

PRELIMINARY NOT FOR CONSTRUCTION

Davidson MS Administration & Library SD Structural Calculations

San Rafael, California

ZFA Project Number: 21370

Structural Calcs_V2

Application Number: 01-119794

DSA File Number: 21-39

February 17, 2022

Prepared For:

Quattrocchi Kwok Architects

Santa Rosa, California



Prepared By:

Dudley Mei, PE, Engineer

Chris Warner, SE, Principal-in-Charge

Santa Rosa, California

DSA Comment: Justify w/ calc for 2x4 cly jst for accessible ceiling

C51

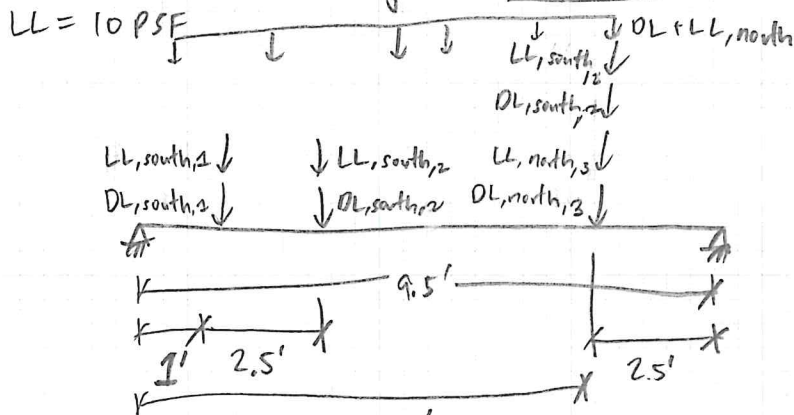
Ceiling DL

Wt. of 2x4 ceiling joist @ 16" o.c. = 1.1 PSF

Wt. of 1'x1' adhesive-applied acoustic tile ceiling system and wd framing = 1.0 PSF

Misc. = 1.5 PSF

⇒ Design for 4 PSF DL



$$DL_{south,1} = 4 \text{ PSF} \left(\frac{1'}{2} \right) \left(\frac{1.33'}{2} \right) = 1.33 \text{ LB}$$

$$LL_{south,1} = 10 \text{ PSF} \left(\frac{1'}{2} \right) \left(\frac{1.33'}{2} \right) = 3.3 \text{ LB}$$

$$DL_{south,2} = 4 \text{ PSF} \left(\frac{4'}{2} \right) \left(\frac{1.33'}{2} \right) = 5.3 \text{ LB}$$

$$LL_{south,2} = 10 \text{ PSF} \left(\frac{4'}{2} \right) \left(\frac{1.33'}{2} \right) = 13.3 \text{ LB}$$

$$DL_{north,3} = 4 \text{ PSF} \left(\frac{7.5'}{2} \right) \left(\frac{1.33'}{2} \right) = 10 \text{ LB}$$

$$LL_{north,3} = 10 \text{ PSF} \left(\frac{7.5'}{2} \right) \left(\frac{1.33'}{2} \right) = 25 \text{ LB}$$

$$DL_{north} = 4 \text{ PSF} (1.33') = 5.3 \text{ PLF}$$

$$LL_{north} = 10 \text{ PSF} (1.33') = 13.3 \text{ PLF}$$

⇒ See Enccalc

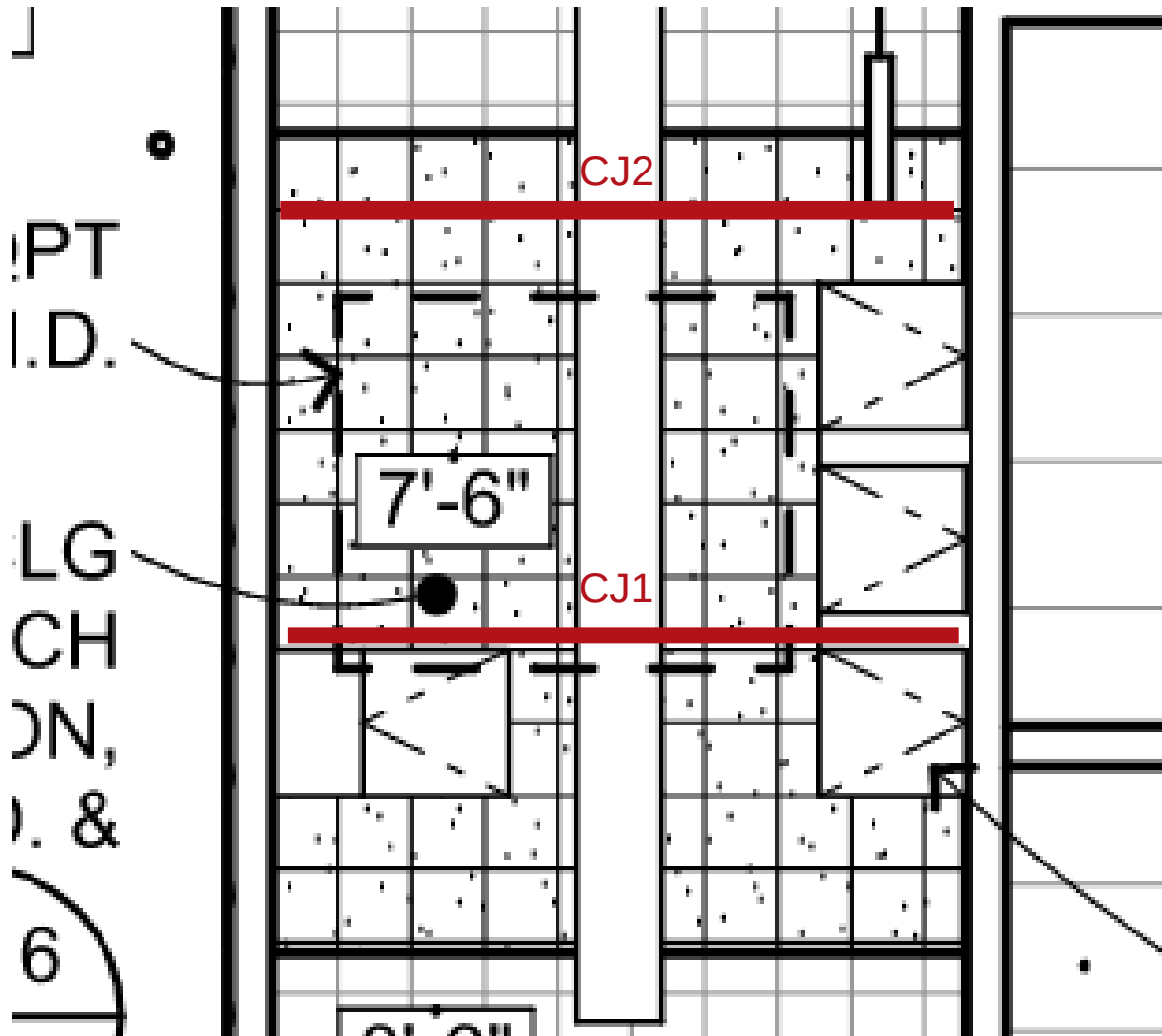
(2) 2x4 @ ceiling hatch OK

D/C = 32.2%.

$$\Delta_{tot} = \frac{L}{513}$$

Max. reaction = 102 LB, Cap. LV24 = 555 LB OK

30s WING CEILING KEY PLAN



Project Title:
 Engineer:
 Project ID:
 Project Descr:

Wood Beam

Project File: 21650 Davidson MS Mech Upgrade.ec6

LIC# : KW-06015331, Build:20.22.2.9

ZFA STRUCTURAL ENGINEERS

(c) ENERCALC INC 1983-2022

DESCRIPTION: CJ1

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

Load Combination Set : IBC 2018

Material Properties

Analysis Method : Allowable Stress Design

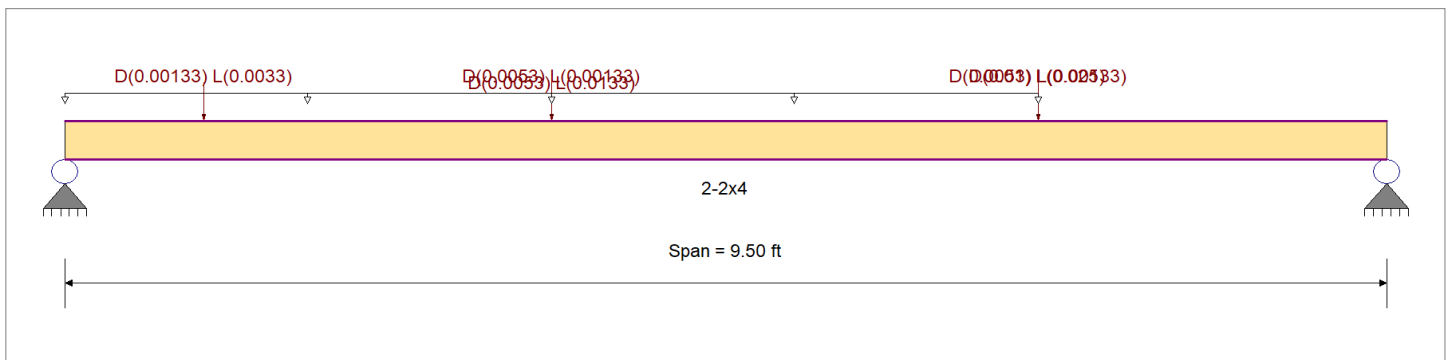
Load Combination : IBC 2018

Wood Species : Douglas Fir-Larch

Wood Grade : No.1

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

Fb +	1000 psi	E : Modulus of Elasticity	
Fb -	1000 psi	Ebend- xx	1700ksi
Fc - Prll	1500 psi	Eminbend - xx	620ksi
Fc - Perp	625 psi		
Fv	180 psi		
Ft	675 psi	Density	31.21pcf



Applied Loads

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

Beam self weight NOT internally calculated and added

Point Load : D = 0.001330, L = 0.00330 k @ 1.0 ft, (DL+LL,south,1)

Point Load : D = 0.00530, L = 0.001330 k @ 3.50 ft, (DL+LL,south,2)

Point Load : D = 0.00530, L = 0.001330 k @ 7.0 ft, (DL+LL,south,2)

Point Load : D = 0.010, L = 0.0250 k @ 7.0 ft, (DL+LL,north,3)

Uniform Load : D = 0.00530, L = 0.01330 k/ft, Extent = 0.0 --> 7.0 ft, Tributary Width = 1.0 ft, (DL,north)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.322	1	Maximum Shear Stress Ratio	=	0.076	: 1
Section used for this span		2-2x4		Section used for this span		2-2x4	
fb: Actual	=	483.57	psi	fv: Actual	=	13.77	psi
Fb: Allowable	=	1,500.00	psi	Fv: Allowable	=	180.00	psi
Load Combination		+D+L		Load Combination		+D+L	
Location of maximum on span	=	4.854	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		0.149	in	Ratio =	764	>=360	Span: 1 : L Only
Max Upward Transient Deflection		0	in	Ratio =	0	<360	n/a
Max Downward Total Deflection		0.222	in	Ratio =	513	>=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	C _d	C _{F/V}	C _i	C _r	C _m	C _t	C _L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 9.50 ft	1	0.117	0.027	0.90	1.500	1.00	1.00	1.00	1.00	1.00	0.08	157.87	1350.00	0.03	4.36	162.00
+D+L					1.500	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 9.50 ft	1	0.322	0.076	1.00	1.500	1.00	1.00	1.00	1.00	1.00	0.25	483.57	1500.00	0.10	13.77	180.00
+D+0.750L					1.500	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 9.50 ft	1	0.214	0.051	1.25	1.500	1.00	1.00	1.00	1.00	1.00	0.21	402.14	1875.00	0.08	11.41	225.00
+0.60D					1.500	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 9.50 ft	1	0.039	0.009	1.60	1.500	1.00	1.00	1.00	1.00	1.00	0.05	94.72	2400.00	0.02	2.62	288.00

Project Title:
Engineer:
Project ID:
Project Descr:

Wood Beam

Project File: 21650 Davidson MS Mech Upgrade.ec6

LIC# : KW-06015331, Build:20.22.2.9

ZFA STRUCTURAL ENGINEERS

(c) ENERCALC INC 1983-2022

DESCRIPTION: [CJ1](#)

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.2218	4.785		0.0000	0.000

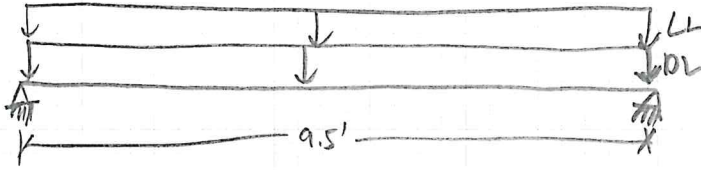
Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.102	0.082
Overall MINimum	0.070	0.055
D Only	0.032	0.027
+D+L	0.102	0.082
+D+0.750L	0.084	0.068
+0.60D	0.019	0.016
L Only	0.070	0.055

CJ2



Loading

DL = 4 PSF

LL = 10 PSF

} $T_w = 1.33'$

⇒ USE 2x4 @ 16" o.c.
 $D/C = 38.2\%$
 $\Delta_{tot} = \frac{L}{302}$

Project Title:
Engineer:
Project ID:
Project Descr:

Wood Beam

Project File: 21650 Davidson MS Mech Upgrade.ec6

LIC# : KW-06015331, Build:20.22.2.9

ZFA STRUCTURAL ENGINEERS

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DESCRIPTION: CJ2

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

Load Combination Set : IBC 2018

Material Properties

Analysis Method : Allowable Stress Design

Load Combination : IBC 2018

Wood Species : Douglas Fir-Larch

Wood Grade : No.1

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

Fb + 1000 psi

Fb - 1000 psi

Fc - Prll 1500 psi

Fc - Perp 625 psi

Fv 180 psi

Ft 675 psi

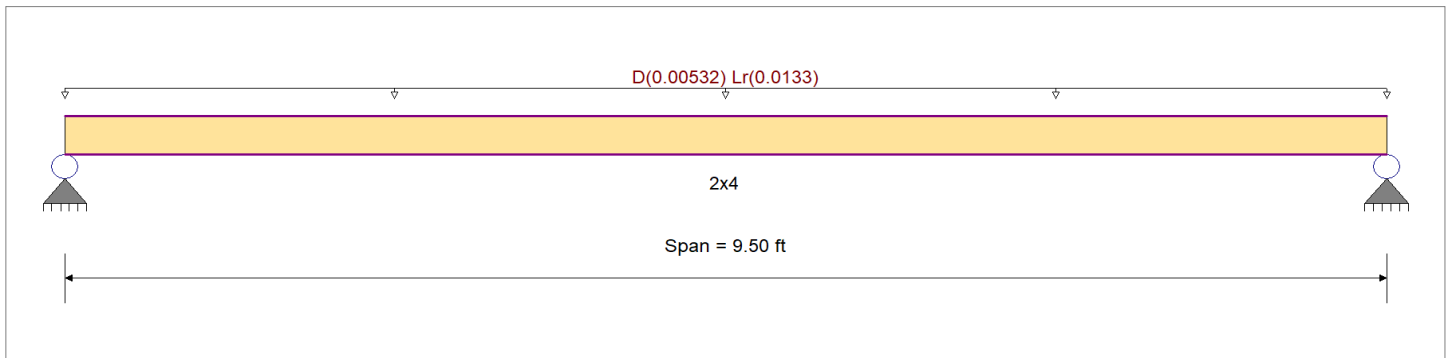
E : Modulus of Elasticity

Ebend- xx 1700ksi

Eminbend - xx 620ksi

Density 31.21pcf

Repetitive Member Stress Increase



Applied Loads

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

Beam self weight NOT internally calculated and added

Uniform Load : D = 0.0040, Lr = 0.010 ksf, Tributary Width = 1.330 ft, (Loading)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.382	1	Maximum Shear Stress Ratio	=	0.106	1
Section used for this span		2x4		Section used for this span		2x4	
fb: Actual	=	823.08psi		fv: Actual	=	23.79 psi	
Fb: Allowable	=	2,156.25psi		Fv: Allowable	=	225.00 psi	
Load Combination		+D+Lr		Load Combination		+D+Lr	
Location of maximum on span	=	4.750ft		Location of maximum on span	=	9.223 ft	
Span # where maximum occurs	=	Span # 1		Span # where maximum occurs	=	Span # 1	
Maximum Deflection							
Max Downward Transient Deflection	0.269 in	Ratio =	423 >=360	Span: 1 : Lr Only			
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a			
Max Downward Total Deflection	0.377 in	Ratio =	302 >=180	Span: 1 : +D+Lr			
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	C _d	C _{F/V}	C _i	C _r	C _m	C _t	C _L	M	fb	F'b	V	fv	F'v	
D Only													0.00	0.00	0.00	0.00	
Length = 9.50 ft	1	0.151	0.042	0.90	1.500	1.00	1.15	1.00	1.00	1.00	0.06	235.17	1552.50	0.02	6.80	162.00	
+D+Lr					1.500	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00	
Length = 9.50 ft	1	0.382	0.106	1.25	1.500	1.00	1.15	1.00	1.00	1.00	0.21	823.08	2156.25	0.08	23.79	225.00	
+D+0.750Lr					1.500	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00	
Length = 9.50 ft	1	0.314	0.087	1.25	1.500	1.00	1.15	1.00	1.00	1.00	0.17	676.10	2156.25	0.07	19.55	225.00	
+0.60D					1.500	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00	
Length = 9.50 ft	1	0.051	0.014	1.60	1.500	1.00	1.15	1.00	1.00	1.00	0.04	141.10	2760.00	0.01	4.08	288.00	

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+Lr	1	0.3767	4.785		0.0000	0.000

Project Title:
Engineer:
Project ID:
Project Descr:

Wood Beam

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LIC# : KW-06015331, Build:20.22.2.9

ZFA STRUCTURAL ENGINEERS

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DESCRIPTION: CJ2

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.088	0.088
Overall MINimum	0.063	0.063
D Only	0.025	0.025
+D+Lr	0.088	0.088
+D+0.750Lr	0.073	0.073
+0.60D	0.015	0.015
Lr Only	0.063	0.063

section engineer job # date page
 DSA Comment: M-2.1 // Coordinate all wall penetrations at existing shear walls w/ SEOR, Admin Building Shear Wall @ Grid 2

approx. 4'-6" which is more than a 10% loss of strength this line. Any wall impacted by more than 10% loss of strength is to be checked to current code force and detail requirements.

$$\text{Total length of SW} = 322.5''$$

$$\text{Existing opening sizes} = 14'' + 18'' = 32''$$

See 1/M2.4B on Appl #01-106020

(2) of the ducts will connect to these existing openings

$$\text{Existing SW length w/ existing openings} = 322.5'' - 32'' = 291''$$

$$10\% \text{ of } 291'' = 29.1'' \text{ (allowable shear wall opening size)}$$

$$(2) \text{ ducts to the south} = 14.5'' + 14.5'' = 29'' < 29.1'' \text{ OK}$$

Loss in strength is less than 10% OK

ZFA STRUCTURAL ENGINEERS

project name

section

DM
engineer

21370
job #

02/25/22
date

page

DSA Comment: C/M-4.1 // Provide calc or pre-approval.

⇒ Assume at least (1) holdown bracket per side.

Max. shear or tension force = 736 LB per side

↑
From DOAS calc's
in Structural Calcs - V2

For (3) screws, Max. $V = \frac{736 \text{ LB}}{3} = 245 \text{ LB}$

Capacity of (3) #10 in shear = $370 \text{ LB}(3) = 1110 \text{ LB}$ OK