

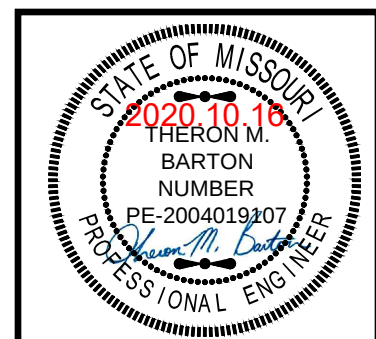
Apex Engineers, Inc.
1625 Locust St
Kansas City, MO 64108

Ph: (816) 421-3222
Fax: (816) 421-1050



STRUCTURAL DESIGN CALCULATIONS

PROJECT:	39808
LOCATION:	1712 SW 27th Street Lee's Summit, MO
CLIENT:	Rob Washam Homes
DATE:	10/16/2020



Project Title:
Engineer:
Project ID:
Project Descr:



Wood Beam

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APEX ENGINEERS INC

Lic. #: KW-06005244

DESCRIPTION: Sawn lumber replacing LVL in mater bathroom on main floor

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
Load Combination : ASCE 7-16

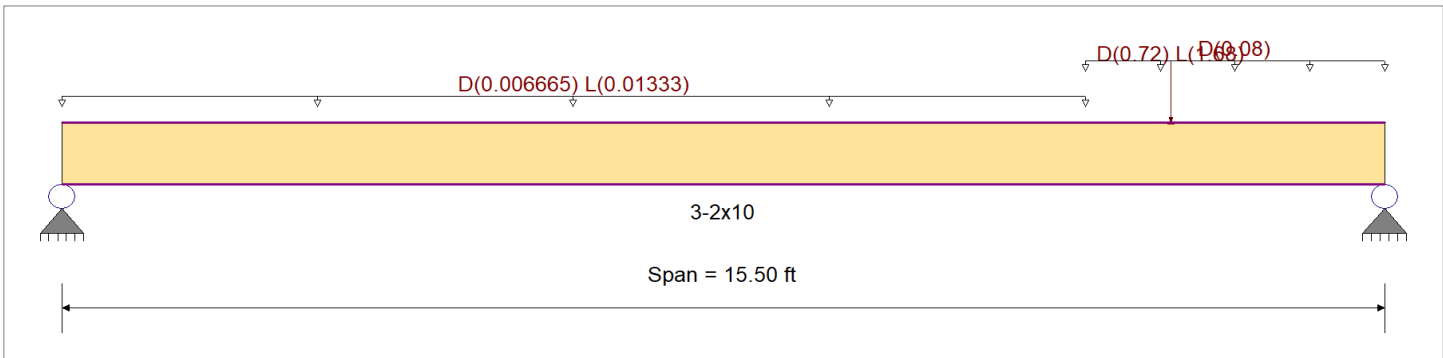
Wood Species : Douglas Fir-Larch
Wood Grade : No.2

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

Fb + 900.0 psi
Fb - 900.0 psi
Fc - Prll 1,350.0 psi
Fc - Perp 625.0 psi
Fv 180.0 psi
Ft 575.0 psi

E : Modulus of Elasticity
Ebend- xx 1,600.0 ksi
Eminbend - xx 580.0 ksi

Density 31.210 pcf
Repetitive Member Stress Increase



Applied Loads

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

Load for Span Number 1

Uniform Load : D = 0.0050, L = 0.010 ksf, Extent = 0.0 --> 12.0 ft, Tributary Width = 1.333 ft

Uniform Load : D = 0.010 ksf, Extent = 12.0 --> 15.50 ft, Tributary Width = 8.0 ft

Point Load : D = 0.720, L = 1.680 k @ 13.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.924	1	Maximum Shear Stress Ratio	=	0.460	: 1
Section used for this span		3-2x10		Section used for this span		3-2x10	
fb: Actual	=	1,051.70	psi	fv: Actual	=	82.71	psi
Fb: Allowable	=	1,138.50	psi	Fv: Allowable	=	180.00	psi
Load Combination		+D+L+H		Load Combination		+D+L+H	
Location of maximum on span	=	12.954	ft	Location of maximum on span	=	14.765	ft
Span # where maximum occurs	=	Span # 1		Span # where maximum occurs	=	Span # 1	
Maximum Deflection							
Max Downward Transient Deflection		0.259	in	Ratio =		718	>=360
Max Upward Transient Deflection		0.000	in	Ratio =		0	<360
Max Downward Total Deflection		0.399	in	Ratio =		466	>=360
Max Upward Total Deflection		0.000	in	Ratio =		0	<360

Maximum Forces & Stresses for Load Combinations

Load Combination Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values		
		M	V	C _d	C _{F/V}	C _i	C _r	C _m	C _t	C _L	M	fb	F'b	V	fv	F'v
+D+H													0.00	0.00	0.00	0.00
Length = 15.50 ft	1	0.357	0.183	0.90	1.100	1.00	1.15	1.00	1.00	1.00	1.96	365.82	1024.65	0.82	29.71	162.00
+D+L+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1	0.924	0.460	1.00	1.100	1.00	1.15	1.00	1.00	1.00	5.62	1,051.70	1138.50	2.30	82.71	180.00
+D+Lr+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1	0.257	0.132	1.25	1.100	1.00	1.15	1.00	1.00	1.00	1.96	365.82	1423.13	0.82	29.71	225.00
+D+S+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1	0.279	0.144	1.15	1.100	1.00	1.15	1.00	1.00	1.00	1.96	365.82	1309.28	0.82	29.71	207.00
+D+0.750Lr+0.750L+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1	0.619	0.309	1.25	1.100	1.00	1.15	1.00	1.00	1.00	4.71	880.23	1423.13	1.93	69.46	225.00
+D+0.750L+0.750S+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00

Project Title:
 Engineer:
 Project ID:
 Project Descr:



Wood Beam

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Lic. # : KW-06005244

APEX ENGINEERS INC

DESCRIPTION: Sawn lumber replacing LVL in mater bathroom on main floor

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values		
			M	V	C _d	C _{F/V}	C _i	C _r	C _m	C _t	C _L	M	f _b	F _b	V	f _v	F _v
Length = 15.50 ft	1		0.672	0.336	1.15	1.100	1.00	1.15	1.00	1.00	1.00	4.71	880.23	1309.28	1.93	69.46	207.00
+D+0.60W+H						1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1		0.201	0.103	1.60	1.100	1.00	1.15	1.00	1.00	1.00	1.96	365.82	1821.60	0.82	29.71	288.00
+D+0.750Lr+0.750L+0.450W+H						1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1		0.483	0.241	1.60	1.100	1.00	1.15	1.00	1.00	1.00	4.71	880.23	1821.60	1.93	69.46	288.00
+D+0.750L+0.750S+0.450W+H						1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1		0.483	0.241	1.60	1.100	1.00	1.15	1.00	1.00	1.00	4.71	880.23	1821.60	1.93	69.46	288.00
+0.60D+0.60W+0.60H						1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1		0.120	0.062	1.60	1.100	1.00	1.15	1.00	1.00	1.00	1.17	219.49	1821.60	0.49	17.82	288.00
+D+0.70E+0.60H						1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1		0.201	0.103	1.60	1.100	1.00	1.15	1.00	1.00	1.00	1.96	365.82	1821.60	0.82	29.71	288.00
+D+0.750L+0.750S+0.5250E+H						1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1		0.483	0.241	1.60	1.100	1.00	1.15	1.00	1.00	1.00	4.71	880.23	1821.60	1.93	69.46	288.00
+0.60D+0.70E+H						1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1		0.120	0.062	1.60	1.100	1.00	1.15	1.00	1.00	1.00	1.17	219.49	1821.60	0.49	17.82	288.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	1	0.3988	8.712		0.0000	0.000

Maximum Deflections for Load Combinations

Load Combination	Span	Max. Downward Defl	Location in Span	Max. Upward Defl	Location in Span
+D+H	1	0.1398 in	8.712 ft	0.0000 in	0.000 ft
+D+L+H	1	0.3988 in	8.712 ft	0.0000 in	0.000 ft
+D+Lr+H	1	0.1398 in	8.712 ft	0.0000 in	0.000 ft
+D+S+H	1	0.1398 in	8.712 ft	0.0000 in	0.000 ft
+D+0.750Lr+0.750L+H	1	0.3341 in	8.712 ft	0.0000 in	0.000 ft
+D+0.750L+0.750S+H	1	0.3341 in	8.712 ft	0.0000 in	0.000 ft
+D+0.60W+H	1	0.1398 in	8.712 ft	0.0000 in	0.000 ft
+D+0.750Lr+0.750L+0.450W+H	1	0.3341 in	8.712 ft	0.0000 in	0.000 ft
+D+0.750L+0.750S+0.450W+H	1	0.3341 in	8.712 ft	0.0000 in	0.000 ft
+0.60D+0.60W+0.60H	1	0.0839 in	8.712 ft	0.0000 in	0.000 ft
+D+0.70E+0.60H	1	0.1398 in	8.712 ft	0.0000 in	0.000 ft
+D+0.750L+0.750S+0.5250E+H	1	0.3341 in	8.712 ft	0.0000 in	0.000 ft
+0.60D+0.70E+H	1	0.0839 in	8.712 ft	0.0000 in	0.000 ft
D Only	1	0.1398 in	8.712 ft	0.0000 in	0.000 ft
L Only	1	0.2590 in	8.712 ft	0.0000 in	0.000 ft

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.566	2.354
Overall MINimum	0.369	1.471
+D+H	0.197	0.883
+D+L+H	0.566	2.354
+D+Lr+H	0.197	0.883
+D+S+H	0.197	0.883
+D+0.750Lr+0.750L+H	0.474	1.986
+D+0.750L+0.750S+H	0.474	1.986
+D+0.60W+H	0.197	0.883
+D+0.750Lr+0.750L+0.450W+H	0.474	1.986
+D+0.750L+0.750S+0.450W+H	0.474	1.986
+0.60D+0.60W+0.60H	0.118	0.530
+D+0.70E+0.60H	0.197	0.883
+D+0.750L+0.750S+0.5250E+H	0.474	1.986
+0.60D+0.70E+H	0.118	0.530
D Only	0.197	0.883
L Only	0.369	1.471
H Only		

Project Title:
 Engineer:
 Project ID:
 Project Descr:

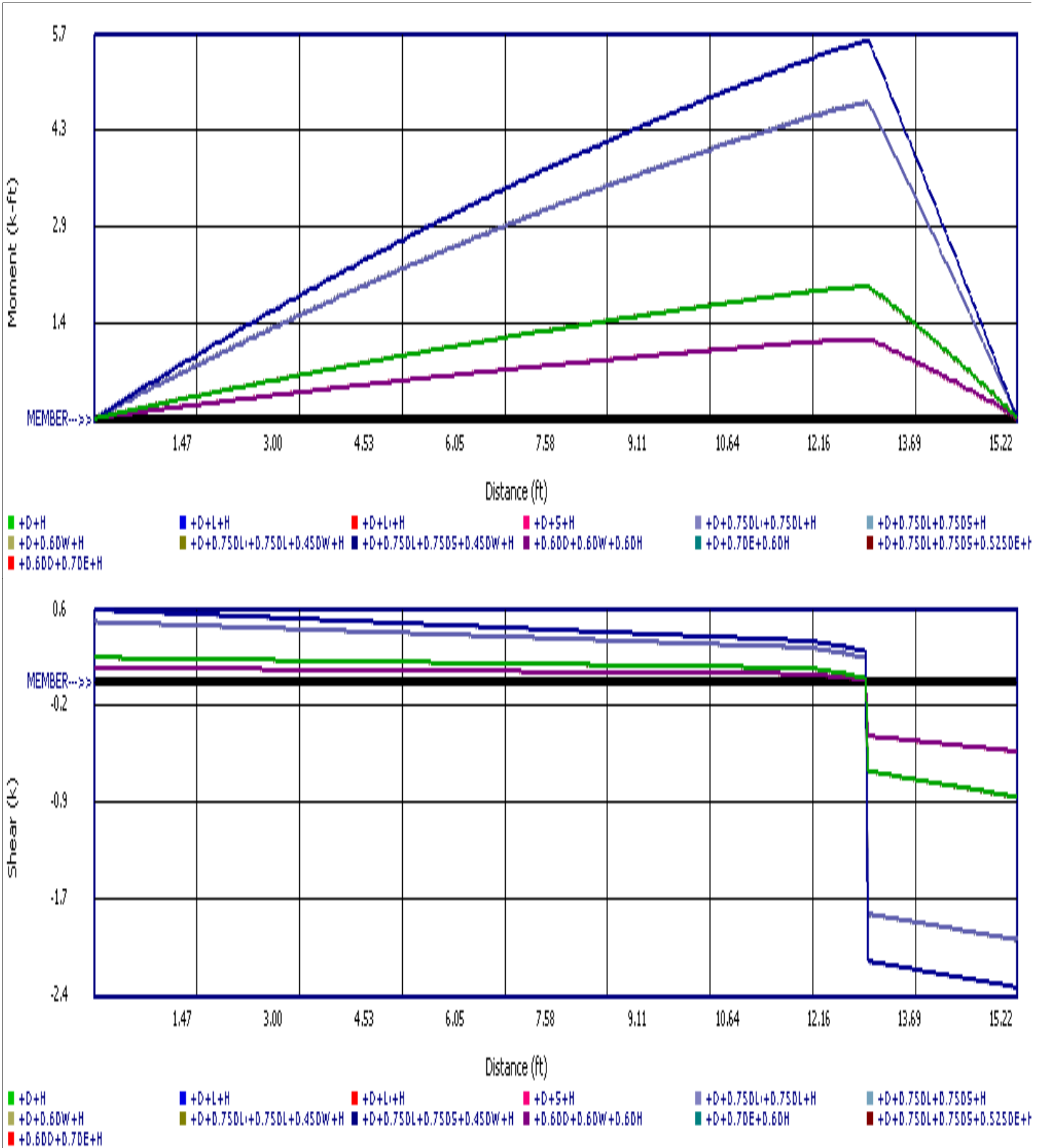


Wood Beam

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DESCRIPTION: Sawn lumber replacing LVL in mater bathroom on main floor



Project Title:
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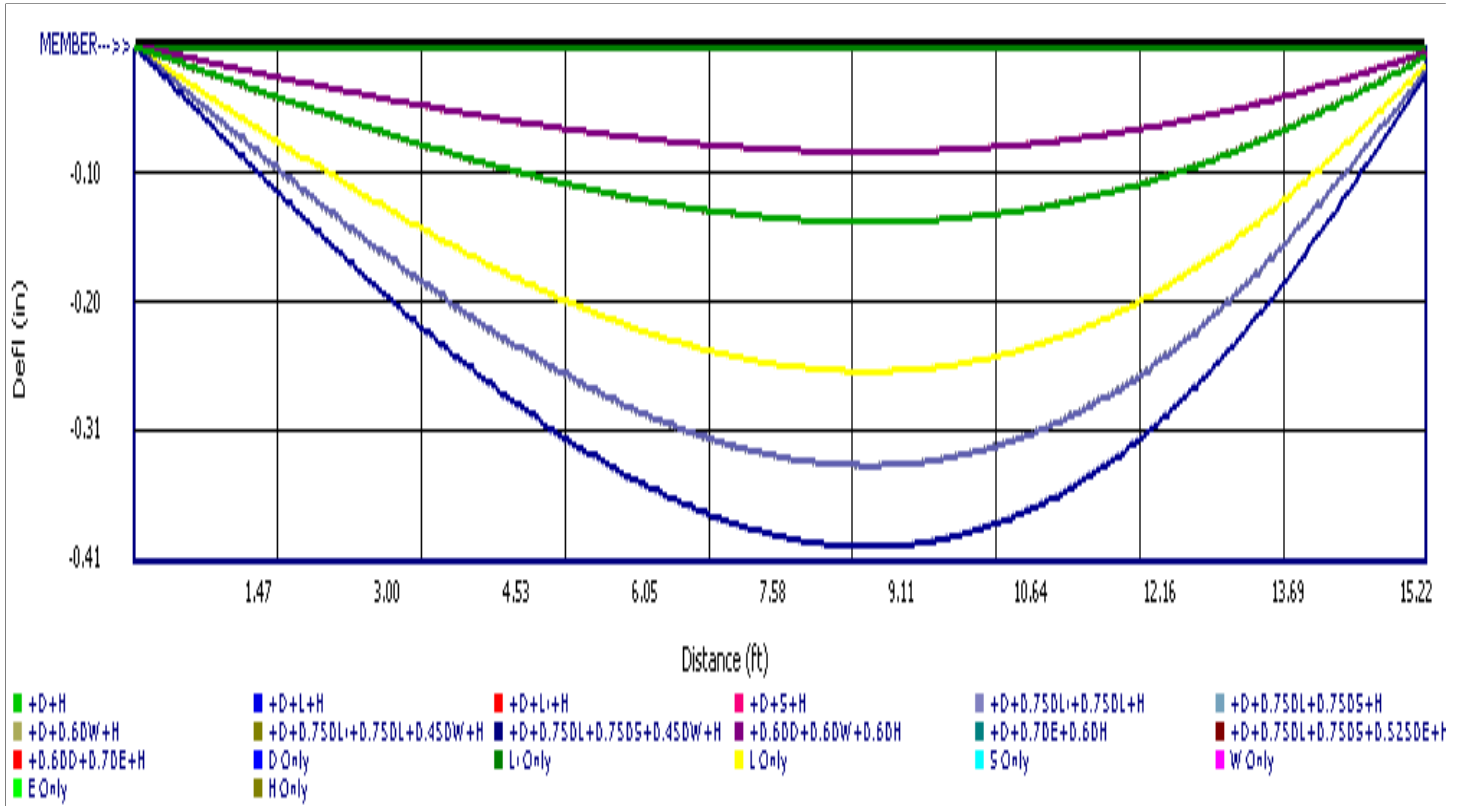


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Wood Beam

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DESCRIPTION: LVL supporting bathroom FJ header

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
 Load Combination : ASCE 7-16

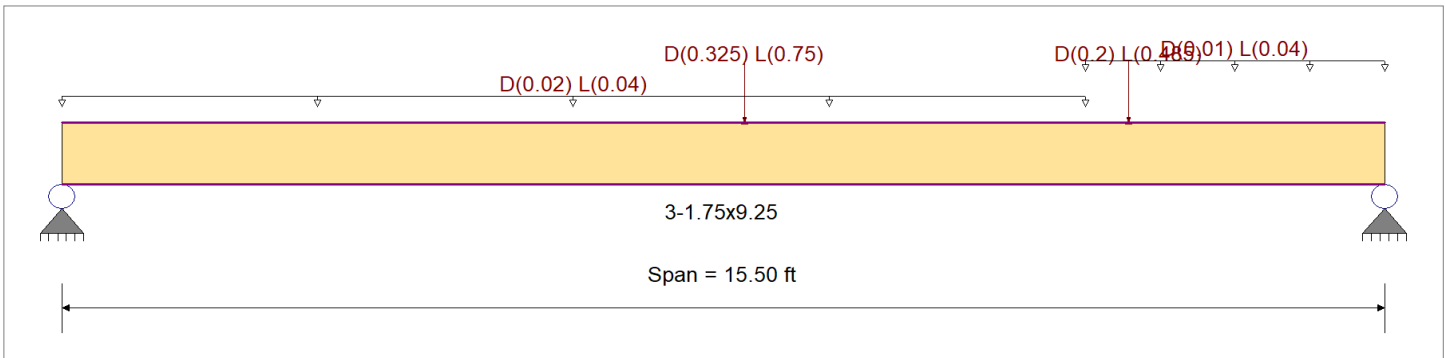
Wood Species : iLevel Truss Joist
 Wood Grade : MicroLam LVL 2.0 E

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

Fb + 2,600.0 psi
 Fb - 2,600.0 psi
 Fc - Prll 2,510.0 psi
 Fc - Perp 750.0 psi
 Fv 285.0 psi
 Ft 1,555.0 psi

E : Modulus of Elasticity
 Ebend- xx 2,100.0 ksi
 Eminbend - xx 1,016.54 ksi

Density 42.010 pcf
 Repetitive Member Stress Increase



Applied Loads

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

Load for Span Number 1

Uniform Load : D = 0.020, L = 0.040 ksf, Extent = 0.0 --> 12.0 ft, Tributary Width = 1.0 ft
 Uniform Load : D = 0.010, L = 0.040 ksf, Extent = 12.0 --> 15.50 ft, Tributary Width = 1.0 ft
 Point Load : D = 0.3250, L = 0.750 k @ 8.0 ft
 Point Load : D = 0.20, L = 0.4850 k @ 12.50 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.414	1	Maximum Shear Stress Ratio	=	0.163	1
Section used for this span		3-1.75x9.25		Section used for this span		3-1.75x9.25	
fb: Actual	=	1,118.11	psi	fv: Actual	=	46.47	psi
Fb: Allowable	=	2,704.00	psi	Fv: Allowable	=	285.00	psi
Load Combination		+D+L+H		Load Combination		+D+L+H	
Location of maximum on span	=	8.033	ft	Location of maximum on span	=	14.765	ft
Span # where maximum occurs	=	Span # 1		Span # where maximum occurs	=	Span # 1	
Maximum Deflection							
Max Downward Transient Deflection		0.260	in	Ratio =		714	>=360
Max Upward Transient Deflection		0.000	in	Ratio =		0	<360
Max Downward Total Deflection		0.375	in	Ratio =		496	>=480
Max Upward Total Deflection		0.000	in	Ratio =		0	<480

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios		C _d	C _{FV}	C _i	C _r	C _m	C _t	C _L	Moment Values			Shear Values		
			M	V								M	fb	F'b	V	fv	F'v
+D+H	Length = 15.50 ft	1	0.140	0.054	0.90	1.000	1.00	1.04	1.00	1.00	1.00	2.13	341.67	2433.60	0.00	0.00	0.00
+D+L+H	Length = 15.50 ft	1	0.414	0.163	1.00	1.000	1.00	1.04	1.00	1.00	1.00	6.98	1,118.11	2704.00	0.45	13.76	256.50
+D+Lr+H	Length = 15.50 ft	1	0.101	0.039	1.25	1.000	1.00	1.04	1.00	1.00	1.00	2.13	341.67	3380.00	0.00	0.00	0.00
+D+S+H	Length = 15.50 ft	1	0.110	0.042	1.15	1.000	1.00	1.04	1.00	1.00	1.00	2.13	341.67	3109.60	0.00	0.00	0.00
+D+0.750Lr+0.750L+H	Length = 15.50 ft	1	0.273	0.107	1.25	1.000	1.00	1.04	1.00	1.00	1.00	5.76	924.00	3380.00	0.45	13.76	327.75
	Length = 15.50 ft	1				1.000	1.00	1.04	1.00	1.00	1.00				0.00	0.00	0.00
	Length = 15.50 ft	1				1.000	1.00	1.04	1.00	1.00	1.00				1.24	38.29	356.25

Project Title:
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APEX ENGINEERS INC

DESCRIPTION: LVL supporting bathroom FJ header

Load Combination	Segment Length	Span #	Max Stress Ratios		C _d	C _{F/V}	C _i	C _r	C _m	C _t	C _L	Moment Values			Shear Values		
			M	V								M	ftb	F'b	V	fv	Fv
+D+0.750L+0.750S+H						1.000	1.00	1.04	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1		0.297	0.117	1.15	1.000	1.00	1.04	1.00	1.00	1.00	5.76	924.00	3109.60	1.24	38.29	327.75
+D+0.60W+H						1.000	1.00	1.04	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1		0.079	0.030	1.60	1.000	1.00	1.04	1.00	1.00	1.00	2.13	341.67	4326.40	0.45	13.76	456.00
+D+0.750Lr+0.750L+0.450W+H						1.000	1.00	1.04	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1		0.214	0.084	1.60	1.000	1.00	1.04	1.00	1.00	1.00	5.76	924.00	4326.40	1.24	38.29	456.00
+D+0.750L+0.750S+0.450W+H						1.000	1.00	1.04	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1		0.214	0.084	1.60	1.000	1.00	1.04	1.00	1.00	1.00	5.76	924.00	4326.40	1.24	38.29	456.00
+0.60D+0.60W+0.60H						1.000	1.00	1.04	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1		0.047	0.018	1.60	1.000	1.00	1.04	1.00	1.00	1.00	1.28	205.00	4326.40	0.27	8.26	456.00
+D+0.70E+0.60H						1.000	1.00	1.04	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1		0.079	0.030	1.60	1.000	1.00	1.04	1.00	1.00	1.00	2.13	341.67	4326.40	0.45	13.76	456.00
+D+0.750L+0.750S+0.5250E+H						1.000	1.00	1.04	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1		0.214	0.084	1.60	1.000	1.00	1.04	1.00	1.00	1.00	5.76	924.00	4326.40	1.24	38.29	456.00
+0.60D+0.70E+H						1.000	1.00	1.04	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 15.50 ft	1		0.047	0.018	1.60	1.000	1.00	1.04	1.00	1.00	1.00	1.28	205.00	4326.40	0.27	8.26	456.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	1	0.3750	7.976		0.0000	0.000

Maximum Deflections for Load Combinations

Load Combination	Span	Max. Downward Defl	Location in Span	Max. Upward Defl	Location in Span
+D+H	1	0.1145 in	7.976 ft	0.0000 in	0.000 ft
+D+L+H	1	0.3750 in	7.976 ft	0.0000 in	0.000 ft
+D+Lr+H	1	0.1145 in	7.976 ft	0.0000 in	0.000 ft
+D+S+H	1	0.1145 in	7.976 ft	0.0000 in	0.000 ft
+D+0.750Lr+0.750L+H	1	0.3099 in	7.976 ft	0.0000 in	0.000 ft
+D+0.750L+0.750S+H	1	0.3099 in	7.976 ft	0.0000 in	0.000 ft
+D+0.60W+H	1	0.1145 in	7.976 ft	0.0000 in	0.000 ft
+D+0.750Lr+0.750L+0.450W+H	1	0.3099 in	7.976 ft	0.0000 in	0.000 ft
+D+0.750L+0.750S+0.450W+H	1	0.3099 in	7.976 ft	0.0000 in	0.000 ft
+0.60D+0.60W+0.60H	1	0.0687 in	7.976 ft	0.0000 in	0.000 ft
+D+0.70E+0.60H	1	0.1145 in	7.976 ft	0.0000 in	0.000 ft
+D+0.750L+0.750S+0.5250E+H	1	0.3099 in	7.976 ft	0.0000 in	0.000 ft
+0.60D+0.70E+H	1	0.0687 in	7.976 ft	0.0000 in	0.000 ft
D Only	1	0.1145 in	7.976 ft	0.0000 in	0.000 ft
L Only	1	0.2605 in	7.976 ft	0.0000 in	0.000 ft

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.114	1.541
Overall MINimum	0.767	1.088
+D+H	0.347	0.453
+D+L+H	1.114	1.541
+D+Lr+H	0.347	0.453
+D+S+H	0.347	0.453
+D+0.750Lr+0.750L+H	0.922	1.269
+D+0.750L+0.750S+H	0.922	1.269
+D+0.60W+H	0.347	0.453
+D+0.750Lr+0.750L+0.450W+H	0.922	1.269
+D+0.750L+0.750S+0.450W+H	0.922	1.269
+0.60D+0.60W+0.60H	0.208	0.272
+D+0.70E+0.60H	0.347	0.453
+D+0.750L+0.750S+0.5250E+H	0.922	1.269
+0.60D+0.70E+H	0.208	0.272
D Only	0.347	0.453
L Only	0.767	1.088
H Only		

Project Title:
 Engineer:
 Project ID:
 Project Descr:

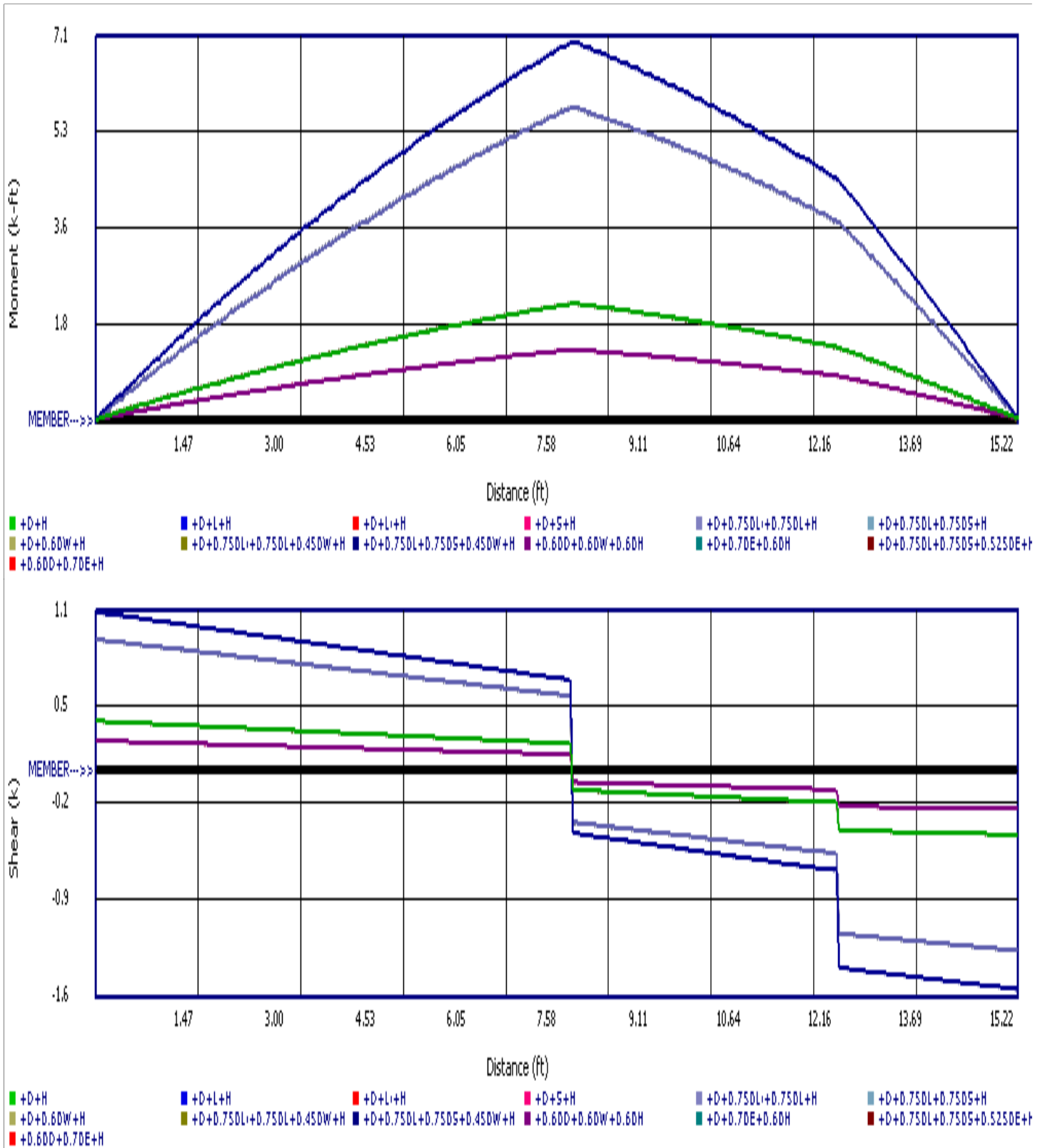


Wood Beam

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DESCRIPTION: LVL supporting bathroom FJ header



Project Title:
 Engineer:
 Project ID:
 Project Descr:



Wood Beam

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