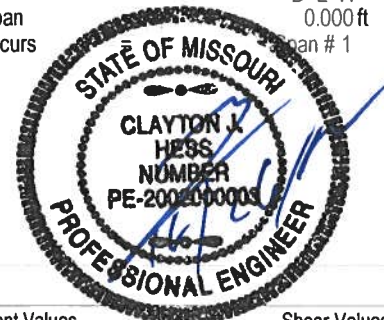
Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	C_{FV}	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
+D+H											0.00	0.00	0.00	0.00	0.00	0.00

Apex Engineers
1625 Locust St
Kansas City, Missouri 64108
www.apex-engineers.com
Title Block" selection.
Title Block Line 6

Wood Beam

SW Blackstone Place_Lot 1531 Napa Valley_LSMO\2018.10.24_Struct_Kevin Higdon Homes\Eng\beam calcs.ec6

Lic. # : KW-06005244   **Licensee : APEX ENGINEERS INC**

Description :   LVL Over Master Bedroom

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	C_d	C_{FN}	C_i	C_r	C_m	C_t	C_L	Moment Values M	fb	F'b	Shear Values V	fv	F'v
Length = 21.50 ft	1	0.227	0.099	0.90	1.000	1.00	1.00	1.00	1.00	1.00	8.38	531.86	2340.00	1.06	25.35	256.50
+D+L+H					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 21.50 ft	1	0.562	0.238	1.00	1.000	1.00	1.00	1.00	1.00	1.00	23.02	1,461.48	2600.00	2.85	67.94	285.00
+D+Lr+H					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 21.50 ft	1	0.164	0.071	1.25	1.000	1.00	1.00	1.00	1.00	1.00	8.38	531.86	3250.00	1.06	25.35	356.25
+D+S+H					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 21.50 ft	1	0.178	0.077	1.15	1.000	1.00	1.00	1.00	1.00	1.00	8.38	531.86	2990.00	1.06	25.35	327.75
+D+0.750Lr+0.750L+H					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 21.50 ft	1	0.378	0.161	1.25	1.000	1.00	1.00	1.00	1.00	1.00	19.36	1,229.08	3250.00	2.41	57.29	356.25
+D+0.750L+0.750S+H					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 21.50 ft	1	0.411	0.175	1.15	1.000	1.00	1.00	1.00	1.00	1.00	19.36	1,229.08	2990.00	2.41	57.29	327.75
+D+0.60W+H					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 21.50 ft	1	0.128	0.056	1.60	1.000	1.00	1.00	1.00	1.00	1.00	8.38	531.86	4160.00	1.06	25.35	456.00
+D+0.70E+H					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 21.50 ft	1	0.128	0.056	1.60	1.000	1.00	1.00	1.00	1.00	1.00	8.38	531.86	4160.00	1.06	25.35	456.00
+D+0.750Lr+0.750L+0.450W+H					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 21.50 ft	1	0.295	0.126	1.60	1.000	1.00	1.00	1.00	1.00	1.00	19.36	1,229.08	4160.00	2.41	57.29	456.00
+D+0.750L+0.750S+0.450W+H					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 21.50 ft	1	0.295	0.126	1.60	1.000	1.00	1.00	1.00	1.00	1.00	19.36	1,229.08	4160.00	2.41	57.29	456.00
+D+0.750L+0.750S+0.5250E+H					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 21.50 ft	1	0.295	0.126	1.60	1.000	1.00	1.00	1.00	1.00	1.00	19.36	1,229.08	4160.00	2.41	57.29	456.00
+0.60D+0.60W+0.60H					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 21.50 ft	1	0.077	0.033	1.60	1.000	1.00	1.00	1.00	1.00	1.00	5.03	319.12	4160.00	0.64	15.21	456.00
+0.60D+0.70E+0.60H					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 21.50 ft	1	0.077	0.033	1.60	1.000	1.00	1.00	1.00	1.00	1.00	5.03	319.12	4160.00	0.64	15.21	456.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	1	0.5247	10.593		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1   Values in KIPS

| Load Combination	Support 1	Support 2
Overall MAXimum	3.213	2.801
Overall MINimum	2.010	1.736
+D+H	1.203	1.065
+D+L+H	3.213	2.801
+D+Lr+H	1.203	1.065
+D+S+H	1.203	1.065
+D+0.750Lr+0.750L+H	2.710	2.367
+D+0.750L+0.750S+H	2.710	2.367
+D+0.60W+H	1.203	1.065
+D+0.70E+H	1.203	1.065
+D+0.750Lr+0.750L+0.450W+H	2.710	2.367
+D+0.750L+0.750S+0.450W+H	2.710	2.367
+D+0.750L+0.750S+0.5250E+H	2.710	2.367
+0.60D+0.60W+0.60H	0.722	0.639
+0.60D+0.70E+0.60H	0.722	0.639
D Only	1.203	1.065
Lr Only		
L Only	2.010	1.736
S Only		
W Only		
E Only		
H Only		

Project:	1531 SW Blackstone Pl
Client:	Kevin Higdon Homes
Engineer:	JMJ
Date:	10/25/2018
Description:	Notched LVL

A APEX
ENGINEERS INC

B. TAPERED BEAM
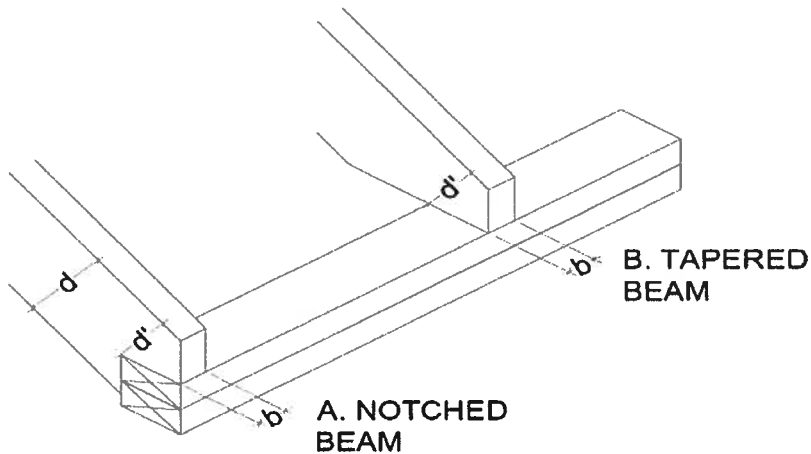
A. NOTCHED BEAM

NOTCHED/TAPERED BEAM CALCULATIONS

Input (to find shear value):

	1
Location =	North End
Type of notch =	Tapered Beam
Type of lumber =	LVL
b =	3.50 in
d =	18.00 in
d_n =	9.00 in
L =	21.60 ft
V =	2810 lb
C_D =	1.15
f_v =	134 psi
F'_v =	328 psi
Pass or Fail	Pass

The shear force in the member at the notch is calculated as:

The actual shear stress in the member at the notch is calculated as:

For notched members: $\quad f_v = \dfrac{3V}{2bd_n}\left[\dfrac{d}{d_n}\right]^2$

For tapered members: $\quad f_v = \dfrac{3V}{2bd_n}$

The adjusted design value of the allowable shear stress is calculated as:

$$F'_v = F_v C_D$$

Nomenclature:

- b = Width of Member
- d = Depth of Member (Unnotched)
- d_n = Depth of Member at Notch (Measured Perpendicular to the Longitudinal Axis)
- L = Span Length of Member
- V = Shear Force in Member at Notch
- C_D = Load Duration Factor (From NDS Table 2.3.2)
- f_v = Actual Shear Stress in Member at Notch
- F_v = Reference design value for allowable shear stress (from manufacturers data)
- F'_v = Allowable Shear Stress

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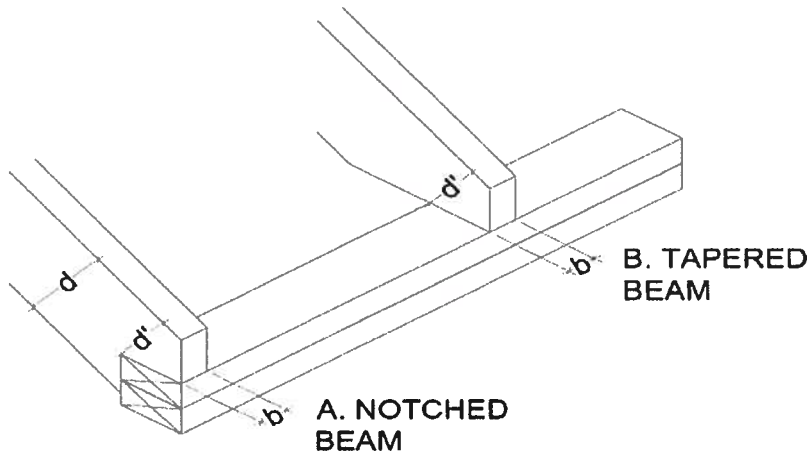
A. NOTCHED BEAM

NOTCHED/TAPERED BEAM CALCULATIONS

Input (to find shear value):

	1
Location =	South End
Type of notch =	Tapered Beam
Type of lumber =	LVL
b =	3.50 in
d =	18.00 in
d_n =	9.00 in
L =	21.60 ft
V =	3210 lb
C_D =	1.15
f_v =	153 psi
F'_v =	328 psi
Pass or Fail	Pass

The shear force in the member at the notch is calculated as:

The actual shear stress in the member at the notch is calculated as:

For notched members:
$$f_v = \frac{3V}{2bd_n}\left[\frac{d}{d_n}\right]^2$$

For tapered members:
$$f_v = \frac{3V}{2bd_n}$$

The adjusted design value of the allowable shear stress is calculated as:

$$F'_v = F_v C_D$$

Nomenclature:

- b = Width of Member
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- F_v = Reference design value for allowable shear stress (from manufacturers data)
- F'_v = Allowable Shear Stress