STRUCTURAL CALCULATIONS

MERCER RESIDENCE

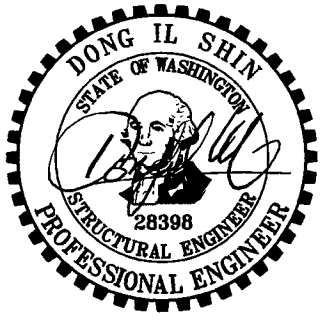
6950 SE Maker Street
Mercer Island, WA 98040

CODE: IBC 2018 & ASCE/SEI 7-16
PROJECT NO.: 22-300

D. S. Engineering
Consulting Structural Engineers

3121 147th Place SE
Mill Creek, WA 98012
T: 425-338-4776

06/22/2022



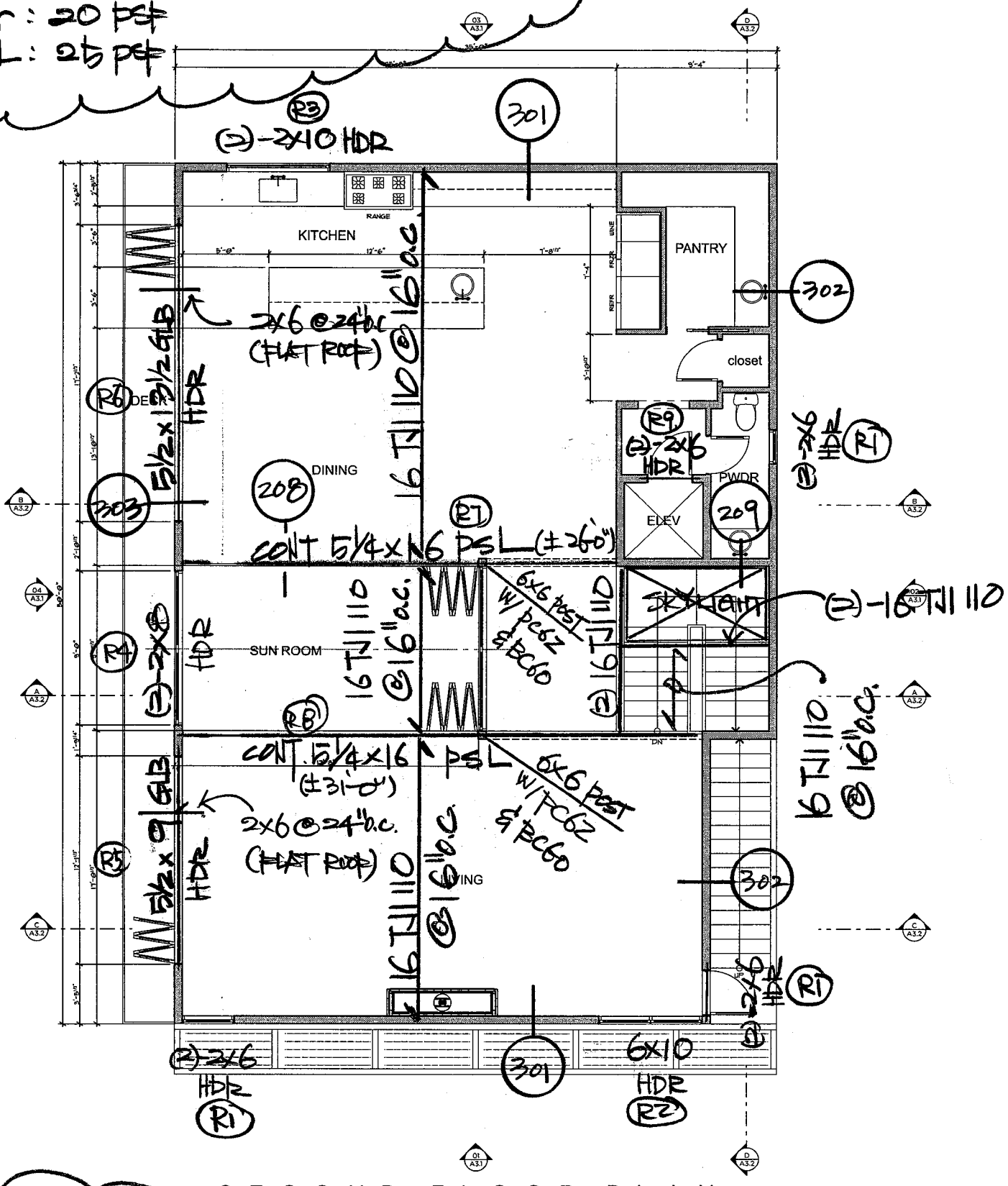
Design Analysis

ROOF:

DL: 25 PSF (INCLUDED 10 PSF SOLAR)

LR: 20 PSF

SL: 25 PSF



SECOND FLOOR PLAN

SCALE: 1/4" = 1'-0"

DECK

DL: 20 PSF

LL: 60 PSF

SL: 25 PSF

ROOF FRAMING PLAN

R1

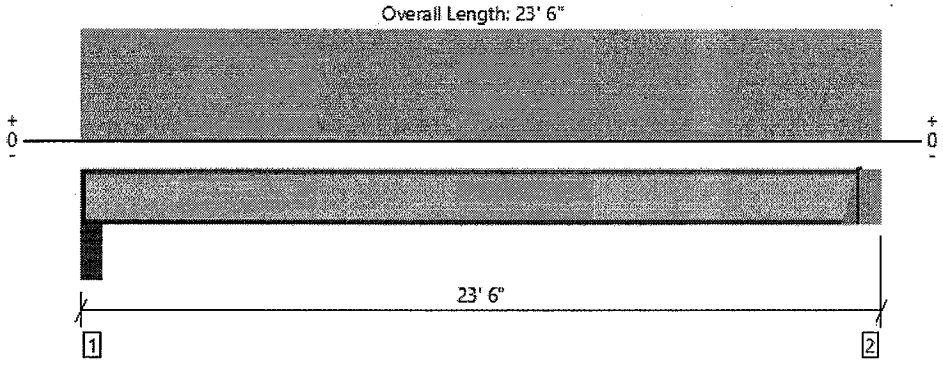
FORTE WEB

MEMBER REPORT

PASSED

Level, Roof: Joist

1 piece(s) 16" TJI® 110 @ 16" OC



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)	756 @ 23' 1/2"	1047 (1.75")	Passed (72%)	1.15	1.0 D + 1.0 S (All Spans)
Shear (lbs)	756 @ 23' 1/2"	2467	Passed (31%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	4281 @ 11' 8 1/2"	4922	Passed (87%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.399 @ 11' 8 1/2"	0.756	Passed (L/682)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.797 @ 11' 8 1/2"	1.133	Passed (L/341)	--	1.0 D + 1.0 S (All Spans)

System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Roof Live	Snow	Total	
1 - Stud wall - HF	5.50"	4.25"	1.75"	390	312	390	1092	1 1/4" Rim Board
2 - Hanger on 16" PSL beam	5.50"	Hanger[1]	1.75" / - [2]	393	314	393	1100	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.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	3' 2" o/c	
Bottom Edge (Lu)	22' 11" o/c	

- TJI joists are only analyzed using Maximum Allowable bracing solutions.
- Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
2 - Top Mount Hanger	ITS1.81/16	2.00"	4-10dx1.5	2-10dx1.5	2-Strong-Grip	

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

Vertical Load	Location	Spacing	Dead (0.90)	Roof Live (non-snow: 1.25)	Snow (1.15)	Comments
1 - Uniform (PSF)	0 to 23' 6"	16"	25.0	20.0	25.0	Default Load

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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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Weyerhaeuser

4/25/2022 8:24:19 AM UTC
ForteWEB v3.2, Engine: V8.2.0.17, Data: V8.1.0.16
File Name: Strant

R2

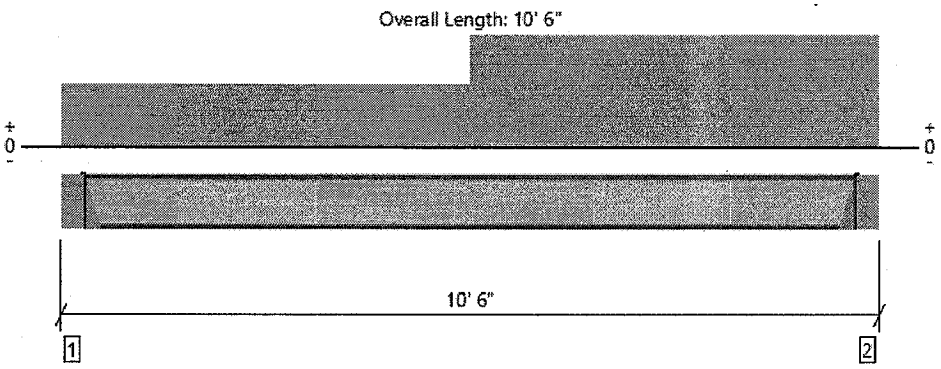
FORTE WEB

MEMBER REPORT

PASSED

Level, Roof: Joist

1 piece(s) 16" TJI® 110 @ 16" OC



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)	423 @ 10' 1/2"	910 (1.75")	Passed (47%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	423 @ 10' 1/2"	2145	Passed (20%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	994 @ 5' 9 7/8"	4922	Passed (20%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Live Load Defl. (in)	0.028 @ 5' 5 1/2"	0.319	Passed (L/999+)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.043 @ 5' 4 1/2"	0.479	Passed (L/999+)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Snow	Total	
1 - Hanger on 16" PSL beam	5.50"	Hanger[1]	1.75" / - [2]	167	96	140	175	578	See note [1]
2 - Hanger on 16" PSL beam	5.50"	Hanger[1]	1.75" / - [2]	148	324	140	175	787	See note [1]

- 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.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	6' 10" o/c	
Bottom Edge (Lu)	9' 7" o/c	

- TJI joists are only analyzed using Maximum Allowable bracing solutions.
- Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Top Mount Hanger	ITS1.81/16	2.00"	4-10dx1.5	2-10dx1.5	2-Strong-Grip	
2 - Top Mount Hanger	ITS1.81/16	2.00"	4-10dx1.5	2-10dx1.5	2-Strong-Grip	

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

Vertical Loads	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Roof Live (non-snow: 1.25)	Snow (1.15)	Comments
1 - Uniform (PSF)	0 to 5' 3"	16"	25.0	-	20.0	25.0	Default Load
2 - Uniform (PSF)	5' 3" to 10' 6"	16"	20.0	60.0	20.0	25.0	

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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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File Name: Strant

R3

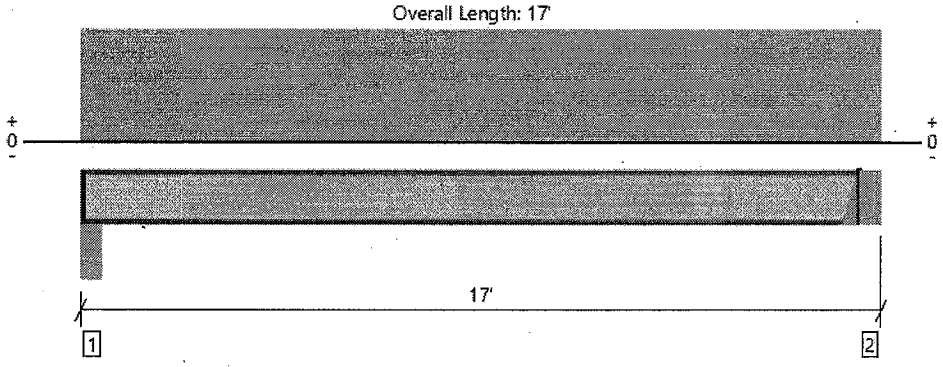
FORTE WEB

MEMBER REPORT

PASSED

Level, Roof: Joist

1 piece(s) 16" TJI® 110 @ 16" OC



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)	916 @ 16' 6 1/2"	916 (1.77")	Passed (100%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	916 @ 16' 6 1/2"	2145	Passed (43%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	3703 @ 8' 5 1/2"	4280	Passed (87%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.281 @ 8' 5 1/2"	0.539	Passed (L/690)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.391 @ 8' 5 1/2"	0.808	Passed (L/496)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Total	
1 - Beam - HF	5.50"	4.25"	1.89"	282	677	282	1241	1 1/4" Rim Board
2 - Hanger on 16" PSL beam	5.50"	Hanger[1]	1.77" / - [2]	285	683	285	1253	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.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	3' 4" o/c	
Bottom Edge (Lu)	16' 5" o/c	

- TJI joists are only analyzed using Maximum Allowable bracing solutions.
- Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
2 - Top Mount Hanger	ITS1.81/16	2.00"	4-10dx1.5	2-10dx1.5	2-Strong-Grip	

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

Vertical Load	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
1 - Uniform (PSF)	0 to 17'	16"	25.0	60.0	25.0	Default Load

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

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File Name: Strant

R4

FORTE WEB

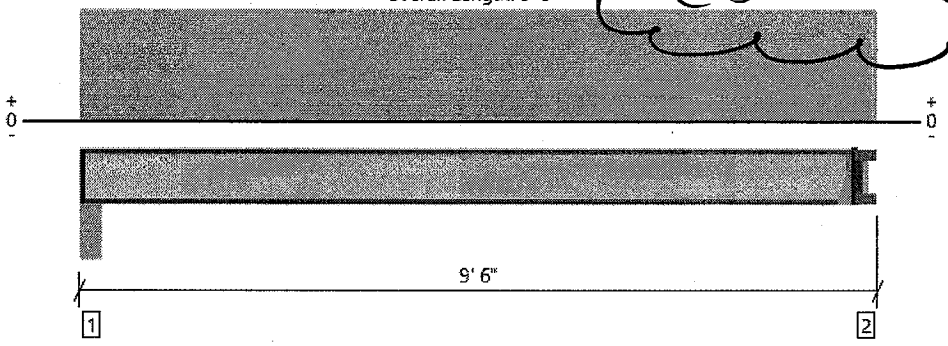
MEMBER REPORT

PASSED

Level, Roof: Joist

1 piece(s) 16" TJI® 110 @ 12" OC

(2)-16" TJI 110



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)	1458 @ 9' 1/2"	1458 (3.10")	Passed (100%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	1458 @ 9' 1/2"	2467	Passed (59%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Moment (Ft-lbs)	3159 @ 4' 8 1/2"	4922	Passed (64%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Live Load Defl. (in)	0.079 @ 4' 8 1/2"	0.289	Passed (L/999+)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.122 @ 4' 8 1/2"	0.433	Passed (L/853)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Snow	Total	
1 - Beam - HF	5.50"	4.25"	3.40"	560	744	250	622	2176	1 1/4" Rim Board
2 - Hanger on 16" TJI	5.50"	Hanger[1]	3.10" / - [2]	570	757	254	633	2214	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.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	3' 9" o/c	
Bottom Edge (Lu)	8' 11" o/c	

- TJI joists are only analyzed using Maximum Allowable bracing solutions.
- Maximum allowable bracing intervals based on applied load.

25#s (5.25'/2)

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
2 - Top Mount Hanger	WP1.81X H=15.938	4.00"	4-10dx1.5	N/A	2-10dx1.5	Web Stiffeners, Backer Block(s)

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

20#s (5.25'/2)

25#s (5.25'/2)

Vertical Loads	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Roof Live (non-snow: 1.25)	Snow (1.15)	Comments
1 - Uniform (PLF)	0 to 9' 6"	N/A	66.0	-	53.0	66.0	Default Load
2 - Uniform (PLF)	0 to 9' 6"	N/A	53.0	158.0	-	66.0	

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

20#s (5.25'/2)

60#s (5.25'/2)

ForteWEB Software Operator	Job Notes
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File Name: Strant

R5

FORTE WEB

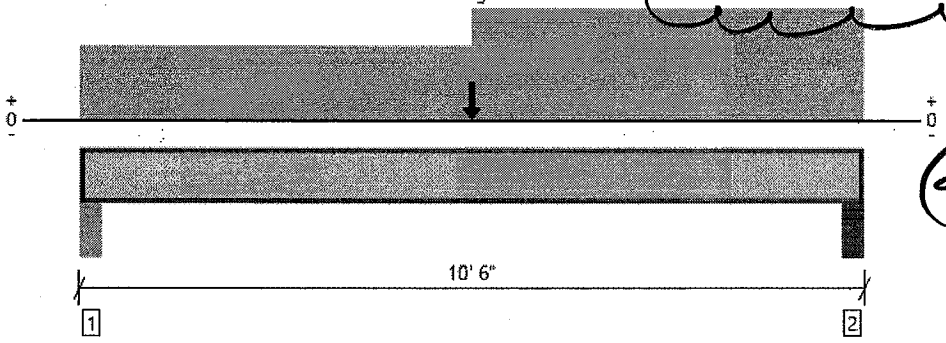
MEMBER REPORT **PASSED**

Level, Roof: Joist

1 piece(s) 16" TJI® 110 @ 12" OC

(2) -16" TJI 110

Overall Length: 10' 6"



(STAIR)

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)	1176 @ 10' 1 1/2"	1581 (3.50")	Passed (74%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	1146 @ 10' 1/2"	2467	Passed (46%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Moment (Ft-lbs)	4627 @ 5' 3"	4922	Passed (94%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Live Load Defl. (in)	0.120 @ 5' 3"	0.325	Passed (L/978)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.185 @ 5' 3"	0.488	Passed (L/633)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Snow	Total	
1 - Beam - HF	5.50"	4.25"	1.82"	405	448	206	441	1500	1 1/4" Rim Board
2 - Stud wall - HF	5.50"	4.25"	2.18"	391	617	149	441	1598	1 1/4" Rim Board

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	3' o/c	
Bottom Edge (Lu)	10' 4" o/c	

- TJI joists are only analyzed using Maximum Allowable bracing solutions.
- Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Roof Live (non-snow: 1.25)	Snow (1.15)	Comments
1 - Uniform (PLF)	0 to 5' 3"	N/A	25.0	-	20.0	25.0	Default Load
2 - Uniform (PLF)	5' 3" to 10' 6"	N/A	20.0	60.0	-	25.0	
3 - Point (lb)	5' 3"	N/A	560	750	250	620	

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

- DL: (20+25)# (5.25'x9.5'/4)
- LL: 60# (5.25'x9.5'/4)
- Lr: 20# (5.25'x9.5'/4)
- SL: 25# (10.5'x9.5'/4)

ForteWEB Software Operator	Job Notes
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4/25/2022 9:05:25 AM UTC
ForteWEB v3.2, Engine: V8.2.0.17, Data: V8.1.0.16
File Name: Strant

R6

Wood Beam

File: examples.ec6

Lic. # : KW-06010224
D.S. ENGINEERING PC

DESCRIPTION: header (R1) (TYP. U.O.N.) @ NON-BEARING WALL

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

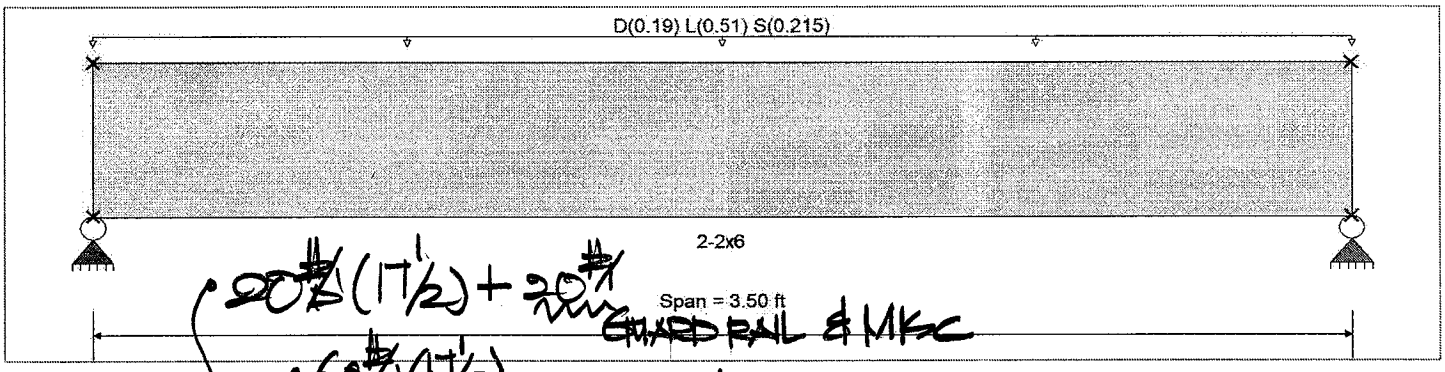
Wood Species : Douglas Fir-Larch
Wood Grade : No.2

Beam Bracing : Completely Unbraced

Fb +	900 psi
Fb -	900 psi
Fc - Prll	1350 psi
Fc - Perp	625 psi
Fv	180 psi
Ft	575 psi

E : Modulus of Elasticity

Ebend- xx	1600 ksi
Eminbend - xx	580 ksi
Density	31.21 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.190, L = 0.510, S = 0.2150 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.734 : 1	Maximum Shear Stress Ratio	=	0.463 : 1
Section used for this span		2-2x6	Section used for this span		2-2x6
fb: Actual	=	854.76 psi	fv: Actual	=	83.34 psi
Fb: Allowable	=	1,164.46 psi	Fv: Allowable	=	180.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	1.750 ft	Location of maximum on span	=	3.053 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.026 in	Ratio =	1613 >=240
Max Upward Transient Deflection	0.000 in	Ratio =	0 <240
Max Downward Total Deflection	0.038 in	Ratio =	1116 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S+0.5250E+H	1	0.0376	1.763		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 — Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.290	1.290
Overall MINimum	0.376	0.376
+D+H	0.339	0.339
+D+L+H	1.231	1.231
+D+Lr+H	0.339	0.339
+D+S+H	0.715	0.715
+D+0.750Lr+0.750L+H	1.008	1.008
+D+0.750L+0.750S+H	1.290	1.290
+D+0.60W+H	0.339	0.339
+D+0.70E+H	0.339	0.339

ELEVATOR
$W_{EL} = 25\#/(24'1/2) = 300$
$W_{HR} = 20\ (11) = 240$
$W_{SL} = 25\ (11) = 300$

RT

DESCRIPTION: header (R1)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
+D+0.750Lr+0.750L+0.450W+H	1.008	1.008
+D+0.750L+0.750S+0.450W+H	1.290	1.290
+D+0.750L+0.750S+0.5250E+H	1.290	1.290
+0.60D+0.60W+0.60H	0.203	0.203
+0.60D+0.70E+0.60H	0.203	0.203
D Only	0.339	0.339
L Only	0.893	0.893
S Only	0.376	0.376
H Only		

R8

Wood Beam

DESCRIPTION: header (R2)

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

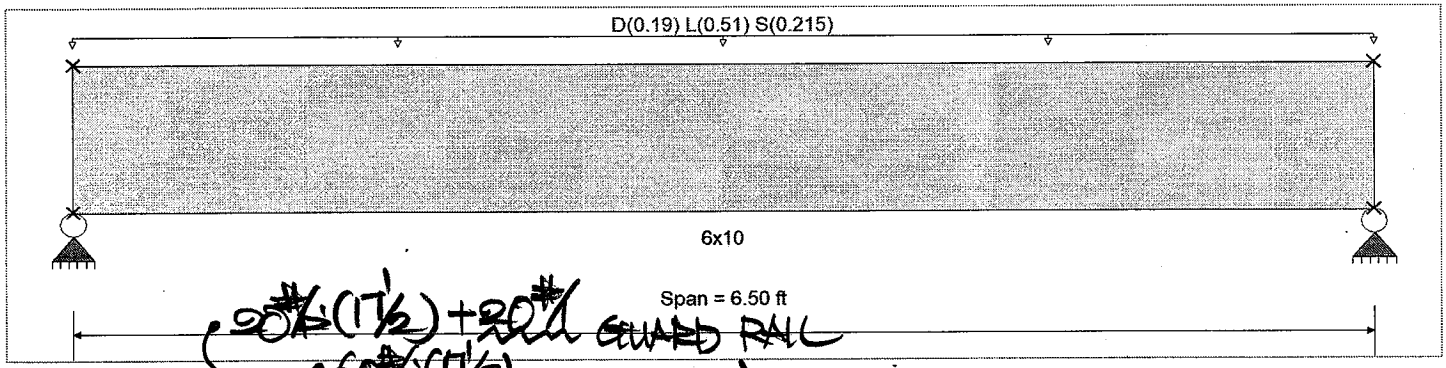
Wood Species : Douglas Fir-Larch
Wood Grade : No.2

Beam Bracing : Completely Unbraced

Fb +	875 psi
Fb -	875 psi
Fc - Prll	600 psi
Fc - Perp	625 psi
Fv	170 psi
Ft	425 psi

E : Modulus of Elasticity

Ebend- xx	1300 ksi
Eminbend - xx	470 ksi
Density	31.21 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.190, L = 0.510, S = 0.2150, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.625 : 1	Maximum Shear Stress Ratio	=	0.296 : 1
Section used for this span		6x10	Section used for this span		6x10
fb: Actual	=	544.91 psi	fv: Actual	=	50.38 psi
Fb: Allowable	=	871.44 psi	Fv: Allowable	=	170.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	3.250 ft	Location of maximum on span	=	5.717 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.040 in	Ratio =	1933 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.059 in	Ratio =	1323 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.0589	3.274		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	2.421	2.421
Overall MINimum	0.699	0.699
D Only	0.654	0.654
+D+L	2.312	2.312
+D+S	1.353	1.353
+D+0.750L	1.897	1.897
+D+0.750L+0.750S	2.421	2.421
+0.60D	0.393	0.393
L Only	1.658	1.658
S Only	0.699	0.699

R9

Wood Beam

DESCRIPTION: header (R3)

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

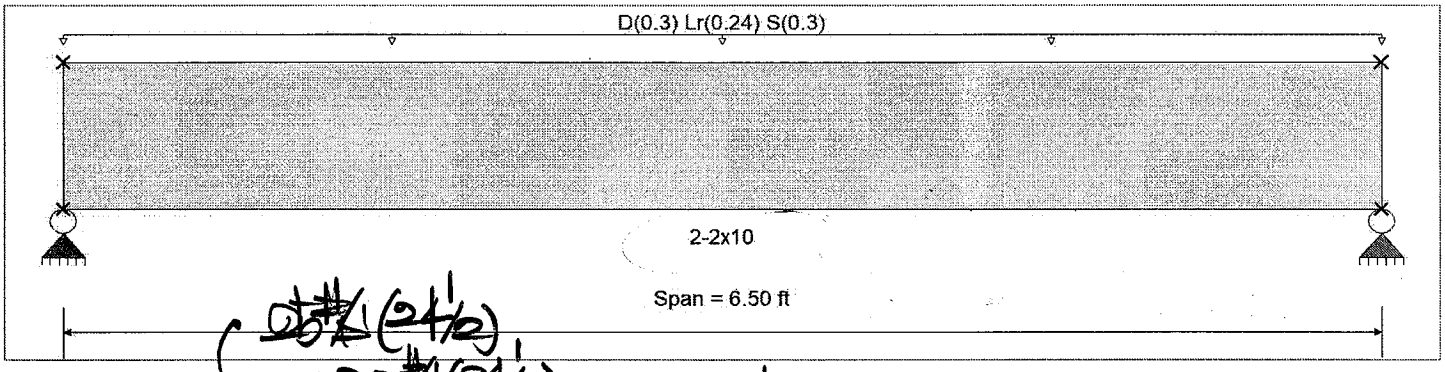
Wood Species : Douglas Fir-Larch
Wood Grade : No.2

Beam Bracing : Completely Unbraced

Fb +	900 psi
Fb -	900 psi
Fc - Prll	1350 psi
Fc - Perp	625 psi
Fv	180 psi
Ft	575 psi

E : Modulus of Elasticity

Ebend- xx	1600 ksi
Eminbend - xx	580 ksi
Density	31.21 pcf



25#/(24/12) 30#/(24/12) 25#/(24/12)

Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.30, Lr = 0.240, S = 0.30, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.802** 1	Maximum Shear Stress Ratio	=	**0.394** : 1
Section used for this span		**2-2x10**	Section used for this span		**2-2x10**
fb: Actual	=	897.73 psi	fv: Actual	=	81.59 psi
Fb: Allowable	=	1,119.24 psi	Fv: Allowable	=	207.00 psi
Load Combination		+D+S+H	Load Combination		+D+S+H
Location of maximum on span	=	3.250 ft	Location of maximum on span	=	5.741 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.038 in	Ratio =	2037 >=240
Max Upward Transient Deflection	0.000 in	Ratio =	0 <240
Max Downward Total Deflection	0.077 in	Ratio =	1008 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S+H	1	0.0773	3.274		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.970	1.970
Overall MINimum	0.975	0.975
+D+H	0.995	0.995
+D+L+H	0.995	0.995
+D+Lr+H	1.775	1.775
+D+S+H	1.970	1.970
+D+0.750Lr+0.750L+H	1.580	1.580
+D+0.750L+0.750S+H	1.726	1.726
+D+0.60W+H	0.995	0.995
+D+0.70E+H	0.995	0.995

R10

DESCRIPTION: header (R3)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
+D+0.750Lr+0.750L+0.450W+H	1.580	1.580
+D+0.750L+0.750S+0.450W+H	1.726	1.726
+D+0.750L+0.750S+0.5250E+H	1.726	1.726
+0.60D+0.60W+0.60H	0.597	0.597
+0.60D+0.70E+0.60H	0.597	0.597
D Only	0.995	0.995
Lr Only	0.780	0.780
S Only	0.975	0.975
H Only		

Wood Beam

File: examples.ec6

Lic. # : KW-06010224
D.S. ENGINEERING PC

DESCRIPTION: header

R4

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

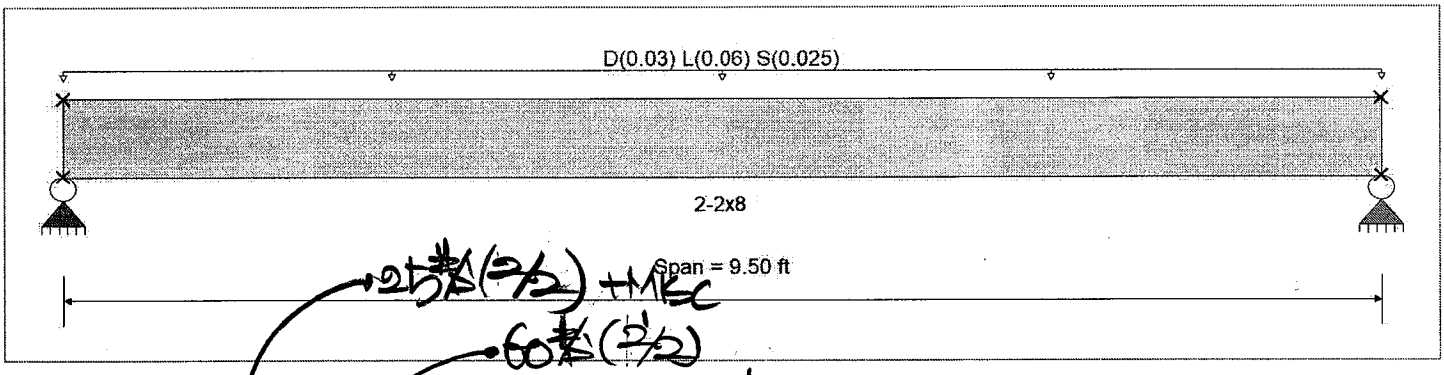
Wood Species : Douglas Fir-Larch
Wood Grade : No.2

Beam Bracing : Completely Unbraced

Fb +	900 psi
Fb -	900 psi
Fc - Prll	1350 psi
Fc - Perp	625 psi
Fv	180 psi
Ft	575 psi

E : Modulus of Elasticity

Ebend- xx	1600 ksi
Eminbend - xx	580 ksi
Density	31.21 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.030, L = 0.060, S = 0.0250 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.460 : 1	Maximum Shear Stress Ratio	=	0.151 : 1
Section used for this span		2-2x8	Section used for this span		2-2x8
fb: Actual	=	487.87 psi	fv: Actual	=	27.18 psi
Fb: Allowable	=	1,061.57 psi	Fv: Allowable	=	180.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	4.750 ft	Location of maximum on span	=	8.911 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.073 in	Ratio =	1571 >=240
Max Upward Transient Deflection	0.000 in	Ratio =	0 <240
Max Downward Total Deflection	0.119 in	Ratio =	957 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S+0.5250E+H	1	0.1191	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	0.468	0.468
Overall MINimum	0.119	0.119
+D+H	0.165	0.165
+D+L+H	0.450	0.450
+D+Lr+H	0.165	0.165
+D+S+H	0.284	0.284
+D+0.750Lr+0.750L+H	0.379	0.379
+D+0.750L+0.750S+H	0.468	0.468
+D+0.60W+H	0.165	0.165
+D+0.70E+H	0.165	0.165

R12

DESCRIPTION: header

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
+D+0.750Lr+0.750L+0.450W+H	0.379	0.379
+D+0.750L+0.750S+0.450W+H	0.468	0.468
+D+0.750L+0.750S+0.5250E+H	0.468	0.468
+0.60D+0.60W+0.60H	0.099	0.099
+0.60D+0.70E+0.60H	0.099	0.099
D Only	0.165	0.165
L Only	0.285	0.285
S Only	0.119	0.119
H Only		

Wood Beam

File: examples.ec6

Lic. # : KW-06010224
D.S. ENGINEERING PC

DESCRIPTION: flat roof

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.2

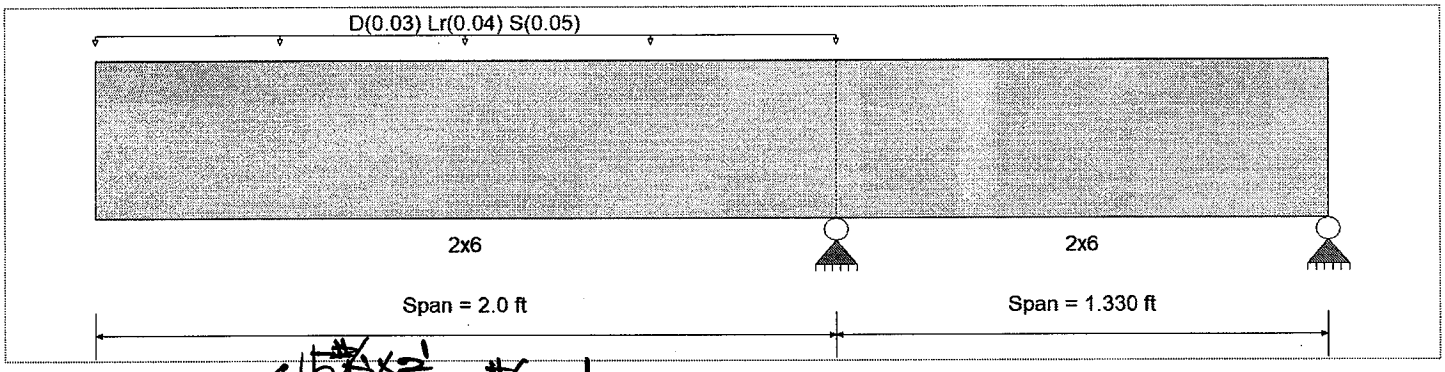
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	900 psi
Fb -	900 psi
Fc - Prll	1350 psi
Fc - Perp	625 psi
Fv	180 psi
Ft	575 psi

E : Modulus of Elasticity

Ebend- xx	1600 ksi
Eminbend - xx	580 ksi
Density	31.21 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 = 0.030, Lr = 0.040, S = 0.050 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.164 : 1	Maximum Shear Stress Ratio	=	0.108 : 1
Section used for this span		2x6	Section used for this span		2x6
fb: Actual	=	253.88 psi	fv: Actual	=	22.43 psi
Fb: Allowable	=	1,547.33 psi	Fv: Allowable	=	207.00 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	2.000 ft	Location of maximum on span	=	1.542 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.010 in	Ratio =	4888 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.016 in	Ratio =	3054 >=180
Max Upward Total Deflection	-0.001 in	Ratio =	16684 >=180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.0157	0.000		0.0000	0.000
	2	0.0000	0.000	+D+S	-0.0010	0.565

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum		0.280	-0.120
Overall MINimum		0.175	-0.045
D Only		0.105	-0.045
+D+L		0.105	-0.045
+D+Lr		0.245	-0.105
+D+S		0.280	-0.120
+D+0.750Lr+0.750L		0.210	-0.090
+D+0.750L+0.750S		0.237	-0.102
+0.60D		0.063	-0.027

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DESCRIPTION: flat roof

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Lr Only		0.140	-0.060
S Only		0.175	-0.075

R15

Wood Beam

Lic. # : KW-06010224
D.S. ENGINEERING PC

DESCRIPTION: header (R5)

CODE REFERENCES

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

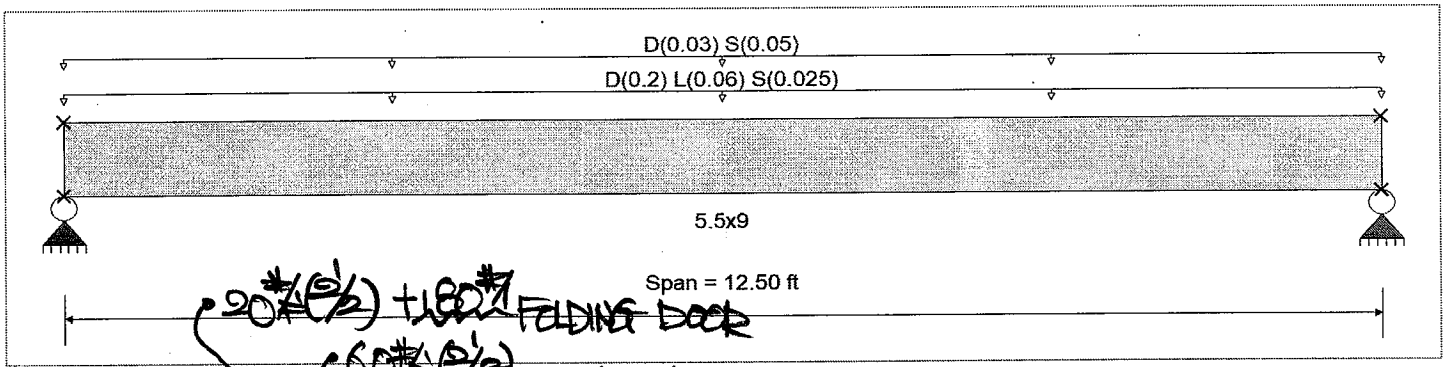
Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2018

Wood Species : DF/DF
Wood Grade : 24F-V4

Beam Bracing : Completely Unbraced

Fb +	2400 psi	*E : Modulus of Elasticity*	
Fb -	1850 psi	Ebend- xx	1800 ksi
Fc - Prll	1650 psi	Eminbend - xx	950 ksi
Fc - Perp	650 psi	Ebend- yy	1600 ksi
Fv	265 psi	Eminbend - yy	850 ksi
Ft	1100 psi	Density	31.21 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.20, L = 0.060, S = 0.0250 , Tributary Width = 1.0 ft
Uniform Load : D = 0.030, S = 0.050 , Tributary Width = 1.0 ft, (from flat roof)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio		0.400 : 1	Maximum Shear Stress Ratio	=	0.190 : 1
Section used for this span		5.5x9	Section used for this span		5.5x9
fb: Actual	=	949.27 psi	fv: Actual	=	50.30 psi
Fb: Allowable	=	2,375.48 psi	Fv: Allowable	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	6.250 ft	Location of maximum on span	=	11.770 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.069 in	Ratio =	2177 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.314 in	Ratio =	477 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.3142	6.296		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	2.137	2.137
Overall MINimum	0.469	0.469
D Only	1.505	1.505
+D+L	1.880	1.880
+D+S	1.973	1.973
+D+0.750L	1.786	1.786
+D+0.750L+0.750S	2.137	2.137
+0.60D	0.903	0.903
L Only	0.375	0.375

R16

DESCRIPTION: header (R5)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
S Only	0.469	0.469

R17

Wood Beam

DESCRIPTION: header (R6)

CODE REFERENCES

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

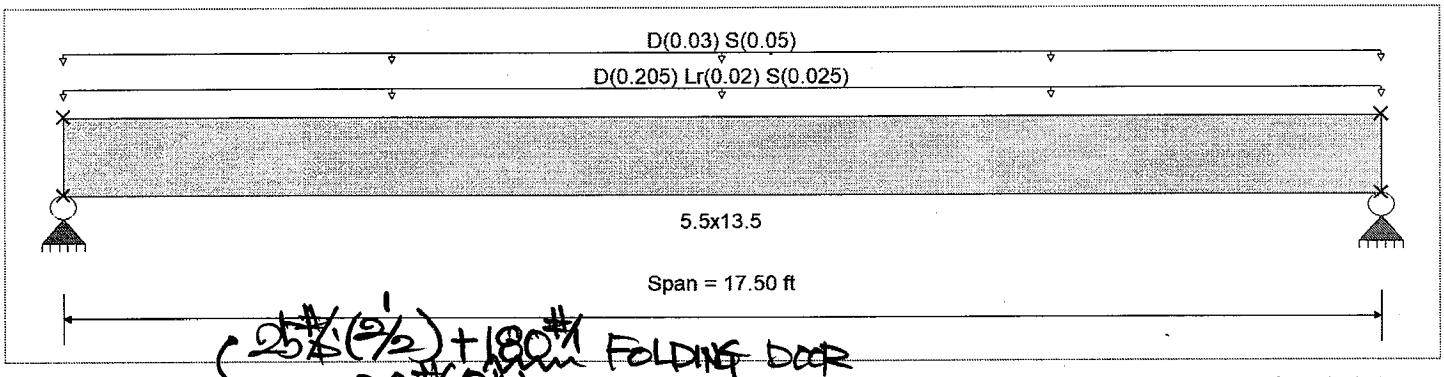
Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2018

Wood Species : DF/DF
Wood Grade : 24F-V4

Beam Bracing : Completely Unbraced

Fb +	2400 psi	*E : Modulus of Elasticity*	
Fb -	1850 psi	Ebend- xx	1800 ksi
Fc - Prll	1650 psi	Eminbend - xx	950 ksi
Fc - Perp	650 psi	Ebend- yy	1600 ksi
Fv	265 psi	Eminbend - yy	850 ksi
Ft	1100 psi	Density	31.21 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.2050, Lr = 0.020, S = 0.0250 , Tributary Width = 1.0 ft
Uniform Load : D = 0.030, S = 0.050 , Tributary Width = 1.0 ft, (from flat roof)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.336 : 1	Maximum Shear Stress Ratio	=	0.166 : 1
Section used for this span		5.5x13.5	Section used for this span		5.5x13.5
fb: Actual	=	896.66 psi	fv: Actual	=	50.49 psi
Fb: Allowable	=	2,669.59 psi	Fv: Allowable	=	304.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	8.750 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	0.078 in	Ratio =	2677 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.341 in	Ratio =	615 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.3410	8.814		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	2.853	2.853
Overall MINimum	0.656	0.656
D Only	2.197	2.197
+D+L	2.197	2.197
+D+Lr	2.372	2.372
+D+S	2.853	2.853
+D+0.750Lr+0.750L	2.328	2.328
+D+0.750L+0.750S	2.689	2.689
+0.60D	1.318	1.318

R12

DESCRIPTION: header (R6)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Lr Only	0.175	0.175
S Only	0.656	0.656

R19

Wood Beam

File: examples.ec6

Lic. # : KW-06010224
D.S. ENGINEERING PC

DESCRIPTION: beam (RT)

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

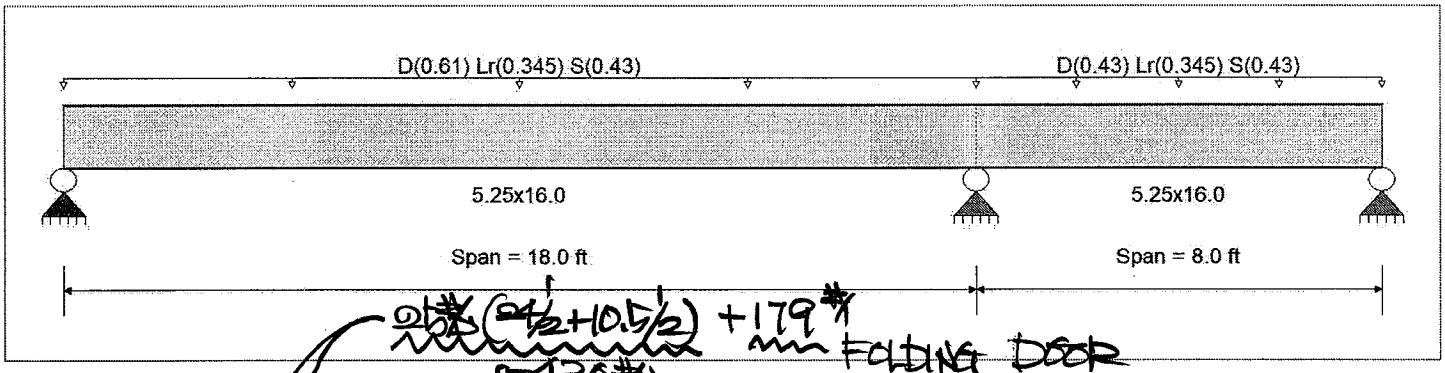
Wood Species : iLevel Truss Joist
Wood Grade : Parallam PSL 2.2E

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

Fb +	2900 psi
Fb -	2900 psi
Fc - Prll	2900 psi
Fc - Perp	750 psi
Fv	290 psi
Ft	2025 psi

E : Modulus of Elasticity

Ebend- xx	2200 ksi
Eminbend - xx	1118.19 ksi
Density	45.07 pcf



20#/ft (24'/2 + 10.5'/2) + 179# FOLDING DOOR (=430#)

20#/ft (24'/2 + 10.5'/2)

25#/ft (24'/2 + 10.5'/2)

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 = 0.610, Lr = 0.3450, S = 0.430 , Tributary Width = 1.0 ft
Load for Span Number 2
Uniform Load : D = 0.430, Lr = 0.3450, S = 0.430 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.532 : 1	Maximum Shear Stress Ratio	=	0.535 : 1
Section used for this span		5.25x16.0	Section used for this span		5.25x16.0
fb: Actual	=	1,718.51 psi	fv: Actual	=	178.30 psi
Fb: Allowable	=	3,230.19 psi	Fv: Allowable	=	333.50 psi
Load Combination		+D+S+H	Load Combination		+D+S+H
Location of maximum on span	=	18.000 ft	Location of maximum on span	=	16.693 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.145 in	Ratio =	1494 >=240
Max Upward Transient Deflection	-0.014 in	Ratio =	6710 >=240
Max Downward Total Deflection	0.362 in	Ratio =	596 >=180
Max Upward Total Deflection	-0.039 in	Ratio =	2487 >=180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S+H	1	0.3623	8.145		0.0000	0.000
	2	0.0000	8.145	+D+S+H	-0.0386	3.039

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum	7.814	18.934	-0.545
Overall MINimum	3.141	7.958	-0.545
+D+H	4.673	10.976	-0.545
+D+L+H	4.673	10.976	-0.545
+D+Lr+H	7.193	17.361	-0.481
+D+S+H	7.814	18.934	-0.465

R20

DESCRIPTION: beam

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
+D+0.750Lr+0.750L+H	6.563	15.764	-0.497
+D+0.750L+0.750S+H	7.029	16.944	-0.485
+D+0.60W+H	4.673	10.976	-0.545
+D+0.70E+H	4.673	10.976	-0.545
+D+0.750Lr+0.750L+0.450W+H	6.563	15.764	-0.497
+D+0.750L+0.750S+0.450W+H	7.029	16.944	-0.485
+D+0.750L+0.750S+0.5250E+H	7.029	16.944	-0.485
+0.60D+0.60W+0.60H	2.804	6.585	-0.327
+0.60D+0.70E+0.60H	2.804	6.585	-0.327
D Only	4.673	10.976	-0.545
Lr Only	2.520	6.385	0.065
S Only	3.141	7.958	0.081
H Only			

R24

Wood Beam

DESCRIPTION: beam (R8)

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

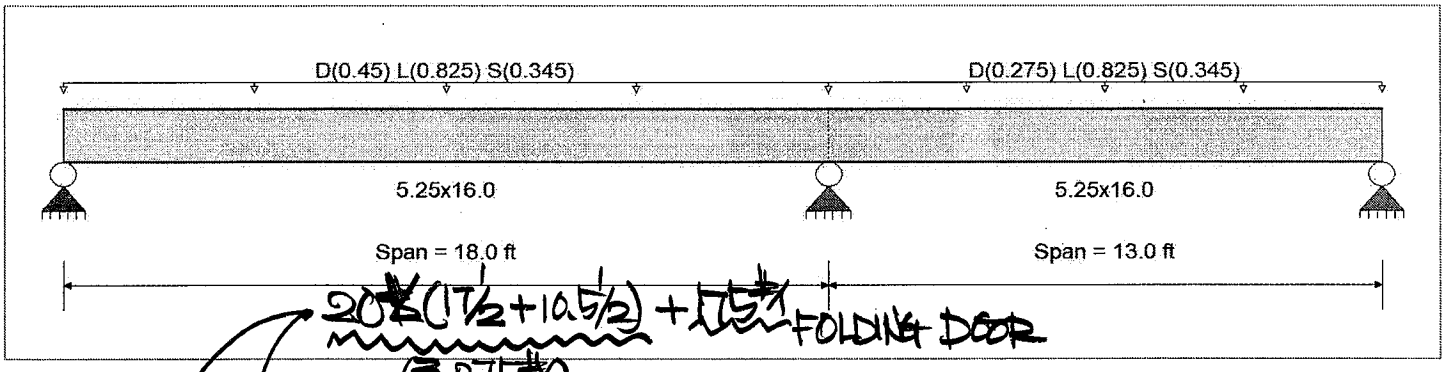
Wood Species : iLevel Truss Joist
Wood Grade : Parallam PSL 2.2E

Fb +	2900 psi
Fb -	2900 psi
Fc - Prll	2900 psi
Fc - Perp	750 psi
Fv	290 psi
Ft	2025 psi

E : Modulus of Elasticity

Ebend- xx	2200 ksi
Eminbend - xx	1118.19 ksi
Density	45.07 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
Load for Span Number 1
Uniform Load : D = 0.450, L = 0.8250, S = 0.3450 , Tributary Width = 1.0 ft
Load for Span Number 2
Uniform Load : D = 0.2750, L = 0.8250, S = 0.3450 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.774 : 1	Maximum Shear Stress Ratio	=	0.755 : 1
Section used for this span		5.25x16.0	Section used for this span		5.25x16.0
fb: Actual	=	2,173.87 psi	fv: Actual	=	219.02 psi
Fb: Allowable	=	2,808.86 psi	Fv: Allowable	=	290.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	18.000 ft	Location of maximum on span	=	16.693 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.264 in	Ratio =	817 >=240
Max Upward Transient Deflection	-0.017 in	Ratio =	9406 >=240
Max Downward Total Deflection	0.447 in	Ratio =	483 >=180
Max Upward Total Deflection	-0.037 in	Ratio =	4168 >=180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S+0.5250E+H	1	0.4467	8.145		0.0000	0.000
L Only	2	0.0187	9.006	+D+0.750L+0.750S+0.5250E+H	-0.0374	2.542

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum	9.835	25.447	4.410
Overall MINimum	2.484	6.827	1.383
+D+H	3.516	8.082	0.891
+D+L+H	9.457	24.408	4.199
+D+Lr+H	3.516	8.082	0.891
+D+S+H	6.001	14.910	2.275

R22

DESCRIPTION: beam

R8

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
+D+0.750Lr+0.750L+H	7.972	20.327	3.372
+D+0.750L+0.750S+H	9.835	25.447	4.410
+D+0.60W+H	3.516	8.082	0.891
+D+0.70E+H	3.516	8.082	0.891
+D+0.750Lr+0.750L+0.450W+H	7.972	20.327	3.372
+D+0.750L+0.750S+0.450W+H	9.835	25.447	4.410
+D+0.750L+0.750S+0.5250E+H	9.835	25.447	4.410
+0.60D+0.60W+0.60H	2.110	4.849	0.535
+0.60D+0.70E+0.60H	2.110	4.849	0.535
D Only	3.516	8.082	0.891
L Only	5.941	16.326	3.308
S Only	2.484	6.827	1.383
H Only			

Wood Beam

DESCRIPTION: header (R9)

CODE REFERENCES

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

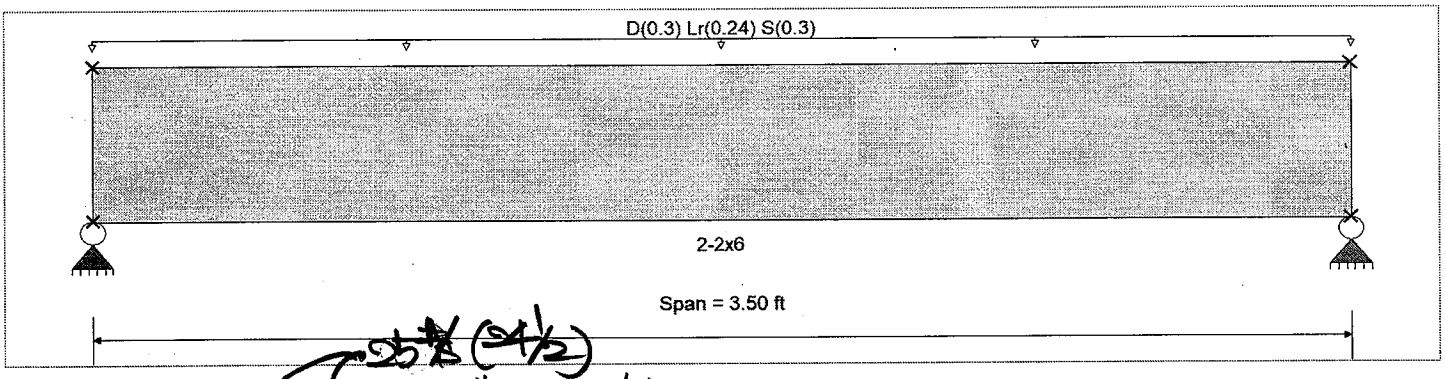
Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2018

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

Beam Bracing : Completely Unbraced

Fb +	900 psi	*E : Modulus of Elasticity*	
Fb -	900 psi	Ebend- xx	1600 ksi
Fc - Prll	1350 psi	Eminbend - xx	580 ksi
Fc - Perp	625 psi		
Fv	180 psi		
Ft	575 psi	Density	31.21 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.30, Lr = 0.240, S = 0.30 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.548 : 1	Maximum Shear Stress Ratio	=	0.345 : 1
Section used for this span		2-2x6	Section used for this span		2-2x6
fb: Actual	=	733.27 psi	fv: Actual	=	71.49 psi
Fb: Allowable	=	1,338.08 psi	Fv: Allowable	=	207.00 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	1.750 ft	Location of maximum on span	=	3.053 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.015 in	Ratio =	2743 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.031 in	Ratio =	1363 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.0308	1.763		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.056	1.056
Overall MINimum	0.525	0.525
D Only	0.531	0.531
+D+L	0.531	0.531
+D+Lr	0.951	0.951
+D+S	1.056	1.056
+D+0.750Lr+0.750L	0.846	0.846
+D+0.750L+0.750S	0.925	0.925
+0.60D	0.319	0.319
Lr Only	0.420	0.420

R24

Wood Beam

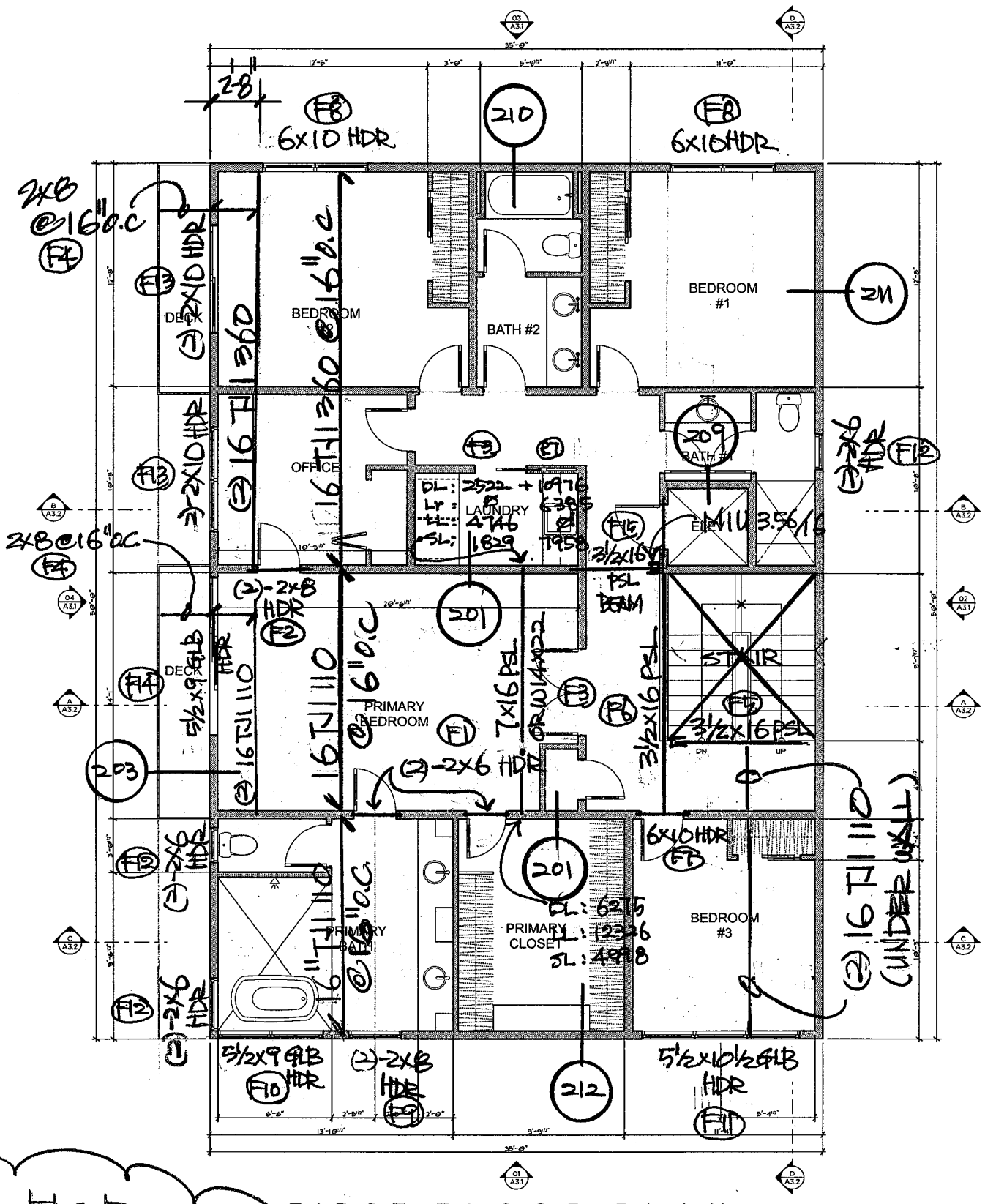
DESCRIPTION: header (R9)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
S Only	0.525	0.525

R25



FIRST FLOOR PLAN

SCALE: 1/4" = 1'-0"

FLOOR

DL: 12 PSF
LL: 40 PSF
(60 PSF @ DECK)

2ND FLOOR FRAMING PLAN

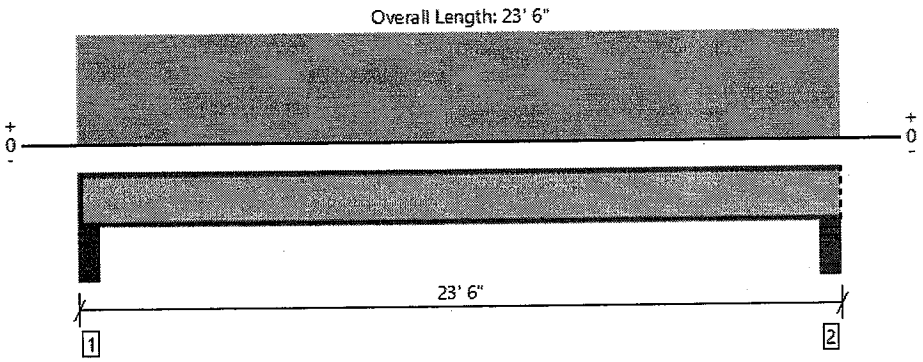
FORTE WEB

MEMBER REPORT

PASSED

Level, Floor: Joist

1 piece(s) 16" TJI® 360 @ 16" OC



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)	815 @ 23' 1 1/2"	1505 (3.50")	Passed (54%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	783 @ 5 1/2"	2190	Passed (36%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	4486 @ 11' 9"	8405	Passed (53%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.378 @ 11' 9"	0.569	Passed (L/723)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.491 @ 11' 9"	1.138	Passed (L/556)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	40	40	Passed	--	--

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

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Weyerhaeuser Edge™ Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: None.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Total	
1 - Stud wall - HF	5.50"	4.25"	1.75"	188	627	815	1 1/4" Rim Board
2 - Stud wall - HF	5.50"	5.50"	1.75"	188	627	815	Blocking

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.
- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	5' 3" o/c	
Bottom Edge (Lu)	23' 5" o/c	

- TJI joists are only analyzed using Maximum Allowable bracing solutions.
- Maximum allowable bracing intervals based on applied load.

Vertical Load	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 23' 6"	16"	12.0	40.0	Default Load

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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
dong shin D.S. Engineering PC (425) 338-4776 shin_don@hotmail.com	

Weyerhaeuser

5/8/2022 10:03:53 AM UTC
ForteWEB v3.2, Engine: V8.2.0.17, Data: V8.1.0.16
File Name:

2-2

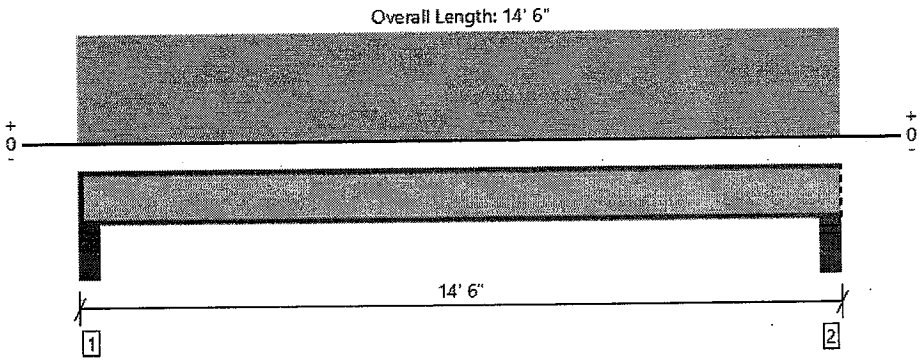
FORTE WEB

MEMBER REPORT

PASSED

Level, Floor: Joist

1 piece(s) 16" TJI® 110 @ 16" OC



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)	503 @ 14' 1 1/2"	1375 (3.50")	Passed (37%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	471 @ 5 1/2"	2145	Passed (22%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	1639 @ 7' 3"	4280	Passed (38%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.082 @ 7' 3"	0.344	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.106 @ 7' 3"	0.688	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	60	40	Passed	--	--

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

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Weyerhaeuser Edge™ Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: None.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Total	
1 - Stud wall - HF	5.50"	4.25"	1.75"	116	387	503	1 1/4" Rim Board
2 - Stud wall - HF	5.50"	5.50"	1.75"	116	387	503	Blocking

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.
- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	5' 3" o/c	
Bottom Edge (Lu)	14' 5" o/c	

- TJI joists are only analyzed using Maximum Allowable bracing solutions.
- Maximum allowable bracing intervals based on applied load.

Vertical Load	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 14' 6"	16"	12.0	40.0	Default Load

Weyerhaeuser Notes

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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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Weyerhaeuser

5/8/2022 10:10:18 AM UTC
ForteWEB v3.2, Engine: V8.2.0.17, Data: V8.1.0.16
File Name:

2-3

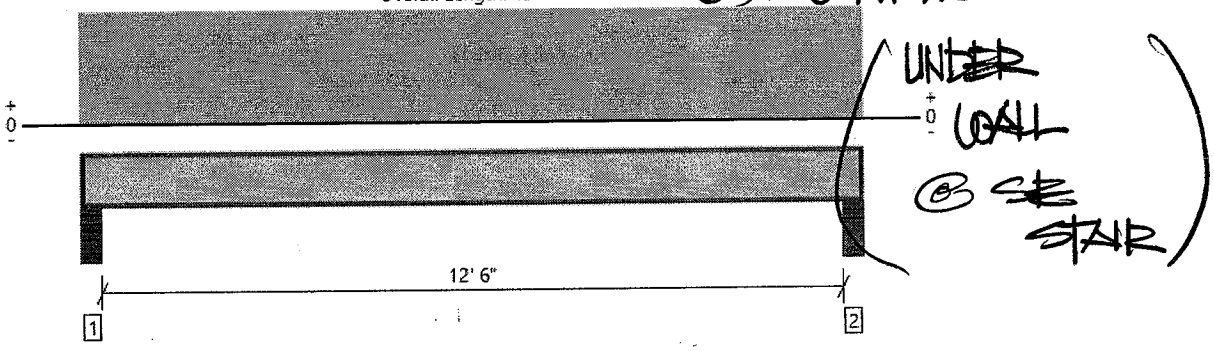
FORTE WEB

MEMBER REPORT

PASSED

Level, Floor: Joist

2 piece(s) 11 7/8" TJI® 110 @ 12" OC



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)	1783 @ 4 1/2"	2750 (3.50")	Passed (65%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1688 @ 5 1/2"	3120	Passed (54%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	5415 @ 6' 8 1/2"	6320	Passed (86%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.137 @ 6' 8 1/2"	0.317	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.309 @ 6' 8 1/2"	0.633	Passed (L/492)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	65	40	Passed	--	--

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

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Weyerhaeuser Edge™ Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: None.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Roof Live	Snow	Total	
1 - Stud wall - HF	5.50"	4.25"	1.75"	1006	805	134	168	2113	1 1/4" Rim Board
2 - Stud wall - HF	5.50"	4.25"	1.75"	1006	805	134	168	2113	1 1/4" Rim Board

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	3' 4" o/c	
Bottom Edge (Lu)	13' 3" o/c	

- TJI joists are only analyzed using Maximum Allowable bracing solutions.
- Maximum allowable bracing intervals based on applied load.

Vertical Load	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Roof Live (non-snow: 1.25)	Snow (1.15)	Comments
1 - Uniform (PLF)	0 to 13' 5"	N/A	150.0	120.0	20.0	25.0	Default Load

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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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Weyerhaeuser

4/25/2022 5:47:28 PM UTC
ForteWEB v3.2, Engine: V8.2.0.17, Data: V8.1.0.16
File Name:

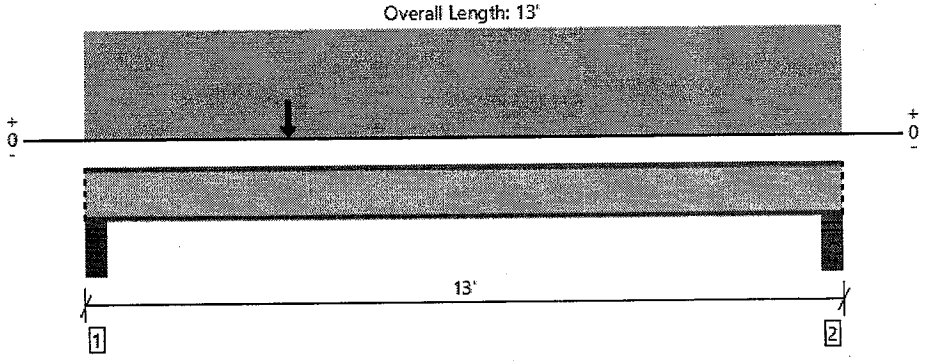
FORTE WEB

MEMBER REPORT

PASSED

Level, Floor: Joist

1 piece(s) 16" TJI® 110 @ 12" OC



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)	912 @ 4 1/2"	1375 (3.50")	Passed (66%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	888 @ 5 1/2"	2145	Passed (41%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	2534 @ 3' 6"	4280	Passed (59%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.095 @ 6' 1 3/8"	0.306	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.128 @ 6' 1 5/16"	0.613	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	65	40	Passed	--	--

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

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Weyerhaeuser Edge™ Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: None.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Total	
1 - Stud wall - HF	5.50"	5.50"	1.76"	234	677	911	Blocking
2 - Stud wall - HF	5.50"	5.50"	1.75"	132	403	535	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	4' 2" o/c	
Bottom Edge (Lu)	13' o/c	

•TJI joists are only analyzed using Maximum Allowable bracing solutions.
•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PLF)	0 to 13'	N/A	12.0	40.0	Default Load
2 - Point (lb)	3' 6"	N/A	210	560	

40#/s (4'x14'/4) EXTERIOR STAIR

15#/s (4'x14'/4) EXTERIOR STAIR

Weyerhaeuser Notes

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

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Weyerhaeuser

5/8/2022 10:50:08 PM UTC
ForteWEB v3.2, Engine: V8.2.0.17, Data: V8.1.0.16
File Name: Strand

2-5

Wood Beam

Lic. # : KW-06010224

DESCRIPTION: deck

CODE REFERENCES (WEST)

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.2

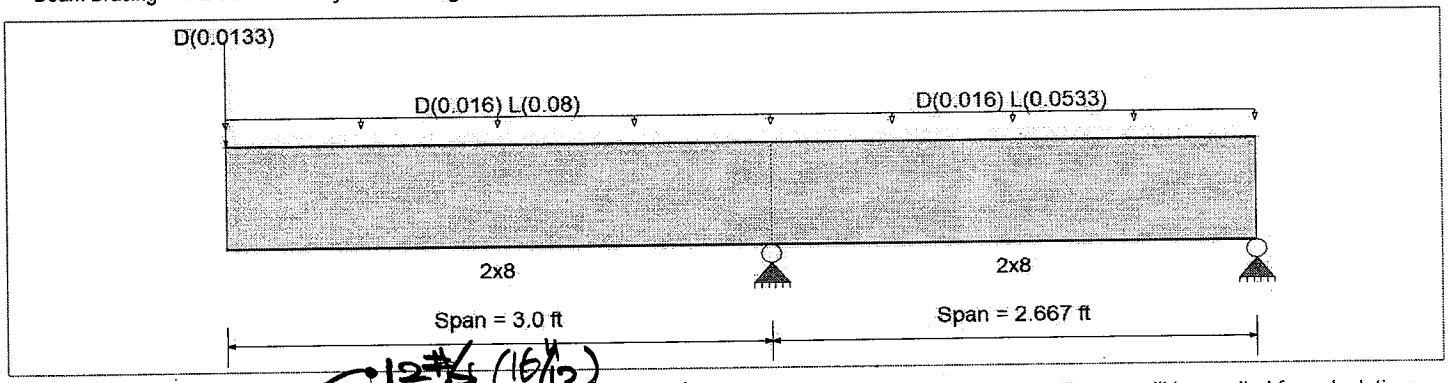
Fb +	900 psi
Fb -	900 psi
Fc - Prll	1350 psi
Fc - Perp	625 psi
Fv	180 psi
Ft	575 psi

E : Modulus of Elasticity

Ebend- xx	1600 ksi
Eminbend - xx	580 ksi
Density	31.21 pcf

Repetitive Member Stress Increase

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



12#/ft (16/12)
60#/ft (16/12)
40#/ft (16/12)

Applied Loads

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

Load for Span Number 1
Uniform Load : D = 0.0160, L = 0.080 , Tributary Width = 1.0 ft, (from deck)
Point Load : D = 0.01330 k @ 0.0 ft, (from guardrail + misc)
Load for Span Number 2
Uniform Load : D = 0.0160, L = 0.05330 , Tributary Width = 1.0 ft, (from floor)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.347 : 1	Maximum Shear Stress Ratio	=	0.186 : 1
Section used for this span		2x8	Section used for this span		2x8
fb: Actual	=	430.94 psi	fv: Actual	=	33.57 psi
Fb: Allowable	=	1,242.00 psi	Fv: Allowable	=	180.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	3.000 ft	Location of maximum on span	=	2.397 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.037 in	Ratio =	1928 >=240
Max Upward Transient Deflection	-0.003 in	Ratio =	10651 >=240
Max Downward Total Deflection	0.050 in	Ratio =	1450 >=180
Max Upward Total Deflection	-0.004 in	Ratio =	8109 >=180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	1	0.0497	0.000		0.0000	0.000
	2	0.0000	0.000	+D+L+H	-0.0039	1.073

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum		0.571	-0.085
Overall MINimum		0.446	-0.021
+D+H		0.125	-0.021
+D+L+H		0.571	-0.085
+D+Lr+H		0.125	-0.021
+D+S+H		0.125	-0.021

DESCRIPTION: deck

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
+D+0.750Lr+0.750L+H		0.459	-0.069
+D+0.750L+0.750S+H		0.459	-0.069
+D+0.60W+H		0.125	-0.021
+D+0.70E+H		0.125	-0.021
+D+0.750Lr+0.750L+0.450W+H		0.459	-0.069
+D+0.750L+0.750S+0.450W+H		0.459	-0.069
+D+0.750L+0.750S+0.5250E+H		0.459	-0.069
+0.60D+0.60W+0.60H		0.075	-0.012
+0.60D+0.70E+0.60H		0.075	-0.012
D Only		0.125	-0.021
L Only		0.446	-0.064
H Only			

Wood Beam

Lic. # : KW-06010224

DESCRIPTION: header

F1

CODE REFERENCES

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

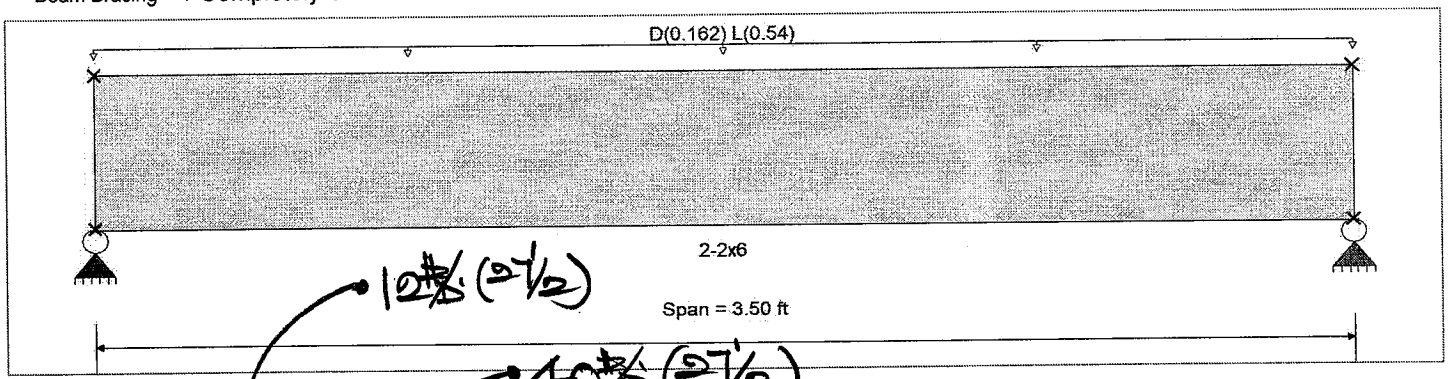
Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2018

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

Beam Bracing : Completely Unbraced

Fb +	900 psi	*E : Modulus of Elasticity*	
Fb -	900 psi	Ebend- xx	1600 ksi
Fc - Prll	1350 psi	Eminbend - xx	580 ksi
Fc - Perp	625 psi		
Fv	180 psi		
Ft	575 psi	Density	31.21 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.1620, L = 0.540 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.736 : 1	Maximum Shear Stress Ratio	=	0.464 : 1
Section used for this span		2-2x6	Section used for this span		2-2x6
fb: Actual	=	857.19 psi	fv: Actual	=	83.57 psi
Fb: Allowable	=	1,164.46 psi	Fv: Allowable	=	180.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	1.750 ft	Location of maximum on span	=	3.053 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.028 in	Ratio =	1524 >=240
Max Upward Transient Deflection	0.000 in	Ratio =	0 <240
Max Downward Total Deflection	0.036 in	Ratio =	1166 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	1	0.0360	1.763		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.235	1.235
Overall MINimum	0.945	0.945
+D+H	0.290	0.290
+D+L+H	1.235	1.235
+D+Lr+H	0.290	0.290
+D+S+H	0.290	0.290
+D+0.750Lr+0.750L+H	0.999	0.999
+D+0.750L+0.750S+H	0.999	0.999
+D+0.60W+H	0.290	0.290
+D+0.70E+H	0.290	0.290

DESCRIPTION: header

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
+D+0.750Lr+0.750L+0.450W+H	0.999	0.999
+D+0.750L+0.750S+0.450W+H	0.999	0.999
+D+0.750L+0.750S+0.5250E+H	0.999	0.999
+0.60D+0.60W+0.60H	0.174	0.174
+0.60D+0.70E+0.60H	0.174	0.174
D Only	0.290	0.290
L Only	0.945	0.945
H Only		

Wood Beam

Lic. # : KW-06010224

DESCRIPTION: header (F2)

CODE REFERENCES

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

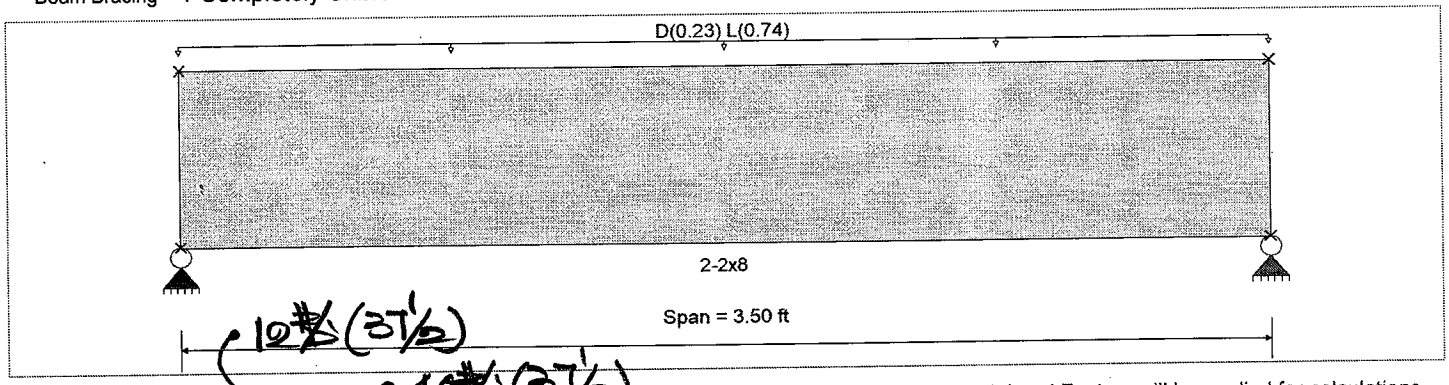
Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2018

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

Beam Bracing : Completely Unbraced

Fb +	900 psi	*E : Modulus of Elasticity*	
Fb -	900 psi	Ebend- xx	1600 ksi
Fc - Prll	1350 psi	Eminbend - xx	580 ksi
Fc - Perp	625 psi		
Fv	180 psi		
Ft	575 psi	Density	31.21 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.230, L = 0.740 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.635 : 1	Maximum Shear Stress Ratio	=	0.429 : 1
Section used for this span		2-2x8	Section used for this span		2-2x8
fb: Actual	=	681.49 psi	fv: Actual	=	77.28 psi
Fb: Allowable	=	1,073.53 psi	Fv: Allowable	=	180.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	1.750 ft	Location of maximum on span	=	2.900 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.016 in	Ratio =	2547 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.022 in	Ratio =	1934 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0217	1.763		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.706	1.706
Overall MINimum	1.295	1.295
D Only	0.411	0.411
+D+L	1.706	1.706
+D+0.750L	1.382	1.382
+0.60D	0.246	0.246
L Only	1.295	1.295

Wood Beam

Project File: ENERCALC_20

LIC# : KW-06015335, Build:20.22.4.26 D.S. ENGINEERING PC (c) ENERCALC INC 1983-2022

DESCRIPTION: beam (F3)

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

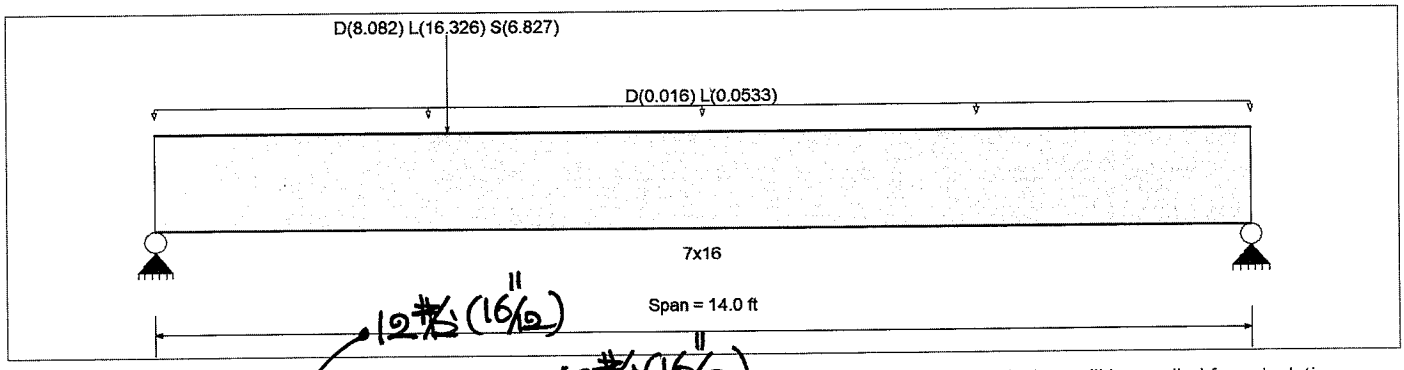
Wood Species : iLevel Truss Joist
Wood Grade : Parallam PSL 2.2E

Fb +	2900 psi
Fb -	2900 psi
Fc - Prll	2900 psi
Fc - Perp	750 psi
Fv	290 psi
Ft	2025 psi

E : Modulus of Elasticity

Ebend- xx	2200 ksi
Eminbend - xx	1118.19 ksi
Density	45.07 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 = 0.0160, L = 0.05330 , Tributary Width = 1.0 ft
Point Load : D = 8.082, L = 16.326, S = 6.827 k @ 3.750 ft, (from 6x6 post with (R7))

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.954** : 1	Maximum Shear Stress Ratio	=	**0.853** : 1
Section used for this span		**7x16**	Section used for this span		**7x16**
fb: Actual	=	2,765.34 psi	fv: Actual	=	247.26 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	290.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	3.781 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	0.237 in	Ratio =	710 >=360	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.370 in	Ratio =	454 >=240	Span: 1 : +D+0.750L+0.750S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.3700	6.285		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	19.268	7.453
Overall MINimum	4.998	1.829
D Only	6.275	2.522
+D+L	18.601	7.268
+D+S	11.273	4.351
+D+0.750L	15.519	6.082
+D+0.750L+0.750S	19.268	7.453
+0.60D	3.765	1.513
L Only	12.326	4.746

DESCRIPTION: beam (F3)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
S Only	4.998	1.829

Wood Column

Lic. # : KW-06010224

DESCRIPTION: 6x8 post under 7x17 PSL

Code References

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

General Information

Analysis Method :	Allowable Stress Design		
End Fixities	Top & Bottom Pinned		
Overall Column Height	9 ft		
(Used for non-slender calculations)			
Wood Species	Douglas Fir-Larch		
Wood Grade	No.2		
Fb +	750.0 psi	Fv	170.0 psi
Fb -	750.0 psi	Ft	475.0 psi
Fc - Prll	700.0 psi	Density	31.210 pcf
Fc - Perp	625.0 psi		

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1,300.0	1,300.0	1,300.0 ksi
Minimum	470.0	470.0	

Wood Section Name	6x8		
Wood Grading/Manuf.	Graded Lumber		
Wood Member Type	Sawn		
Exact Width	5.50 in	Allow Stress Modification Factors	
Exact Depth	7.50 in	Cf or Cv for Bending	1.0
Area	41.250 in^2	Cf or Cv for Compression	1.0
Ix	193.359 in^4	Cf or Cv for Tension	1.0
Iy	103.984 in^4	Cm : Wet Use Factor	1.0
		Ct : Temperature Factor	1.0
		Cfu : Flat Use Factor	1.0
		Kf : Built-up columns	1.0 *NDS 15.3.2*
		Use Cr : Repetitive ?	No

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = ft, K = 1.0
Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 8 ft, K = 1.0

Applied Loads

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

Column self weight included : 80.463 lbs * Dead Load Factor
AXIAL LOADS . . .
from <R7>: Axial Load at 9.0 ft, D = 10.976, Lr = 6.385, S = 7.958 k
from (F3): Axial Load at 9.0 ft, D = 2.522, L = 4.746, S = 1.829 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio = **0.8043 : 1**

Load Combination	+D+0.750L+0.750S
Governing NDS Forumla	Comp Only, fc/Fc'
Location of max.above base	0.0 ft
At maximum location values are . . .	
Applied Axial	24.478 k
Applied Mx	0.0 k-ft
Applied My	0.0 k-ft
Fc : Allowable	737.81 psi

PASS Maximum Shear Stress Ratio = **0.0 : 1**

Load Combination	+0.4775D
Location of max.above base	9.0 ft
Applied Design Shear	0.0 psi
Allowable Shear	272.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.0 k	Bottom along Y-Y	0.0 k
Top along X-X	0.0 k	Bottom along X-X	0.0 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 0.0 in at 0.0 ft above base
for load combination : n/a

Other Factors used to calculate allowable stresses . . .

	Bending	Compression	Tension

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
D Only	0.900	0.937	0.5574	PASS	0.0 ft	0.0	PASS	9.0 ft
+D+L	1.000	0.929	0.6830	PASS	0.0 ft	0.0	PASS	9.0 ft
+D+Lr	1.250	0.908	0.6093	PASS	0.0 ft	0.0	PASS	9.0 ft
+D+S	1.150	0.917	0.7677	PASS	0.0 ft	0.0	PASS	9.0 ft
+D+0.750Lr+0.750L	1.250	0.908	0.6692	PASS	0.0 ft	0.0	PASS	9.0 ft
+D+0.750L+0.750S	1.150	0.917	0.8043	PASS	0.0 ft	0.0	PASS	9.0 ft
+1.123D	1.600	0.875	0.3769	PASS	0.0 ft	0.0	PASS	9.0 ft
+1.092D+0.750L+0.750S	1.600	0.875	0.6361	PASS	0.0 ft	0.0	PASS	9.0 ft
+0.60D	1.600	0.875	0.2014	PASS	0.0 ft	0.0	PASS	9.0 ft
+0.4775D	1.600	0.875	0.1603	PASS	0.0 ft	0.0	PASS	9.0 ft

Steel Beam

Project File: ENERCALC_20

LIC# : KW-06015335, Build:20.22.4.26 D.S. ENGINEERING PC (c) ENERCALC INC 1983-2022

DESCRIPTION: beam (F3) alt

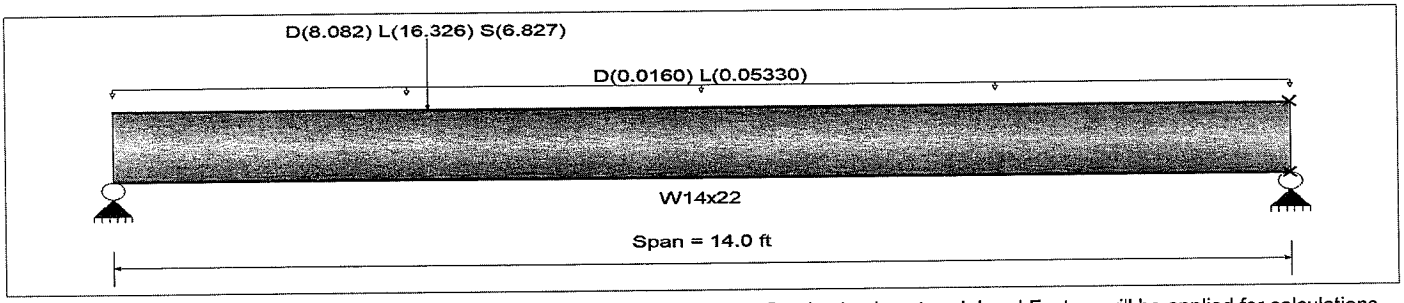
CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method :Allowable Strength Design
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling
Bending Axis : Major Axis Bending

Fy : Steel Yield : 50.0 ksi
E: Modulus : 29,000.0 ksi



Applied Loads

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

Beam self weight calculated and added to loading
Uniform Load : D = 0.0160, L = 0.05330 k/ft, Tributary Width = 1.0 ft

Point Load : D = 8.082, L = 16.326, S = 6.827 k @ 3.750 ft, (from 6x6 post with (R7))

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.861** : 1	Maximum Shear Stress Ratio =	**0.304** : 1
Section used for this span	**W14x22**	Section used for this span	**W14x22**
Ma : Applied	71.298 k-ft	Va : Applied	19.176 k
Mn / Omega : Allowable	82.834 k-ft	Vn/Omega : Allowable	63.020 k
Load Combination	+D+0.750L+0.750S	Load Combination	+D+0.750L+0.750S
		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	0.215 in	Ratio =	780	>=360
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360 Span: 1 : L Only
Max Downward Total Deflection	0.335 in	Ratio =	502	>=240. Span: 1 : +D+0.750L+0.750S
Max Upward Total Deflection	0.000 in	Ratio =	0	<240.0

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	Summary of Moment Values Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Summary of Shear Values Va Max	VnxVnx/Omega	
D Only													
Dsgn. L = 14.00 ft	1	0.276	0.098	22.90		22.90	138.33	82.83	1.00	1.00	6.18	94.53	63.02
+D+L													
Dsgn. L = 14.00 ft	1	0.829	0.294	68.71		68.71	138.33	82.83	1.00	1.00	18.51	94.53	63.02
+D+S													
Dsgn. L = 14.00 ft	1	0.503	0.177	41.62		41.62	138.33	82.83	1.00	1.00	11.18	94.53	63.02
+D+0.750L													
Dsgn. L = 14.00 ft	1	0.691	0.245	57.25		57.25	138.33	82.83	1.00	1.00	15.43	94.53	63.02
+D+0.750L+0.750S													
Dsgn. L = 14.00 ft	1	0.861	0.304	71.30		71.30	138.33	82.83	1.00	1.00	19.18	94.53	63.02
+0.60D													
Dsgn. L = 14.00 ft	1	0.166	0.059	13.74		13.74	138.33	82.83	1.00	1.00	3.71	94.53	63.02

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.3346	6.240		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	19.176	7.362

DESCRIPTION: beam (F3) alt

Vertical Reactions

Support notation : Far left is # Values in KIPS

Load Combination	Support 1	Support 2
Overall MINimum	3.710	1.458
D Only	6.183	2.431
+D+L	18.509	7.177
+D+S	11.182	4.259
+D+0.750L	15.428	5.990
+D+0.750L+0.750S	19.176	7.362
+0.60D	3.710	1.458
L Only	12.326	4.746
S Only	4.998	1.829

Steel Section Properties : W14x22

Depth	=	13.700 in	I xx	=	199.00 in^4	J	=	0.208 in^4
Web Thick	=	0.230 in	S xx		29.00 in^3	Cw	=	314.00 in^6
Flange Width	=	5.000 in	R xx	=	5.540 in			
Flange Thick	=	0.335 in	Zx	=	33.200 in^3			
Area	=	6.490 in^2	I yy	=	7.000 in^4			
Weight	=	22.000 plf	S yy	=	2.800 in^3	Wno	=	16.700 in^2
Kdesign	=	0.735 in	R yy	=	1.040 in	Sw	=	7.000 in^4
K1	=	0.750 in	Zy	=	4.390 in^3	Qf	=	5.340 in^3
rts	=	1.270 in				Qw	=	16.100 in^3
Ycg	=	6.850 in						

DESCRIPTION: deck (F4)

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.2

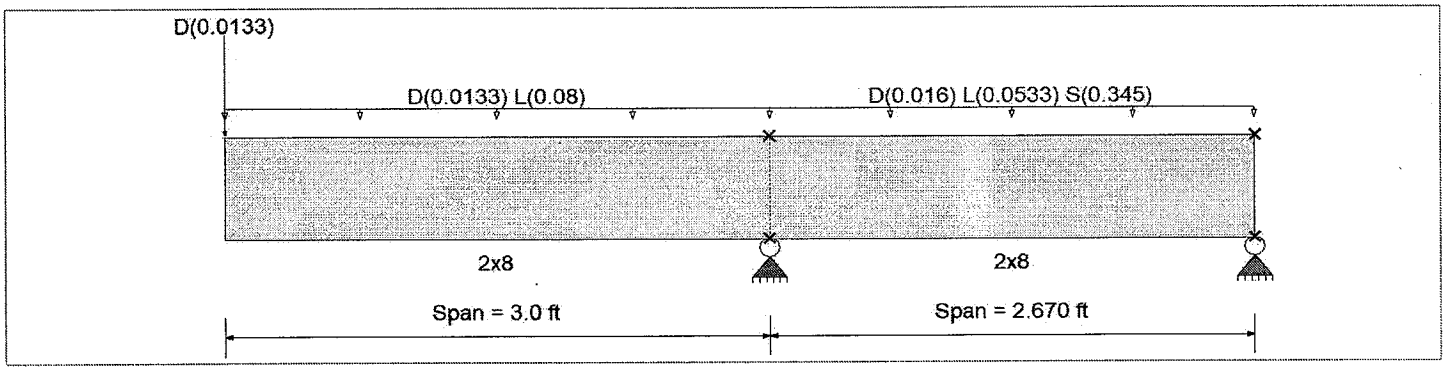
Beam Bracing : Completely Unbraced

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 = 0.01330, L = 0.080 , Tributary Width = 1.0 ft
Point Load : D = 0.01330 k @ 0.0 ft, (guardrail & misc)
Load for Span Number 2
Uniform Load : D = 0.0160, L = 0.05330, S = 0.3450 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.350 : 1	Maximum Shear Stress Ratio	=	0.247 : 1
Section used for this span		2x8	Section used for this span		2x8
fb: Actual	=	419.84 psi	fv: Actual	=	51.15 psi
Fb: Allowable	=	1,199.96 psi	Fv: Allowable	=	207.00 psi
Load Combination		+D+L+H	Load Combination		+D+0.750L+0.750S+H
Location of maximum on span	=	3.000 ft	Location of maximum on span	=	3.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.037 in	Ratio =	1926 >=240
Max Upward Transient Deflection	-0.019 in	Ratio =	3868 >=240
Max Downward Total Deflection	0.048 in	Ratio =	1490 >=180
Max Upward Total Deflection	-0.004 in	Ratio =	8374 >=180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	1	0.0483	0.000		0.0000	0.000
S Only	2	0.0052	1.342	+D+L+H	-0.0027	0.462

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum		0.792	0.461
Overall MINimum		0.461	0.461
+D+H		0.112	-0.016
+D+L+H		0.558	-0.080
+D+Lr+H		0.112	-0.016
+D+S+H		0.572	0.445

2-16

DESCRIPTION: deck (F4)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
+D+0.750Lr+0.750L+H		0.446	-0.064
+D+0.750L+0.750S+H		0.792	0.282
+D+0.60W+H		0.112	-0.016
+D+0.70E+H		0.112	-0.016
+D+0.750Lr+0.750L+0.450W+H		0.446	-0.064
+D+0.750L+0.750S+0.450W+H		0.792	0.282
+D+0.750L+0.750S+0.5250E+H		0.792	0.282
+0.60D+0.60W+0.60H		0.067	-0.010
+0.60D+0.70E+0.60H		0.067	-0.010
D Only		0.112	-0.016
L Only		0.446	-0.064
S Only		0.461	0.461
H Only			

Wood Beam

File: examples.ec6

Lic. # : KW-06010224
D.S. ENGINEERING PC

DESCRIPTION: beam (STAIR) (F5)

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

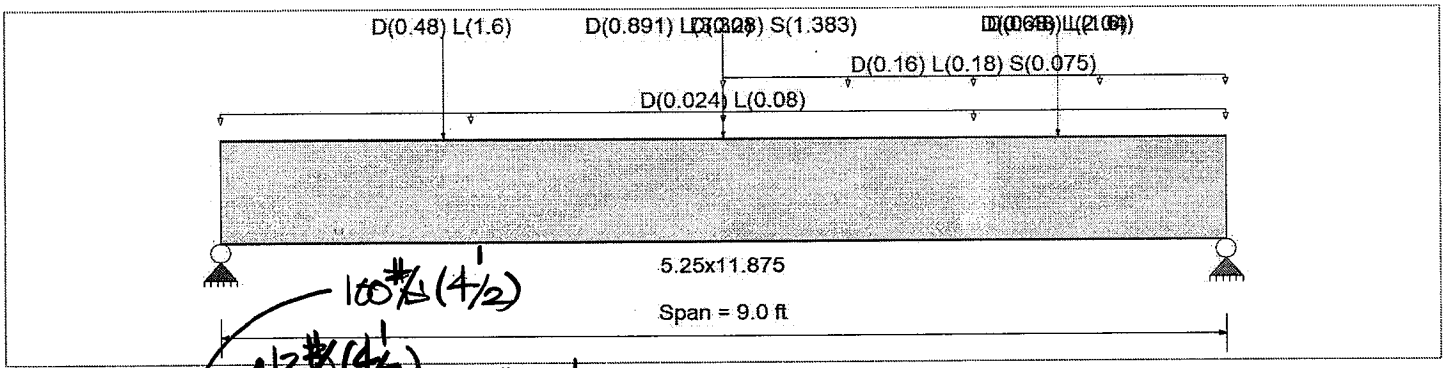
Wood Species : iLevel Truss Joist
Wood Grade : Parallam PSL 2.2E

Fb +	2900 psi
Fb -	2900 psi
Fc - Prll	2900 psi
Fc - Perp	750 psi
Fv	290 psi
Ft	2025 psi

E : Modulus of Elasticity

Ebend- xx	2200 ksi
Eminbend - xx	1118.19 ksi
Density	45.07 pcf

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



100#(4'/2)
12#(4'/2)
40#(4'/2)

Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.0240, L = 0.080 , Tributary Width = 1.0 ft, (from 2nd floor)
Point Load : D = 0.480, L = 1.60 k @ 2.0 ft, (from stair) ← 12#x4'x10' & 40#x4'x10'
Point Load : D = 0.20 k @ 4.50 ft, (from wall wt)
Point Load : D = 0.8910, L = 3.308, S = 1.383 k @ 4.50 ft, (from 5.25x16 PSL)
Point Load : D = 0.680, L = 2.040 k @ 7.50 ft, (from stair (roof)) ← 20#x17'x4'/2 & 60#x17'x4'/2
Point Load : D = 0.480, L = 1.60 k @ 7.50 ft, (from stair)
Uniform Load : D = 0.160, L = 0.180, S = 0.0750 k/ft, Extent = 4.50 –>> 9.0 ft, Tributary Width = 1.0 ft, (from wall (roof))

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.622 : 1	Maximum Shear Stress Ratio	=	0.656 : 1
Section used for this span		5.25x11.875	Section used for this span		5.25x11.875
fb: Actual	=	1,804.01 psi	fv: Actual	=	190.27 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	290.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	4.500 ft	Location of maximum on span	=	8.015 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.115 in	Ratio =	940 >=240
Max Upward Transient Deflection	0.000 in	Ratio =	0 <240
Max Downward Total Deflection	0.158 in	Ratio =	682 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

20#(6'/2)+100# WALL
60#(6'/2)
95#(6'/2)

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	HGLTV3.516 1	0.1582	4.599		0.0000	0.000

Vertical Reactions (940#)

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	5.556	8.365
Overall MINimum	0.776	0.945
+D+H	1.488	2.355
+D+L+H	5.556	8.365

5 1/4x11 7/8 : S=123.4, I=732.6

USE 3 1/2x16 PSL : S=149.3, I=1194.7

DESCRIPTION: beam

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
+D+Lr+H	1.488	2.355
+D+S+H	2.264	3.299
+D+0.750Lr+0.750L+H	4.539	6.862
+D+0.750L+0.750S+H	5.121	7.571
+D+0.60W+H	1.488	2.355
+D+0.70E+H	1.488	2.355
+D+0.750Lr+0.750L+0.450W+H	4.539	6.862
+D+0.750L+0.750S+0.450W+H	5.121	7.571
+D+0.750L+0.750S+0.5250E+H	5.121	7.571
+0.60D+0.60W+0.60H	0.893	1.413
+0.60D+0.70E+0.60H	0.893	1.413
D Only	1.488	2.355
L Only	4.068	6.010
S Only	0.776	0.945
H Only		

Wood Beam

File: examples.ec6

Lic. # : KW-06010224
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DESCRIPTION: beam (stair)

F6

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 : iLevel Truss Joist
Wood Grade : Parallam PSL 2.2E

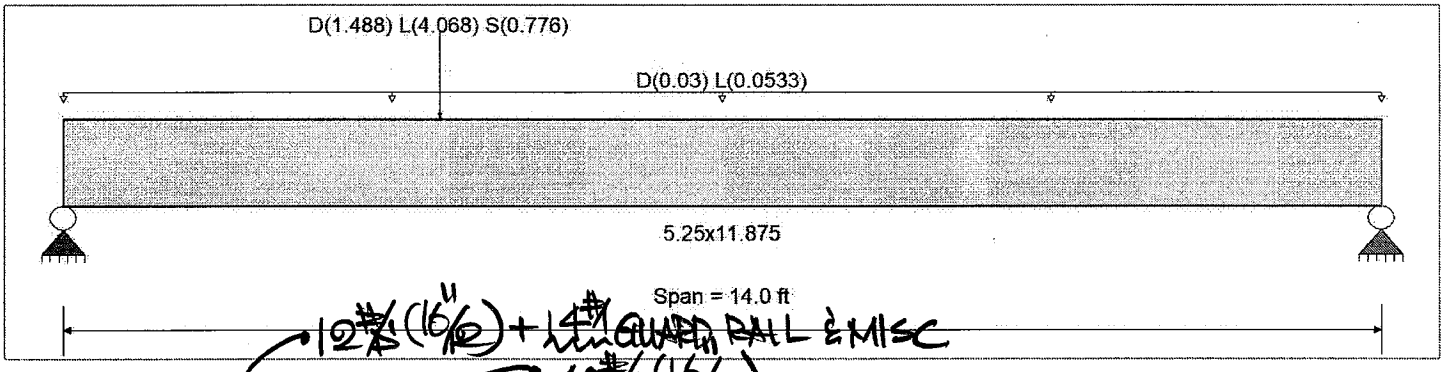
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	2900 psi
Fb -	2900 psi
Fc - Prll	2900 psi
Fc - Perp	750 psi
Fv	290 psi
Ft	2025 psi

E : Modulus of Elasticity

Ebend- xx	2200 ksi
Eminbend - xx	1118.19 ksi
Density	45.07 pcf

Repetitive Member Stress Increase



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.030, L = 0.05330 , Tributary Width = 1.0 ft, (from 2nd floor)
Point Load : D = 1.488, L = 4.068, S = 0.7760 k @ 4.0 ft, (from 5.25x11.875 PSL)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.577 : 1	Maximum Shear Stress Ratio	=	0.381 : 1
Section used for this span		5.25x11.875	Section used for this span		5.25x11.875
fb: Actual	=	1,739.26 psi	fv: Actual	=	110.40 psi
Fb: Allowable	=	3,016.00 psi	Fv: Allowable	=	290.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	4.036 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	0.223 in	Ratio =	754 >=240
Max Upward Transient Deflection	0.000 in	Ratio =	0 <240
Max Downward Total Deflection	0.320 in	Ratio =	524 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

USE 3 1/2 x 16 PSL

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	1	0.3202	6.387		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	4.688	2.307
Overall MINimum	0.554	0.222
+D+H	1.409	0.772
+D+L+H	4.688	2.307
+D+Lr+H	1.409	0.772
+D+S+H	1.964	0.993
+D+0.750Lr+0.750L+H	3.869	1.923
+D+0.750L+0.750S+H	4.284	2.090
+D+0.60W+H	1.409	0.772

2-20

DESCRIPTION: beam (stair)

(F8)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
+D+0.70E+H	1.409	0.772
+D+0.750Lr+0.750L+0.450W+H	3.869	1.923
+D+0.750L+0.750S+0.450W+H	4.284	2.090
+D+0.750L+0.750S+0.5250E+H	4.284	2.090
+0.60D+0.60W+0.60H	0.846	0.463
+0.60D+0.70E+0.60H	0.846	0.463
D Only	1.409	0.772
L Only	3.279	1.535
S Only	0.554	0.222
H Only		

DESCRIPTION: header (F7)

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

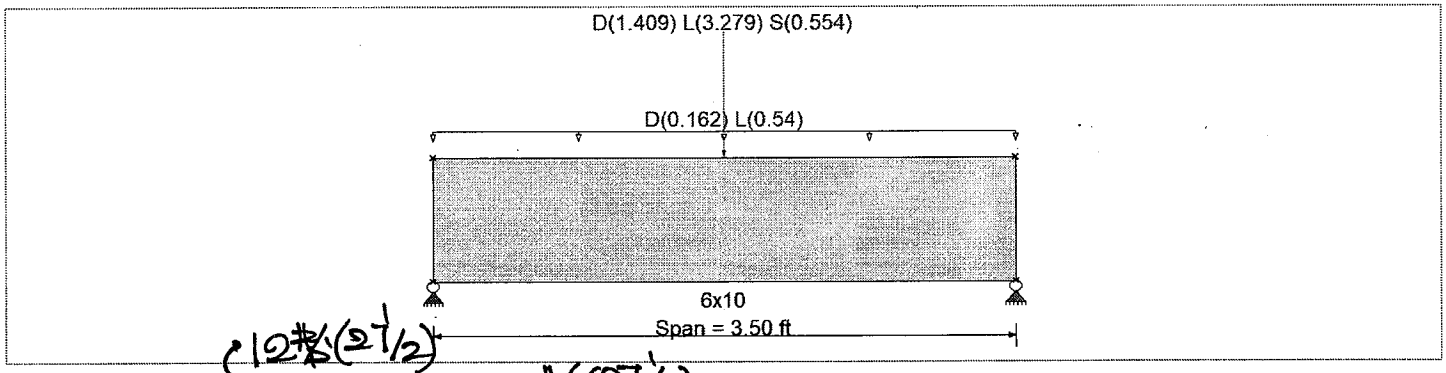
Wood Species : Douglas Fir-Larch
Wood Grade : No.2

Beam Bracing : Completely Unbraced

Fb +	875 psi
Fb -	875 psi
Fc - Prll	600 psi
Fc - Perp	625 psi
Fv	170 psi
Ft	425 psi

E : Modulus of Elasticity

Ebend- xx	1300 ksi
Eminbend - xx	470 ksi
Density	31.21 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.1620, L = 0.540 , Tributary Width = 1.0 ft
Point Load : D = 1.409, L = 3.279, S = 0.5540 k @ 1.750 ft, (from 3.5x16 PSL (F6))

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.863 : 1	Maximum Shear Stress Ratio	=	0.513 : 1
Section used for this span		6x10	Section used for this span		6x10
fb: Actual	=	753.44 psi	fv: Actual	=	87.17 psi
Fb: Allowable	=	873.08 psi	Fv: Allowable	=	170.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	1.750 ft	Location of maximum on span	=	2.721 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.014 in	Ratio =	3099 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.019 in	Ratio =	2212 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0190	1.763		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	3.592	3.592
Overall MINimum	0.277	0.277
D Only	1.008	1.008
+D+L	3.592	3.592
+D+S	1.285	1.285
+D+0.750L	2.946	2.946
+D+0.750L+0.750S	3.154	3.154
+0.60D	0.605	0.605
L Only	2.585	2.585

DESCRIPTION: header (F7)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
S Only	0.277	0.277

Wood Beam

DESCRIPTION: header (F8)

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

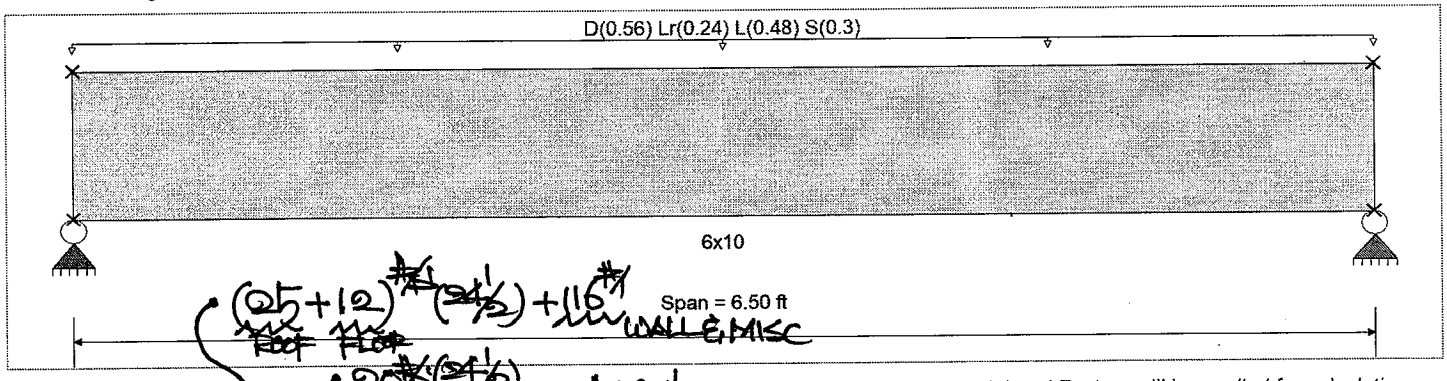
Wood Species : Douglas Fir-Larch
Wood Grade : No.2

Beam Bracing : Completely Unbraced

Fb +	875 psi
Fb -	875 psi
Fc - Prll	600 psi
Fc - Perp	625 psi
Fv	170 psi
Ft	425 psi

E : Modulus of Elasticity

Ebend- xx	1300 ksi
Eminbend - xx	470 ksi
Density	31.21 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.560, Lr = 0.240, L = 0.480, S = 0.30 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.924 : 1	Maximum Shear Stress Ratio	=	0.438 : 1
Section used for this span		6x10	Section used for this span		6x10
fb: Actual	=	805.37 psi	fv: Actual	=	74.46 psi
Fb: Allowable	=	871.44 psi	Fv: Allowable	=	170.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	3.250 ft	Location of maximum on span	=	5.717 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.038 in	Ratio =	2054 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.091 in	Ratio =	852 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.0914	3.274		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	3.758	3.758
Overall MINimum	0.975	0.975
D Only	1.857	1.857
+D+L	3.417	3.417
+D+Lr	2.637	2.637
+D+S	2.832	2.832
+D+0.750Lr+0.750L	3.612	3.612
+D+0.750L+0.750S	3.758	3.758
+0.60D	1.114	1.114
Lr Only	0.780	0.780

2-24

DESCRIPTION: header (F8)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
L Only	1.560	1.560
S Only	0.975	0.975

Wood Beam

File: examples.ec6

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DESCRIPTION: header (S) (F9)

CODE REFERENCES

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

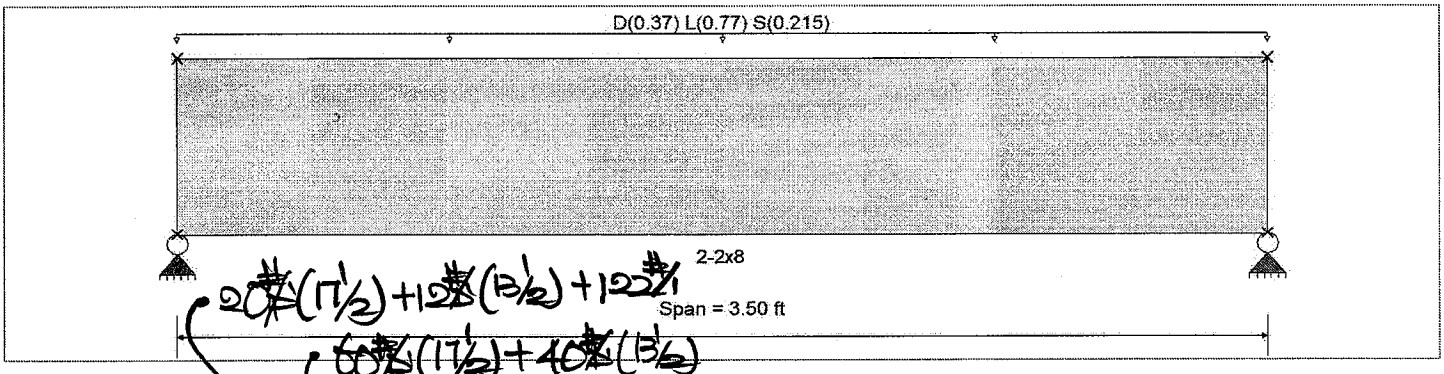
Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2018

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

Beam Bracing : Completely Unbraced

Fb +	900 psi	*E : Modulus of Elasticity*	
Fb -	900 psi	Ebend- xx	1600 ksi
Fc - Prll	1350 psi	Eminbend - xx	580 ksi
Fc - Perp	625 psi		
Fv	180 psi		
Ft	575 psi	Density	31.21 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.370, L = 0.770, S = 0.2150 , Tributary Width = 1.0 ft, (from floor + roof deck)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.746 : 1**	Maximum Shear Stress Ratio	=	**0.504 : 1**
Section used for this span		**2-2x8**	Section used for this span		**2-2x8**
fb: Actual	=	800.35 psi	fv: Actual	=	90.76 psi
Fb: Allowable	=	1,073.53 psi	Fv: Allowable	=	180.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	1.750 ft	Location of maximum on span	=	2.900 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.017 in	Ratio =	2448 >=240
Max Upward Transient Deflection	0.000 in	Ratio =	0 <240
Max Downward Total Deflection	0.026 in	Ratio =	1646 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	1	0.0255	1.763		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	2.003	2.003
Overall MINimum	0.376	0.376
+D+H	0.656	0.656
+D+L+H	2.003	2.003
+D+Lr+H	0.656	0.656
+D+S+H	1.032	1.032
+D+0.750Lr+0.750L+H	1.666	1.666
+D+0.750L+0.750S+H	1.949	1.949
+D+0.60W+H	0.656	0.656
+D+0.70E+H	0.656	0.656

DESCRIPTION: header (S) (F9)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
+D+0.750Lr+0.750L+0.450W+H	1.666	1.666
+D+0.750L+0.750S+0.450W+H	1.949	1.949
+D+0.750L+0.750S+0.5250E+H	1.949	1.949
+0.60D+0.60W+0.60H	0.393	0.393
+0.60D+0.70E+0.60H	0.393	0.393
D Only	0.656	0.656
L Only	1.348	1.348
S Only	0.376	0.376
H Only		

DESCRIPTION: header (F10)

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

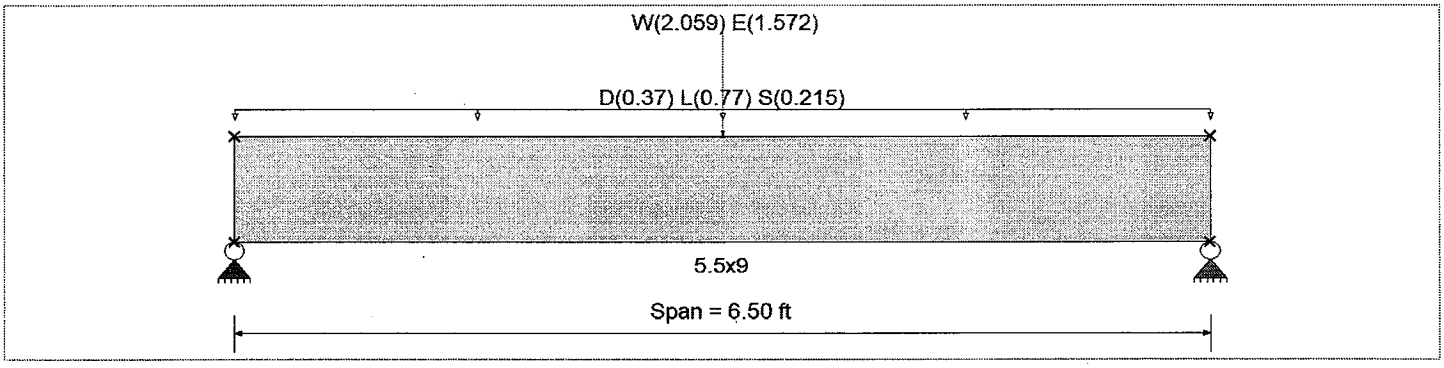
Wood Species : DF/DF
Wood Grade : 24F-V4

Beam Bracing : Completely Unbraced

Fb +	2,400.0 psi
Fb -	1,850.0 psi
Fc - Prll	1,650.0 psi
Fc - Perp	650.0 psi
Fv	265.0 psi
Ft	1,100.0 psi

E : Modulus of Elasticity

Ebend- xx	1,800.0 ksi
Eminbend - xx	950.0 ksi
Ebend- yy	1,600.0 ksi
Eminbend - yy	850.0 ksi
Density	31.210 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.370, L = 0.770, S = 0.2150 , Tributary Width = 1.0 ft, (see (F9))
Point Load : W = 2.059, E = 1.572 k @ 3.250 ft, (from shearwall Calc)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.411** : 1	Maximum Shear Stress Ratio	=	**0.331** : 1
Section used for this span		**5.5x9**	Section used for this span		**5.5x9**
fb: Actual	=	982.19 psi	fv: Actual	=	87.69 psi
Fb: Allowable	=	2,387.32 psi	Fv: Allowable	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	3.250 ft	Location of maximum on span	=	5.765 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.052 in	Ratio =	1508 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.091 in	Ratio =	861 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S+0.450W	1	0.0905	3.274		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	4.102	4.102
Overall MINimum	0.786	0.786
D Only	1.237	1.237
+D+L	3.740	3.740
+D+S	1.936	1.936
+D+0.750L	3.114	3.114
+D+0.750L+0.750S	3.638	3.638
+D+0.60W	1.855	1.855
+D+0.70E	1.788	1.788

DESCRIPTION: header (F10)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
+D+0.750L+0.450W	3.578	3.578
+D+0.750L+0.750S+0.450W	4.102	4.102
+D+0.750L+0.750S+0.5250E	4.051	4.051
+0.60D+0.60W	1.360	1.360
+0.60D+0.70E	1.293	1.293
L Only	2.503	2.503
S Only	0.699	0.699
W Only	1.030	1.030
E Only	0.786	0.786

Wood Beam

Lic. # : KW-06010224

DESCRIPTION: header (F11)

CODE REFERENCES

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

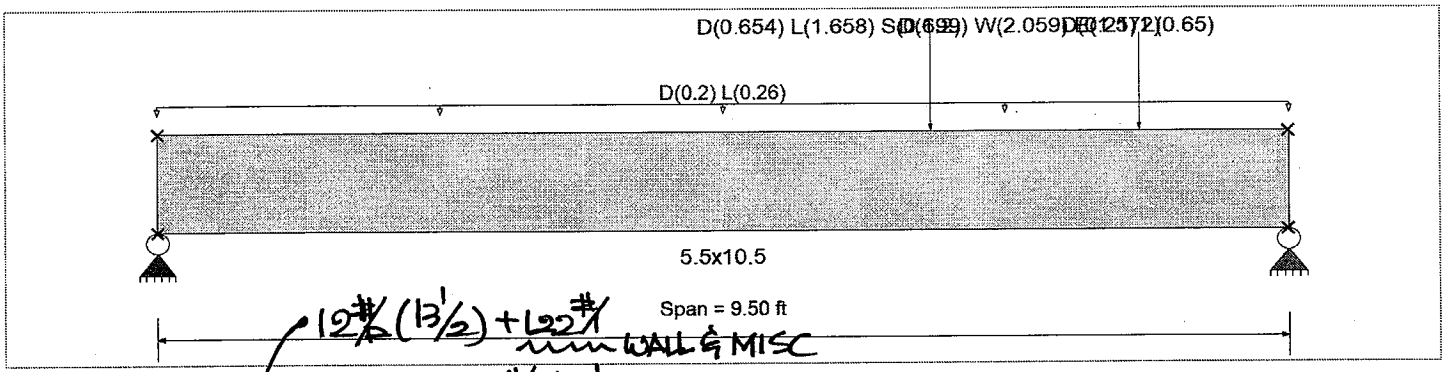
Material Properties

Analysis Method : Allowable Stress Design
Load Combination IBC 2018

Wood Species : DF/DF
Wood Grade : 24F-V4

Beam Bracing : Completely Unbraced

Fb +	2,400.0 psi	*E : Modulus of Elasticity*	
Fb -	1,850.0 psi	Ebend- xx	1,800.0 ksi
Fc - Prll	1,650.0 psi	Eminbend - xx	950.0 ksi
Fc - Perp	650.0 psi	Ebend- yy	1,600.0 ksi
Fv	265.0 psi	Eminbend - yy	850.0 ksi
Ft	1,100.0 psi	Density	31.210 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.20, L = 0.260 , Tributary Width = 1.0 ft, (see (F11))
Point Load : D = 0.6540, L = 1.658, S = 0.6990, W = 2.059, E = 1.572 k @ 6.50 ft, (from shearwall Calc & header (R2))
Point Load : D = 1.20 k @ 6.50 ft, (from wall)
Point Load : D = 0.210, L = 0.650 k @ 8.250 ft, (from stair)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.626 : 1	Maximum Shear Stress Ratio	=	0.489 : 1
Section used for this span		5.5x10.5	Section used for this span		5.5x10.5
fb: Actual	=	1,489.56 psi	fv: Actual	=	129.47 psi
Fb: Allowable	=	2,377.80 psi	Fv: Allowable	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	6.484 ft	Location of maximum on span	=	8.633 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.103 in	Ratio =	1107 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.210 in	Ratio =	543 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S+0.450W	1	0.2097	5.062		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	3.467	5.653
Overall MINimum	0.496	1.076
D Only	1.623	2.460
+D+L	3.467	5.394
+D+S	1.843	2.939
+D+0.750L	3.006	4.661
+D+0.750L+0.750S	3.171	5.019

DESCRIPTION: header (F11)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
+D+0.60W	2.013	3.306
+D+0.70E	1.970	3.213
+D+0.750L+0.450W	3.298	5.295
+D+0.750L+0.750S+0.450W	3.464	5.653
+D+0.750L+0.750S+0.5250E	3.432	5.584
+0.60D+0.60W	1.364	2.321
+0.60D+0.70E	1.321	2.229
L Only	1.844	2.934
S Only	0.221	0.478
W Only	0.650	1.409
E Only	0.496	1.076

Wood Beam

File: examples.ec6

Lic. # : KW-06010224
D.S. ENGINEERING PC

DESCRIPTION: header (W&E) F12

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

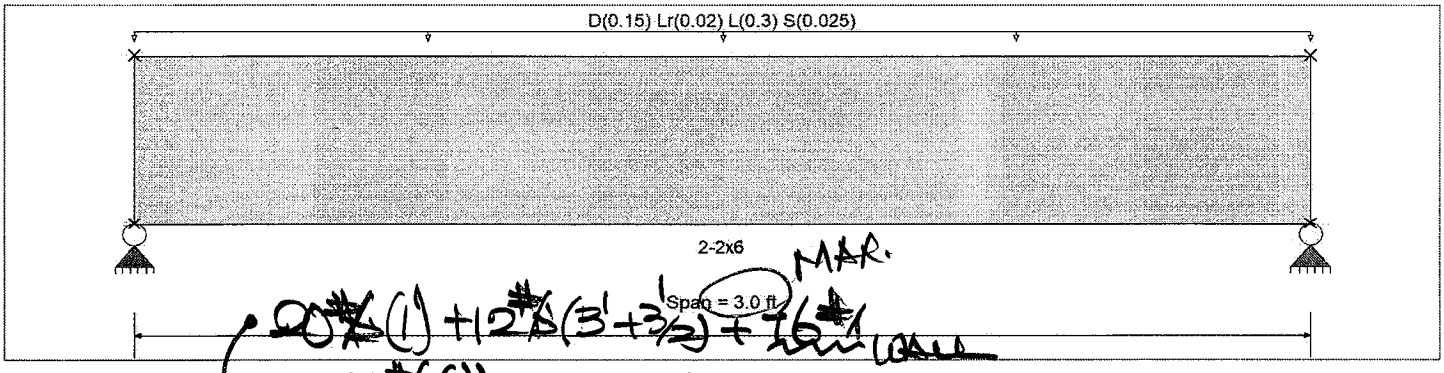
Wood Species : Douglas Fir-Larch
Wood Grade : No.2

Beam Bracing : Completely Unbraced

Fb +	900 psi
Fb -	900 psi
Fc - Prll	1350 psi
Fc - Perp	625 psi
Fv	180 psi
Ft	575 psi

E : Modulus of Elasticity

Ebend- xx	1600 ksi
Eminbend - xx	580 ksi
Density	31.21 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.150, Lr = 0.020, L = 0.30, S = 0.0250 , Tributary Width = 1.0 ft, (from floor + deck + roof)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.347** : 1	Maximum Shear Stress Ratio	=	**0.241** : 1
Section used for this span		**2-2x6**	Section used for this span		**2-2x6**
fb: Actual	=	404.84 psi	fv: Actual	=	43.34 psi
Fb: Allowable	=	1,165.22 psi	Fv: Allowable	=	180.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	1.500 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	0.008 in	Ratio =	4356 >=240
Max Upward Transient Deflection	0.000 in	Ratio =	0 <240
Max Downward Total Deflection	0.012 in	Ratio =	2881 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	1	0.0125	1.511		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.680	0.680
Overall MINimum	0.038	0.038
+D+H	0.230	0.230
+D+L+H	0.680	0.680
+D+Lr+H	0.260	0.260
+D+S+H	0.268	0.268
+D+0.750Lr+0.750L+H	0.590	0.590
+D+0.750L+0.750S+H	0.596	0.596
+D+0.60W+H	0.230	0.230
+D+0.70E+H	0.230	0.230

DESCRIPTION: header (W&E) F12

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
+D+0.750Lr+0.750L+0.450W+H	0.590	0.590
+D+0.750L+0.750S+0.450W+H	0.596	0.596
+D+0.750L+0.750S+0.5250E+H	0.596	0.596
+0.60D+0.60W+0.60H	0.138	0.138
+0.60D+0.70E+0.60H	0.138	0.138
D Only	0.230	0.230
Lr Only	0.030	0.030
L Only	0.450	0.450
S Only	0.038	0.038
H Only		

DESCRIPTION: header (W)

F13

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

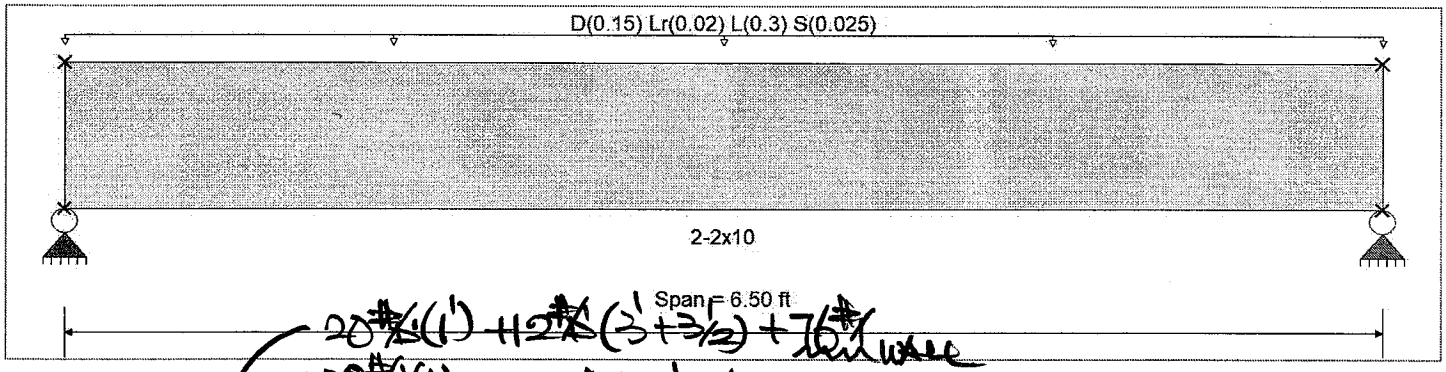
Wood Species : Douglas Fir-Larch
Wood Grade : No.2

Beam Bracing : Completely Unbraced

Fb +	900 psi
Fb -	900 psi
Fc - Prll	1350 psi
Fc - Perp	625 psi
Fv	180 psi
Ft	575 psi

E : Modulus of Elasticity

Ebend- xx	1600 ksi
Eminbend - xx	580 ksi
Density	31.21 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.150, Lr = 0.020, L = 0.30, S = 0.0250 , Tributary Width = 1.0 ft, (from floor + deck + roof)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.692** : 1	Maximum Shear Stress Ratio	=	**0.341** : 1
Section used for this span		**2-2x10**	Section used for this span		**2-2x10**
fb: Actual	=	675.53 psi	fv: Actual	=	61.40 psi
Fb: Allowable	=	975.98 psi	Fv: Allowable	=	180.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	3.250 ft	Location of maximum on span	=	5.741 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.038 in	Ratio =	2037 >=240
Max Upward Transient Deflection	0.000 in	Ratio =	0 <240
Max Downward Total Deflection	0.058 in	Ratio =	1340 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	1	0.0582	3.274		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.482	1.482
Overall MINimum	0.081	0.081
+D+H	0.507	0.507
+D+L+H	1.482	1.482
+D+Lr+H	0.572	0.572
+D+S+H	0.588	0.588
+D+0.750Lr+0.750L+H	1.287	1.287
+D+0.750L+0.750S+H	1.299	1.299
+D+0.60W+H	0.507	0.507
+D+0.70E+H	0.507	0.507

DESCRIPTION: header (W) F13

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
+D+0.750Lr+0.750L+0.450W+H	1.287	1.287
+D+0.750L+0.750S+0.450W+H	1.299	1.299
+D+0.750L+0.750S+0.5250E+H	1.299	1.299
+0.60D+0.60W+0.60H	0.304	0.304
+0.60D+0.70E+0.60H	0.304	0.304
D Only	0.507	0.507
Lr Only	0.065	0.065
L Only	0.975	0.975
S Only	0.081	0.081
H Only		

Wood Beam

Lic. # : KW-06010224

DESCRIPTION: header (F14)

CODE REFERENCES

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

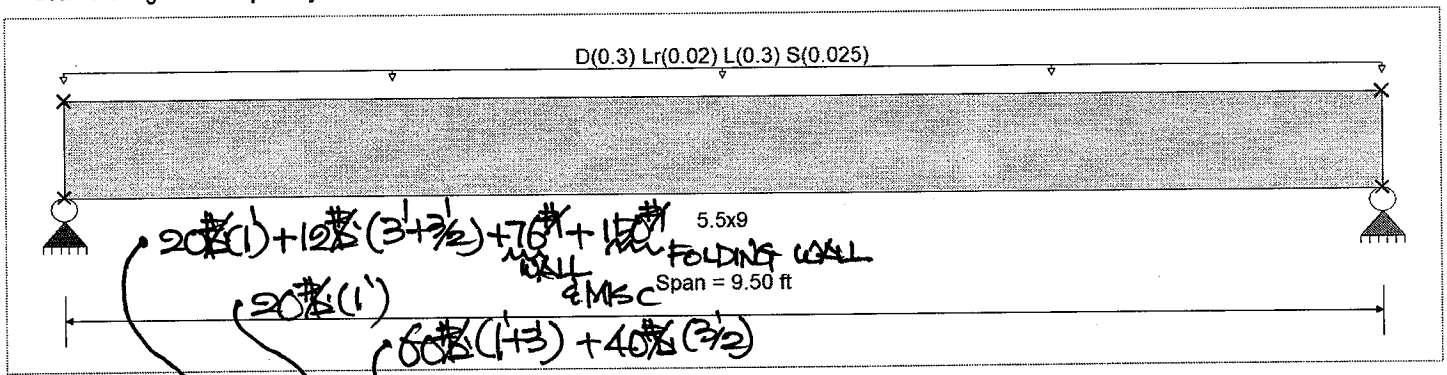
Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2018

Wood Species : DF/DF
Wood Grade : 24F-V4

Beam Bracing : Completely Unbraced

Fb +	2400 psi	*E : Modulus of Elasticity*	
Fb -	1850 psi	Ebend- xx	1800 ksi
Fc - Prll	1650 psi	Eminbend - xx	950 ksi
Fc - Perp	650 psi	Ebend- yy	1600 ksi
Fv	265 psi	Eminbend - yy	850 ksi
Ft	1100 psi	Density	31.21 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.30, Lr = 0.020, L = 0.30, S = 0.0250 , Tributary Width = 1.0 ft, (from 2nd floor + deck + roof)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.467 : 1**	Maximum Shear Stress Ratio	=	**0.281 : 1**
Section used for this span		**5.5x9**	Section used for this span		**5.5x9**
fb: Actual	=	1,113.50 psi	fv: Actual	=	74.43 psi
Fb: Allowable	=	2,381.84 psi	Fv: Allowable	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	4.750 ft	Location of maximum on span	=	8.772 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.092 in	Ratio =	1239 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.187 in	Ratio =	609 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.1872	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	2.901	2.901
Overall MINimum	0.119	0.119
D Only	1.476	1.476
+D+L	2.901	2.901
+D+Lr	1.571	1.571
+D+S	1.595	1.595
+D+0.750Lr+0.750L	2.616	2.616
+D+0.750L+0.750S	2.634	2.634
+0.60D	0.886	0.886
Lr Only	0.095	0.095

DESCRIPTION: header (F14)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
L Only	1.425	1.425
S Only	0.119	0.119

DESCRIPTION: beam (F15)

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

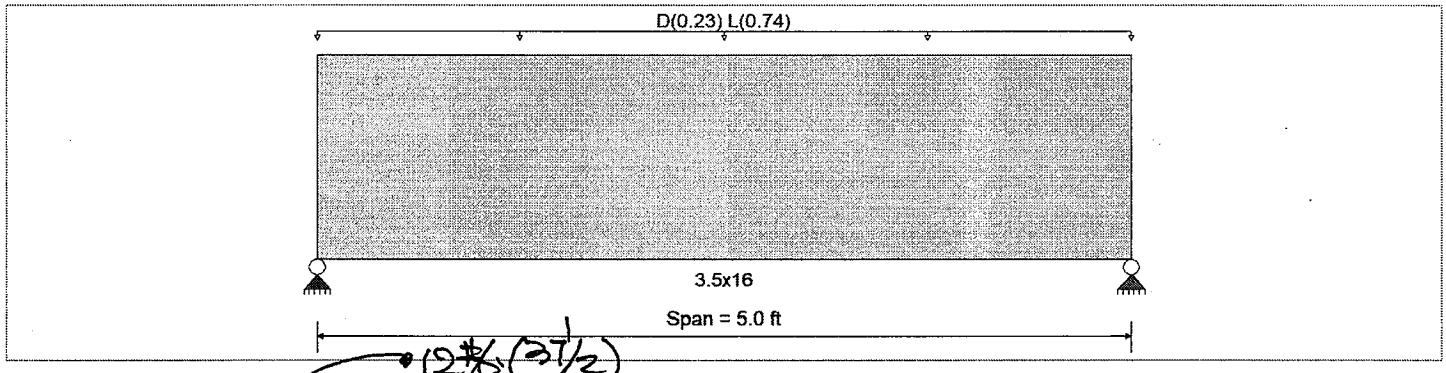
Wood Species : iLevel Truss Joist
Wood Grade : Parallam PSL 2.2E

Fb +	2900 psi
Fb -	2900 psi
Fc - Prll	2900 psi
Fc - Perp	750 psi
Fv	290 psi
Ft	2025 psi

E : Modulus of Elasticity

Ebend- xx	2200 ksi
Eminbend - xx	1118.19 ksi
Density	45.07 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 = 0.230, L = 0.740, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.086 : 1	Maximum Shear Stress Ratio	=	0.107 : 1
Section used for this span		3.5x16	Section used for this span		3.5x16
fb: Actual	=	247.98 psi	fv: Actual	=	30.89 psi
Fb: Allowable	=	2,900.00 psi	Fv: Allowable	=	290.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	2.500 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	0.004 in	Ratio =	15066 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.005 in	Ratio =	11289 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Overall Maximum Deflections

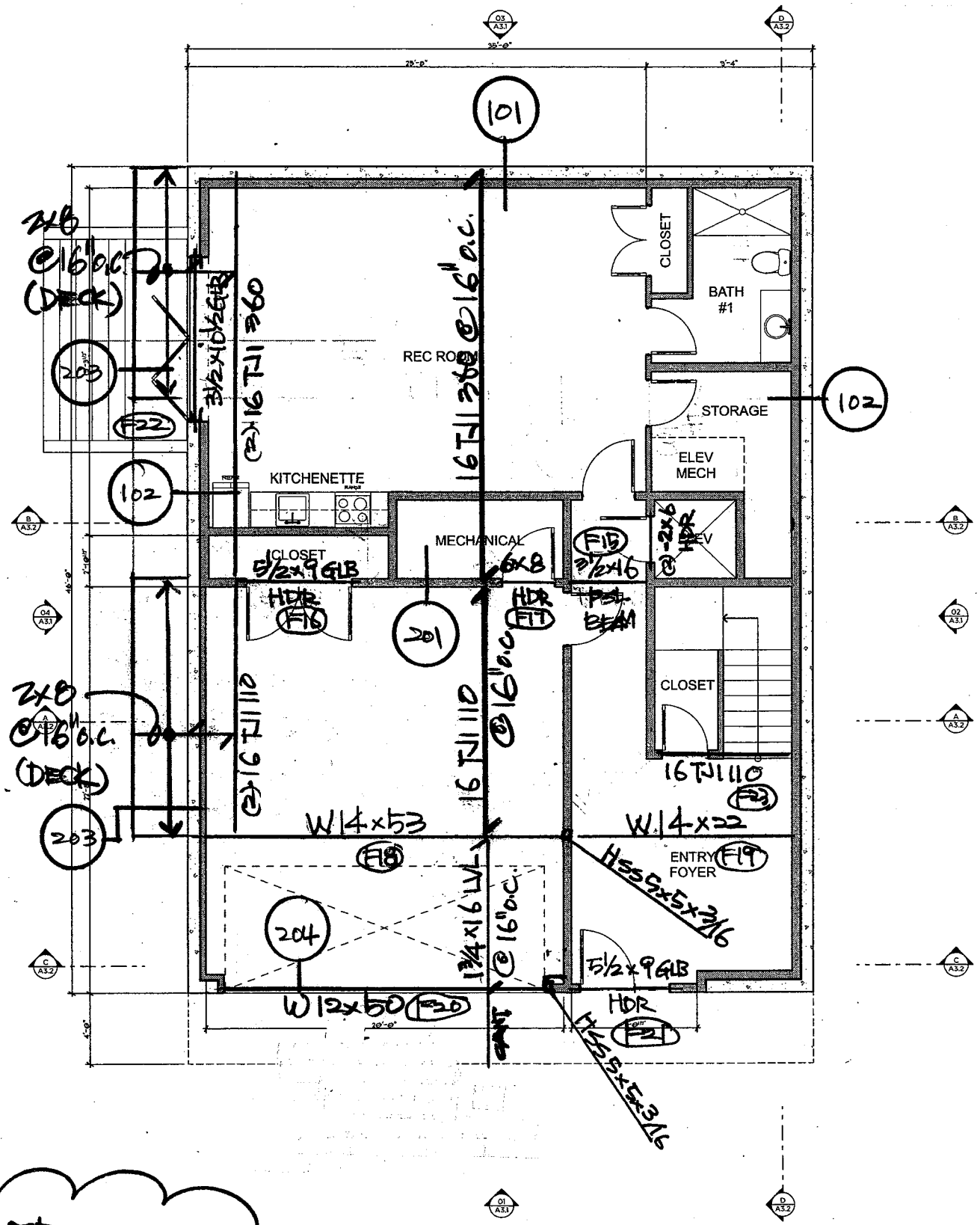
Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0053	2.518		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	2.469	2.469
Overall MINimum	1.850	1.850
D Only	0.619	0.619
+D+L	2.469	2.469
+D+0.750L	2.006	2.006
+0.60D	0.371	0.371
L Only	1.850	1.850

HU416 (2975#)
OR
MIU3.56/16
(3455#)



BASEMENT PLAN

SCALE: 1/4" = 1'-0"

FLOOR

DL: 12 PSF

LL: 40 PSF

(60 PSF @ DECK)

1ST FLOOR FRAMING PLAN

1-1

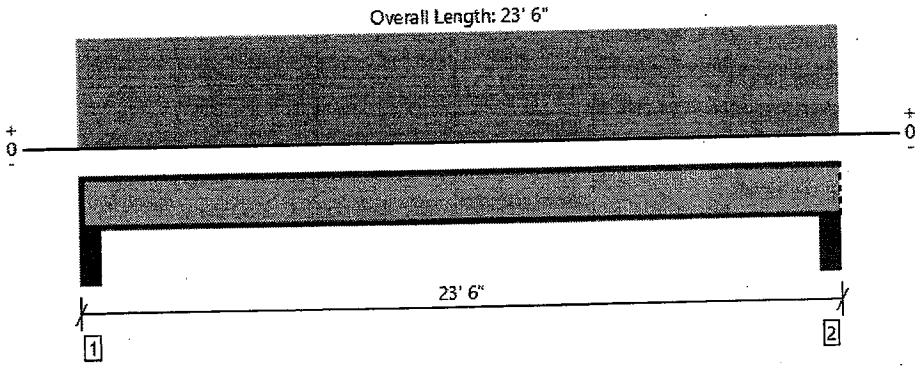
FORTE WEB

MEMBER REPORT

PASSED

Level, Floor: Joist

1 piece(s) 16" TJI® 360 @ 16" OC



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)	815 @ 23' 1 1/2"	1505 (3.50")	Passed (54%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	783 @ 5 1/2"	2190	Passed (36%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	4486 @ 11' 9"	8405	Passed (53%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.378 @ 11' 9"	0.569	Passed (L/723)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.491 @ 11' 9"	1.138	Passed (L/556)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	40	40	Passed	--	--

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

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Weyerhaeuser Edge™ Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: None.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Total	
1 - Stud wall - HF	5.50"	4.25"	1.75"	188	627	815	1 1/4" Rim Board
2 - Stud wall - HF	5.50"	5.50"	1.75"	188	627	815	Blocking

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.
- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	5' 3" o/c	
Bottom Edge (Lu)	23' 5" o/c	

- TJI joists are only analyzed using Maximum Allowable bracing solutions.
- Maximum allowable bracing intervals based on applied load.

Vertical Load	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 23' 6"	16"	12.0	40.0	Default Load

Weyerhaeuser Notes

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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
dong shin D.S. Engineering PC (425) 338-4776 shin_don@hotmail.com	

Weyerhaeuser

5/8/2022 10:03:53 AM UTC
ForteWEB v3.2, Engine: V8.2.0.17, Data: V8.1.0.16
File Name:

1-2

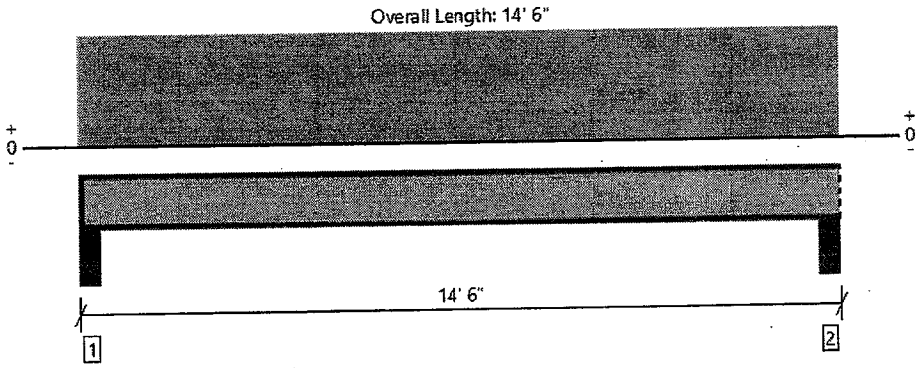
FORTE WEB

MEMBER REPORT

PASSED

Level, Floor: Joist

1 piece(s) 16" TJI® 110 @ 16" OC



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)	503 @ 14' 1 1/2"	1375 (3.50")	Passed (37%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	471 @ 5 1/2"	2145	Passed (22%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	1639 @ 7' 3"	4280	Passed (38%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.082 @ 7' 3"	0.344	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.106 @ 7' 3"	0.688	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	60	40	Passed	--	--

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

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Weyerhaeuser Edge™ Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: None.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Total	
1 - Stud wall - HF	5.50"	4.25"	1.75"	116	387	503	1 1/4" Rim Board
2 - Stud wall - HF	5.50"	5.50"	1.75"	116	387	503	Blocking

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.
- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	5' 3" o/c	
Bottom Edge (Lu)	14' 5" o/c	

- TJI joists are only analyzed using Maximum Allowable bracing solutions.
- Maximum allowable bracing intervals based on applied load.

Vertical Load	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 14' 6"	16"	12.0	40.0	Default Load

Weyerhaeuser Notes

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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
dong shin D.S. Engineering PC (425) 338-4776 shin_don@hotmail.com	

Weyerhaeuser

5/8/2022 10:10:18 AM UTC
ForteWEB v3.2, Engine: V8.2.0.17, Data: V8.1.0.16
File Name:

1-3

Wood Beam

DESCRIPTION: deck

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.2

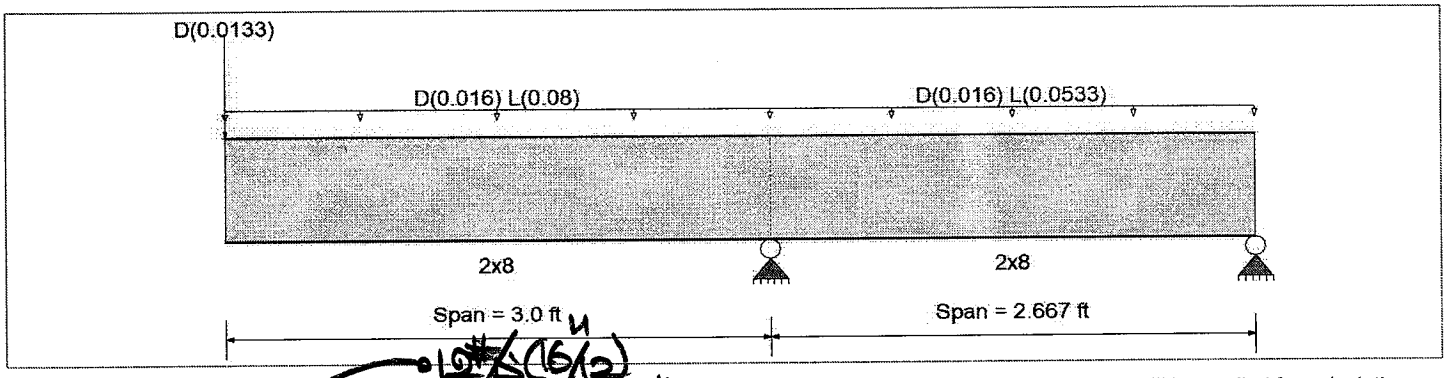
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	900 psi
Fb -	900 psi
Fc - Prll	1350 psi
Fc - Perp	625 psi
Fv	180 psi
Ft	575 psi

E : Modulus of Elasticity

Ebend- xx	1600 ksi
Eminbend - xx	580 ksi
Density	31.21 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 = 0.0160, L = 0.080 , Tributary Width = 1.0 ft, (from deck)
Point Load : D = 0.01330 k @ 0.0 ft, (from guardrail + misc)
Load for Span Number 2
Uniform Load : D = 0.0160, L = 0.05330 , Tributary Width = 1.0 ft, (from floor)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.347 : 1	Maximum Shear Stress Ratio	=	0.186 : 1
Section used for this span		2x8	Section used for this span		2x8
fb: Actual	=	430.94 psi	fv: Actual	=	33.57 psi
Fb: Allowable	=	1,242.00 psi	Fv: Allowable	=	180.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	3.000 ft	Location of maximum on span	=	2.397 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.037 in	Ratio =	1928 >=240
Max Upward Transient Deflection	-0.003 in	Ratio =	10651 >=240
Max Downward Total Deflection	0.050 in	Ratio =	1450 >=180
Max Upward Total Deflection	-0.004 in	Ratio =	8109 >=180

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	1	0.0497	0.000		0.0000	0.000
	2	0.0000	0.000	+D+L+H	-0.0039	1.073

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum		0.571	-0.085
Overall MINimum		0.446	-0.021
+D+H		0.125	-0.021
+D+L+H		0.571	-0.085
+D+Lr+H		0.125	-0.021
+D+S+H		0.125	-0.021

IGNORE TO MAKE CONSERVATIVE JOIST DESIGN

DESCRIPTION: deck

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
+D+0.750Lr+0.750L+H		0.459	-0.069
+D+0.750L+0.750S+H		0.459	-0.069
+D+0.60W+H		0.125	-0.021
+D+0.70E+H		0.125	-0.021
+D+0.750Lr+0.750L+0.450W+H		0.459	-0.069
+D+0.750L+0.750S+0.450W+H		0.459	-0.069
+D+0.750L+0.750S+0.5250E+H		0.459	-0.069
+0.60D+0.60W+0.60H		0.075	-0.012
+0.60D+0.70E+0.60H		0.075	-0.012
D Only		0.125	-0.021
L Only		0.446	-0.064
H Only			

Wood Beam

DESCRIPTION: joist

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 : iLevel Truss Joist
Wood Grade : MicroLam LVL 2.0 E

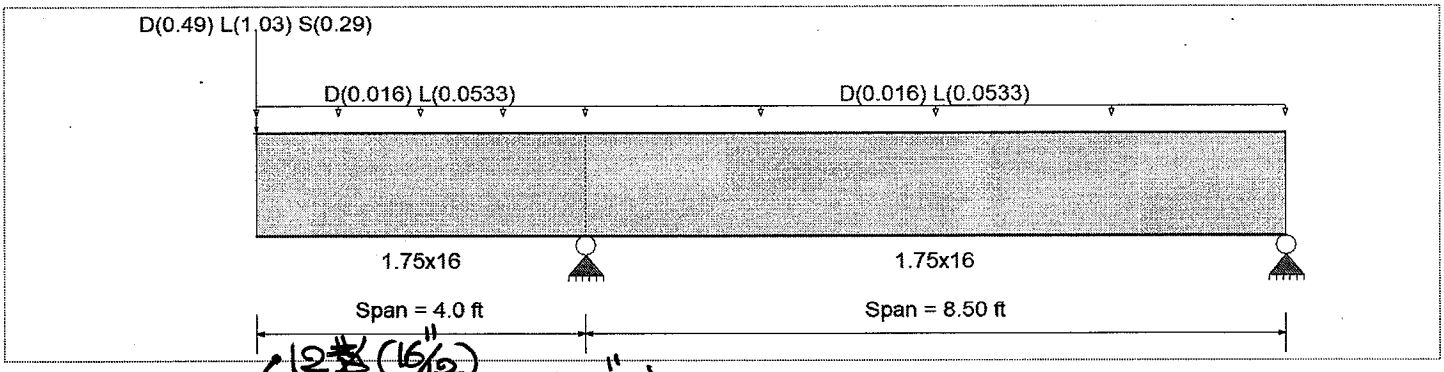
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	2600 psi
Fb -	2600 psi
Fc - Prll	2510 psi
Fc - Perp	750 psi
Fv	285 psi
Ft	1555 psi

E : Modulus of Elasticity

Ebend- xx	2000 ksi
Eminbend - xx	1016.535 ksi
Density	42.01 pcf

Repetitive Member Stress Increase



12#/ft (16"/12)
40#/ft (16"/12)

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 = 0.0160, L = 0.05330 , Tributary Width = 1.0 ft
Point Load : D = 0.490, L = 1.030, S = 0.290 k @ 0.0 ft, (from 2nd floor + roof deck + wall)
Load for Span Number 2
Uniform Load : D = 0.0160, L = 0.05330 , Tributary Width = 1.0 ft

D: [20#/ft (17'/2) + 12#/ft (13'/2) + 122#] x1.33
L: [60#/ft (17'/2) + 40#/ft (13'/2)] x1.33
S: 25#/ft (17'/2) x1.33

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.414 : 1	Maximum Shear Stress Ratio	=	0.325 : 1
Section used for this span		1.75x16	Section used for this span		1.75x16
fb: Actual	=	1,076.75 psi	fv: Actual	=	92.56 psi
Fb: Allowable	=	2,600.25 psi	Fv: Allowable	=	285.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	4.000 ft	Location of maximum on span	=	2.682 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.101 in	Ratio =	950 >=360
Max Upward Transient Deflection	-0.026 in	Ratio =	3950 >=360
Max Downward Total Deflection	0.149 in	Ratio =	644 >=240
Max Upward Total Deflection	-0.038 in	Ratio =	2673 >=240

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.1491	0.000		0.0000	0.000
	2	0.0000	0.000	+D+L	-0.0381	3.466

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum		2.947	-0.484
Overall MINimum		0.426	-0.151
D Only		0.943	-0.151
+D+L		2.947	-0.459
+D+S		1.369	-0.287

Wood Beam

Lic. # : KW-06010224

DESCRIPTION: joist

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
+D+0.750L		2.446	-0.382
+D+0.750L+0.750S		2.766	-0.484
+0.60D		0.566	-0.090
L Only		2.005	-0.308
S Only		0.426	-0.136

Wood Beam

Lic. # : KW-06010224
D.S. ENGINEERING PC

DESCRIPTION: header (F16)

CODE REFERENCES

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

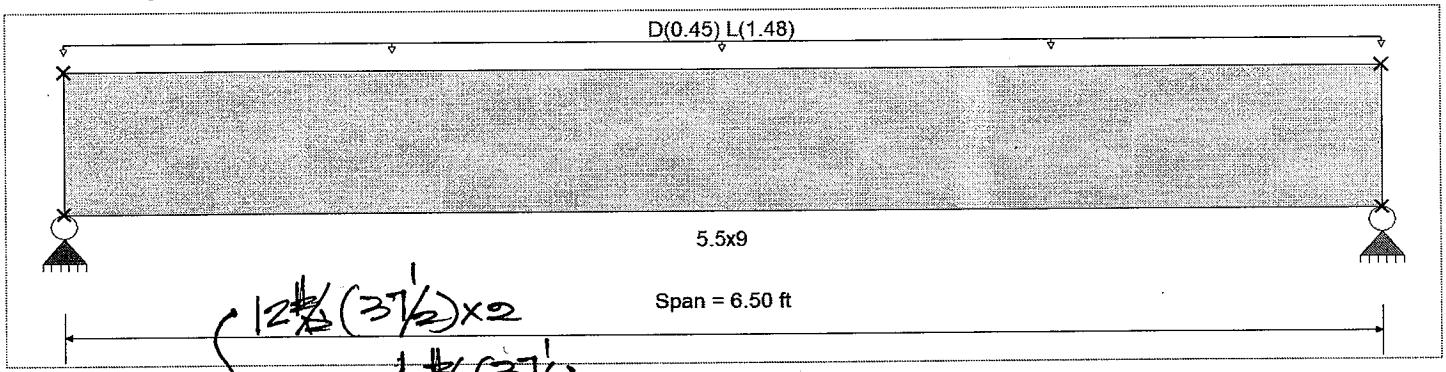
Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2018

Wood Species : DF/DF
Wood Grade : 24F-V4

Beam Bracing : Completely Unbraced

Fb +	2400 psi	*E : Modulus of Elasticity*	
Fb -	1850 psi	Ebend- xx	1800 ksi
Fc - Prll	1650 psi	Eminbend - xx	950 ksi
Fc - Perp	650 psi	Ebend- yy	1600 ksi
Fv	265 psi	Eminbend - yy	850 ksi
Ft	1100 psi	Density	31.21 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.450, L = 1.480 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.694** : 1	Maximum Shear Stress Ratio	=	**0.558** : 1
Section used for this span		**5.5x9**	Section used for this span		**5.5x9**
fb: Actual	=	1,656.48 psi	fv: Actual	=	147.88 psi
Fb: Allowable	=	2,387.32 psi	Fv: Allowable	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	3.250 ft	Location of maximum on span	=	5.765 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.099 in	Ratio =	784 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.130 in	Ratio =	598 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.1304	3.274		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	6.307	6.307
Overall MINimum	4.810	4.810
D Only	1.497	1.497
+D+L	6.307	6.307
+D+0.750L	5.105	5.105
+0.60D	0.898	0.898
L Only	4.810	4.810

Wood Beam

Lic. # : KW-06010224
D.S. ENGINEERING PC

DESCRIPTION: header (F17)

CODE REFERENCES

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

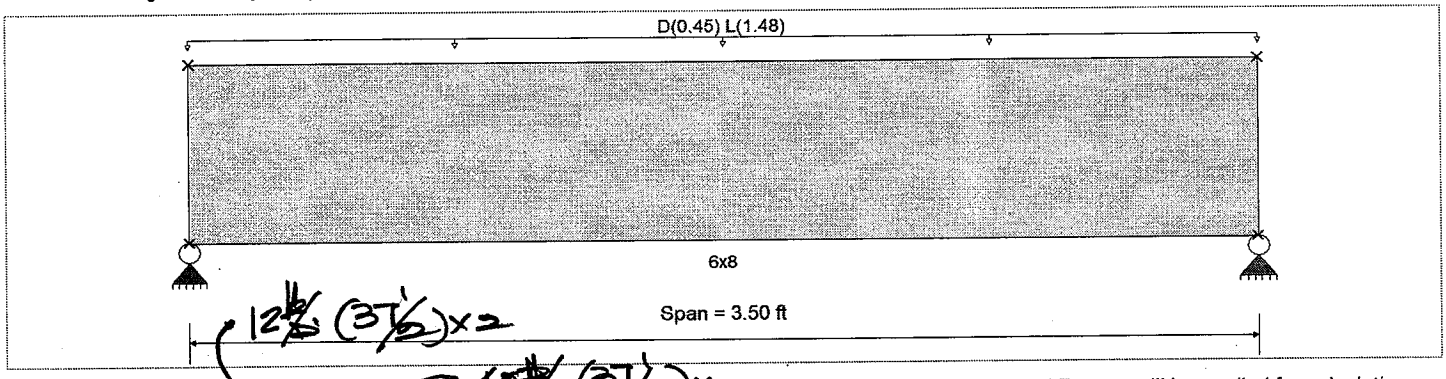
Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2018

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

Beam Bracing : Completely Unbraced

Fb +	875 psi	*E : Modulus of Elasticity*	
Fb -	875 psi	Ebend- xx	1300 ksi
Fc - Prll	600 psi	Eminbend - xx	470 ksi
Fc - Perp	625 psi		
Fv	170 psi		
Ft	425 psi	Density	31.21 pcf



Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.450, L = 1.480 , Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.791 : 1**	Maximum Shear Stress Ratio	=	**0.472 : 1**
Section used for this span		**6x8**	Section used for this span		**6x8**
fb: Actual	=	690.97 psi	fv: Actual	=	80.16 psi
Fb: Allowable	=	873.50 psi	Fv: Allowable	=	170.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	1.750 ft	Location of maximum on span	=	2.887 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.020 in	Ratio =	2100 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.026 in	Ratio =	1603 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0262	1.763		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	3.393	3.393
Overall MINimum	2.590	2.590
D Only	0.803	0.803
+D+L	3.393	3.393
+D+0.750L	2.746	2.746
+0.60D	0.482	0.482
L Only	2.590	2.590

DESCRIPTION: beam (F18)

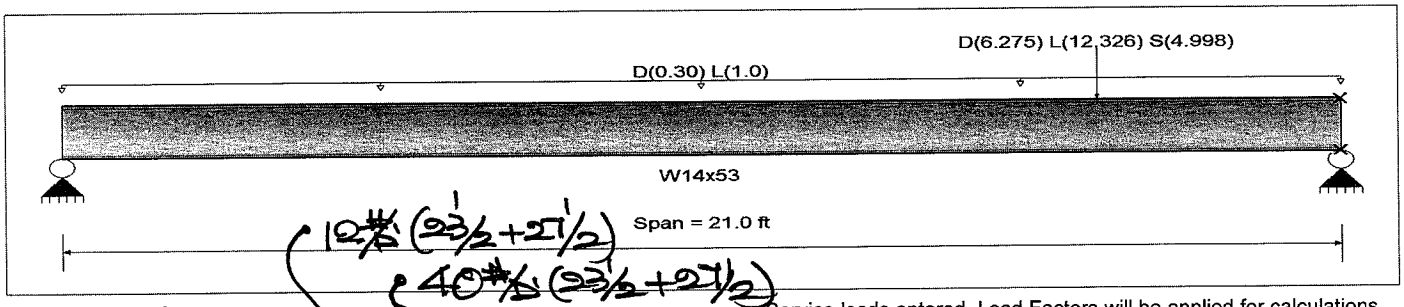
CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method :Allowable Strength Design
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling
Bending Axis : Major Axis Bending

Fy : Steel Yield : 50.0 ksi
E: Modulus : 29,000.0 ksi



Applied Loads

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

Beam self weight calculated and added to loading
Uniform Load : D = 0.30, L = 1.0 k/ft, Tributary Width = 1.0 ft, (from 1st + 2nd floor)

Point Load : D = 6.275, L = 12.326, S = 4.998 k @ 17.0 ft, (from (R3))

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.536** : 1	Maximum Shear Stress Ratio =	**0.285** : 1
Section used for this span	**W14x53**	Section used for this span	**W14x53**
Ma : Applied	116.425 k-ft	Va : Applied	29.264 k
Mn / Omega : Allowable	217.315 k-ft	Vn/Omega : Allowable	102.860 k
Load Combination	+D+L	Load Combination	+D+L
		Location of maximum on span	21.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.424 in	Ratio =	594	>=360	
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360	Span: 1 : L Only
Max Downward Total Deflection	0.596 in	Ratio =	423	>=240.	Span: 1 : +D+L
Max Upward Total Deflection	0.000 in	Ratio =	0	<240.0	

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	Summary of Moment Values Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Summary of Shear Values Va Max	VnxVnx/Omega
D Only												
Dsgn. L = 21.00 ft	1	0.157	0.085	34.03		34.03	362.92	217.32	1.00	1.00	8.79	154.29	102.86
+D+L												
Dsgn. L = 21.00 ft	1	0.536	0.285	116.42		116.42	362.92	217.32	1.00	1.00	29.26	154.29	102.86
+D+S												
Dsgn. L = 21.00 ft	1	0.223	0.125	48.54		48.54	362.92	217.32	1.00	1.00	12.83	154.29	102.86
+D+0.750L												
Dsgn. L = 21.00 ft	1	0.441	0.235	95.80		95.80	362.92	217.32	1.00	1.00	24.14	154.29	102.86
+D+0.750L+0.750S												
Dsgn. L = 21.00 ft	1	0.485	0.264	105.44		105.44	362.92	217.32	1.00	1.00	27.18	154.29	102.86
+0.60D												
Dsgn. L = 21.00 ft	1	0.094	0.051	20.42		20.42	362.92	217.32	1.00	1.00	5.27	154.29	102.86

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.5964	11.040		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	17.750	29.264

DESCRIPTION: beam (F18)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MINimum	0.952	4.046
D Only	4.902	8.786
+D+L	17.750	29.264
+D+S	5.854	12.832
+D+0.750L	14.538	24.145
+D+0.750L+0.750S	15.252	27.179
+0.60D	2.941	5.272
L Only	12.848	20.478
S Only	0.952	4.046

Steel Section Properties : W14x53

Depth	=	13.900 in	I xx	=	541.00 in^4	J	=	1.940 in^4
Web Thick	=	0.370 in	S xx		77.80 in^3	Cw	=	2,540.00 in^6
Flange Width	=	8.060 in	R xx	=	5.890 in			
Flange Thick	=	0.660 in	Zx	=	87.100 in^3			
Area	=	15.600 in^2	I yy	=	57.700 in^4			
Weight	=	53.000 plf	S yy	=	14.300 in^3	Wno	=	26.700 in^2
Kdesign	=	1.250 in	R yy	=	1.920 in	Sw	=	35.500 in^4
K1	=	1.000 in	Zy	=	22.000 in^3	Qf	=	16.800 in^3
rts	=	2.220 in				Qw	=	42.500 in^3
Ycg	=	6.950 in						

Steel Beam

Project File: ENERCALC_20

LIC# : KW-06015335, Build:20.22.4.26 D.S. ENGINEERING PC

DESCRIPTION: beam (F19)

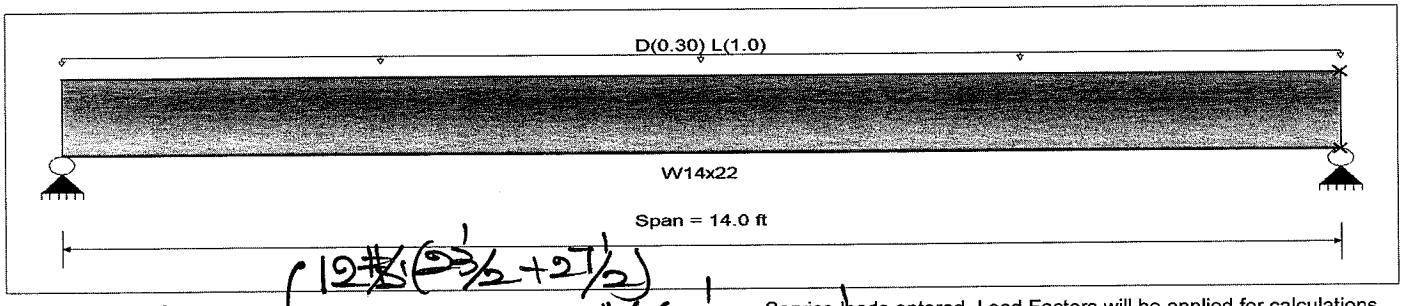
CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method : Allowable Strength Design
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling
Bending Axis : Major Axis Bending

Fy : Steel Yield : 50.0 ksi
E: Modulus : 29,000.0 ksi



(12#/ft(2 1/2 + 2 1/2) + 40#/ft(2 1/2 + 2 1/2))

Applied Loads

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

Beam self weight calculated and added to loading
Uniform Load : D = 0.30, L = 1.0 k/ft, Tributary Width = 1.0 ft, (from 1st + 2nd floor)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.391** : 1	Maximum Shear Stress Ratio =	**0.147** : 1
Section used for this span	**W14x22**	Section used for this span	**W14x22**
Ma : Applied	32.389 k-ft	Va : Applied	9.254 k
Mn / Omega : Allowable	82.834 k-ft	Vn/Omega : Allowable	63.020 k
Load Combination	+D+L	Load Combination	+D+L
		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	0.150 in	Ratio =	1,116	>=360
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360 Span: 1 : L Only
Max Downward Total Deflection	0.199 in	Ratio =	845	>=240. Span: 1 : +D+L
Max Upward Total Deflection	0.000 in	Ratio =	0	<240.0

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	Summary of Moment Values Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Summary of Shear Values Va Max	VnxVnx/Omega	
D Only													
Dsgn. L = 14.00 ft	1	0.095	0.036	7.89		7.89	138.33	82.83	1.00	1.00	2.25	94.53	63.02
+D+L													
Dsgn. L = 14.00 ft	1	0.391	0.147	32.39		32.39	138.33	82.83	1.00	1.00	9.25	94.53	63.02
+D+0.750L													
Dsgn. L = 14.00 ft	1	0.317	0.119	26.26		26.26	138.33	82.83	1.00	1.00	7.50	94.53	63.02
+0.60D													
Dsgn. L = 14.00 ft	1	0.057	0.021	4.73		4.73	138.33	82.83	1.00	1.00	1.35	94.53	63.02

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.1989	7.040		0.0000	0.000

Vertical Reactions

Support notation : Far left is #' Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	9.254	9.254
Overall MINimum	1.352	1.352
D Only	2.254	2.254
+D+L	9.254	9.254
+D+0.750L	7.504	7.504
+0.60D	1.352	1.352
L Only	7.000	7.000

DESCRIPTION: beam (F19)

Steel Section Properties : W14x22

Depth	=	13.700 in	I xx	=	199.00 in^4	J	=	0.208 in^4
Web Thick	=	0.230 in	S xx		29.00 in^3	Cw	=	314.00 in^6
Flange Width	=	5.000 in	R xx	=	5.540 in			
Flange Thick	=	0.335 in	Zx	=	33.200 in^3			
Area	=	6.490 in^2	I yy	=	7.000 in^4			
Weight	=	22.000 plf	S yy	=	2.800 in^3	Wno	=	16.700 in^2
Kdesign	=	0.735 in	R yy	=	1.040 in	Sw	=	7.000 in^4
K1	=	0.750 in	Zy	=	4.390 in^3	Qf	=	5.340 in^3
rts	=	1.270 in				Qw	=	16.100 in^3
Ycg	=	6.850 in						

Steel Beam

Project File: ENERCALC_20

LIC# : KW-06015335, Build:20.22.4.26 D.S. ENGINEERING PC (c) ENERCALC INC 1983-2022

DESCRIPTION: header (F20) : garage door

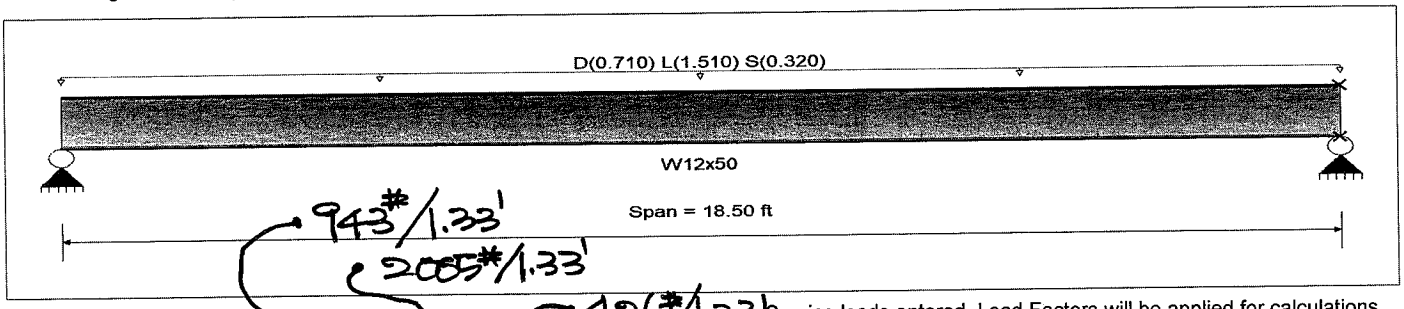
CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method :Allowable Strength Design
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling
Bending Axis : Major Axis Bending

Fy : Steel Yield : 50.0 ksi
E: Modulus : 29,000.0 ksi



Applied Loads

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

Beam self weight calculated and added to loading
Uniform Load : D = 0.710, L = 1.510, S = 0.320 k/ft, Tributary Width = 1.0 ft, (from 1.75x16 LVL)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.541** : 1	Maximum Shear Stress Ratio =	**0.233** : 1
Section used for this span	**W12x50**	Section used for this span	**W12x50**
Ma : Applied	97.113 k-ft	Va : Applied	20.998 k
Mn / Omega : Allowable	179.391 k-ft	Vn/Omega : Allowable	90.280 k
Load Combination	+D+L	Load Combination	+D+L
		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	0.352 in	Ratio =	629	>=360	
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360	Span: 1 : L Only
Max Downward Total Deflection	0.530 in	Ratio =	419	>=240.	Span: 1 : +D+L
Max Upward Total Deflection	0.000 in	Ratio =	0	<240.0	

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	Summary of Moment Values Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Summary of Shear Values Va Max	VnxVnx/Omega	
D Only													
Dsgn. L = 18.50 ft	1	0.181	0.078	32.51		32.51	299.58	179.39	1.00	1.00	7.03	135.42	90.28
+D+L													
Dsgn. L = 18.50 ft	1	0.541	0.233	97.11		97.11	299.58	179.39	1.00	1.00	21.00	135.42	90.28
+D+S													
Dsgn. L = 18.50 ft	1	0.258	0.111	46.20		46.20	299.58	179.39	1.00	1.00	9.99	135.42	90.28
+D+0.750L													
Dsgn. L = 18.50 ft	1	0.451	0.194	80.96		80.96	299.58	179.39	1.00	1.00	17.51	135.42	90.28
+D+0.750L+0.750S													
Dsgn. L = 18.50 ft	1	0.509	0.218	91.23		91.23	299.58	179.39	1.00	1.00	19.73	135.42	90.28
+0.60D													
Dsgn. L = 18.50 ft	1	0.109	0.047	19.51		19.51	299.58	179.39	1.00	1.00	4.22	135.42	90.28

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.5300	9.303		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	20.998	20.998
Overall MINimum	2.960	2.960
D Only	7.030	7.030

Steel Beam

Project File: ENERCALC_20

DESCRIPTION: header (F20) : garage door

Vertical Reactions

Support notation : Far left is # Values in KIPS

Load Combination	Support 1	Support 2
+D+L	20.998	20.998
+D+S	9.990	9.990
+D+0.750L	17.506	17.506
+D+0.750L+0.750S	19.726	19.726
+0.60D	4.218	4.218
L Only	13.968	13.968
S Only	2.960	2.960

Steel Section Properties : W12x50

Depth	=	12.200 in	I xx	=	391.00 in^4	J	=	1.710 in^4
Web Thick	=	0.370 in	S xx		64.20 in^3	Cw	=	1,880.00 in^6
Flange Width	=	8.080 in	R xx	=	5.180 in			
Flange Thick	=	0.640 in	Zx	=	71.900 in^3			
Area	=	14.600 in^2	I yy	=	56.300 in^4			
Weight	=	50.000 plf	S yy	=	13.900 in^3	Wno	=	23.400 in^2
Kdesign	=	1.140 in	R yy	=	1.960 in	Sw	=	30.200 in^4
K1	=	0.938 in	Zy	=	21.300 in^3	Qf	=	14.300 in^3
rts	=	2.250 in				Qw	=	35.400 in^3
Ycg	=	6.100 in						

Wood Beam

DESCRIPTION: header (F21)

CODE REFERENCES

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

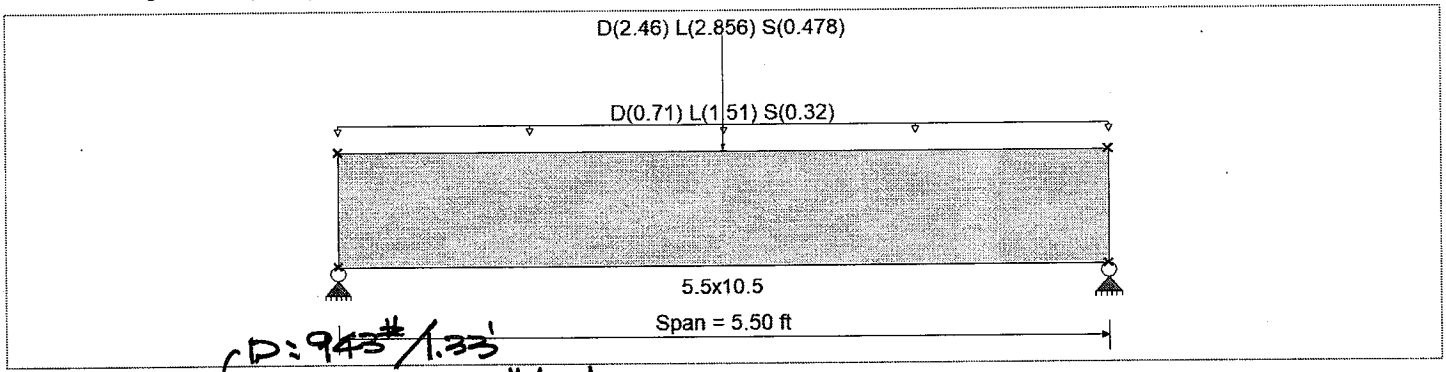
Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2018

Wood Species : DF/DF
Wood Grade : 24F-V4

Beam Bracing : Completely Unbraced

Fb +	2400 psi	*E : Modulus of Elasticity*	
Fb -	1850 psi	Ebend- xx	1800 ksi
Fc - Prll	1650 psi	Eminbend - xx	950 ksi
Fc - Perp	650 psi	Ebend- yy	1600 ksi
Fv	265 psi	Eminbend - yy	850 ksi
Ft	1100 psi	Density	31.21 pcf



D: 943#/1.33'
L: 2005#/1.33'
426#/1.33 (FROM 1.75x16 LVL Joist)

Applied Loads

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

Beam self weight calculated and added to loads
Uniform Load : D = 0.710, L = 1.510, S = 0.320 , Tributary Width = 1.0 ft
Point Load : D = 2.460, L = 2.856, S = 0.4780 k @ 2.750 ft, (from (F11))

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.784 : 1**	Maximum Shear Stress Ratio	=	**0.673 : 1**
Section used for this span		**5.5x10.5**	Section used for this span		**5.5x10.5**
fb: Actual	=	1,870.27 psi	fv: Actual	=	178.45 psi
Fb: Allowable	=	2,386.91 psi	Fv: Allowable	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	2.750 ft	Location of maximum on span	=	4.637 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.051 in	Ratio =	1300 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.082 in	Ratio =	805 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0819	2.770		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	8.797	8.797
Overall MINimum	1.119	1.119
D Only	3.217	3.217
+D+L	8.797	8.797
+D+S	4.336	4.336
+D+0.750L	7.402	7.402
+D+0.750L+0.750S	8.242	8.242
+0.60D	1.930	1.930
L Only	5.581	5.581

Wood Beam

Lic. # : KW-06010224

DESCRIPTION: header (F21)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
S Only	1.119	1.119

Wood Beam

Lic. # : KW-06010224

D.S. ENGINEERING PC

DESCRIPTION: header (F22)

CODE REFERENCES

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

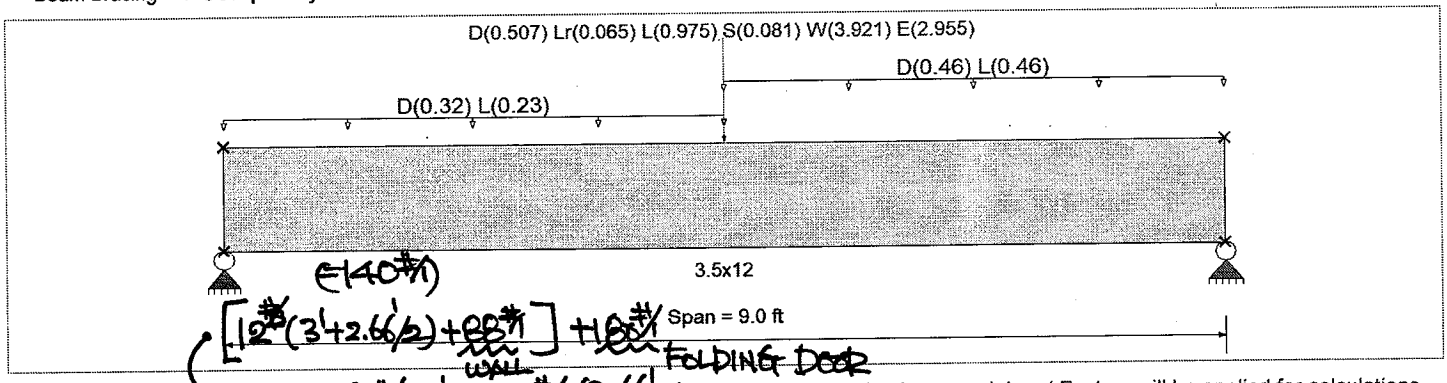
Material Properties

Analysis Method : Allowable Stress Design
Load Combination IBC 2018

Wood Species : DF/DF
Wood Grade : 24F-V4

Beam Bracing : Completely Unbraced

Fb +	2,400.0 psi	*E : Modulus of Elasticity*	
Fb -	1,850.0 psi	Ebend- xx	1,800.0 ksi
Fc - Prll	1,650.0 psi	Eminbend - xx	950.0 ksi
Fc - Perp	650.0 psi	Ebend- yy	1,600.0 ksi
Fv	265.0 psi	Eminbend - yy	850.0 ksi
Ft	1,100.0 psi	Density	31.210 pcf



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 = 0.320, L = 0.230 k/ft, Extent = 0.0 -->> 4.50 ft, Tributary Width = 1.0 ft
Point Load : D = 0.5070, Lr = 0.0650, L = 0.9750, S = 0.0810, W = 3.921, E = 2.955 k @ 4.50 ft, (from shearwall Calc & header (F13))
Uniform Load : D = 0.460, L = 0.460 k/ft, Extent = 4.50 -->> 9.0 ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.671 : 1	Maximum Shear Stress Ratio	=	0.484 : 1
Section used for this span		3.5x12	Section used for this span		3.5x12
fb: Actual	=	1,552.65 psi	fv: Actual	=	128.22 psi
Fb: Allowable	=	2,315.51 psi	Fv: Allowable	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	4.500 ft	Location of maximum on span	=	8.015 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.114 in	Ratio =	946 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.197 in	Ratio =	548 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S+0.450W	1	0.1968	4.566		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	4.141	4.844
Overall MINimum	1.478	1.478
D Only	1.892	2.207
+D+L	3.673	4.506
+D+Lr	1.924	2.239
+D+S	1.932	2.247
+D+0.750Lr+0.750L	3.252	3.955

DESCRIPTION: header (F22)

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
+D+0.750L+0.750S	3.258	3.961
+D+0.60W	3.068	3.383
+D+0.70E	2.926	3.241
+D+0.750Lr+0.750L+0.450W	4.135	4.838
+D+0.750L+0.750S+0.450W	4.141	4.844
+D+0.750L+0.750S+0.5250E	4.034	4.737
+0.60D+0.60W	2.311	2.500
+0.60D+0.70E	2.169	2.358
Lr Only	0.033	0.033
L Only	1.781	2.299
S Only	0.041	0.041
W Only	1.961	1.961
E Only	1.478	1.478

FORTE WEB

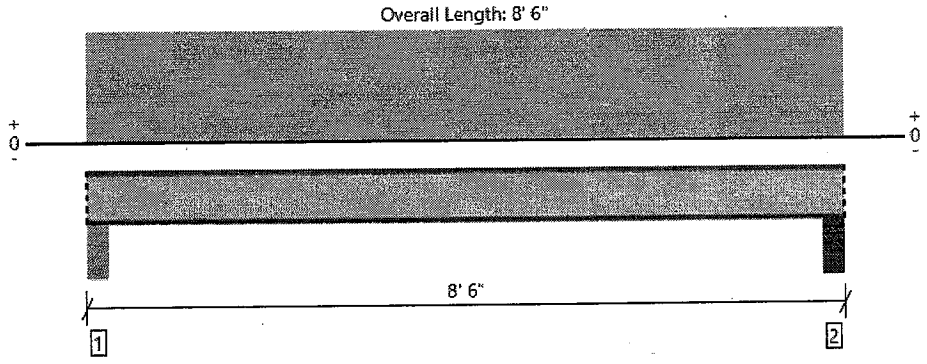
MEMBER REPORT

PASSED

Level, Floor: Joist

1 piece(s) 16" TJI® 110 @ 12" OC

<F23>



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)	553 @ 4 1/2"	1375 (3.50")	Passed (40%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	493 @ 5 1/2"	2145	Passed (23%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	976 @ 4' 3"	4280	Passed (23%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.023 @ 4' 3"	0.194	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.030 @ 4' 3"	0.387	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	70	40	Passed	--	--

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

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Weyerhaeuser Edge™ Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: None.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Total	
1 - Beam - PSL	5.50"	5.50"	1.75"	128	425	553	Blocking
2 - Stud wall - HF	5.50"	5.50"	1.75"	128	425	553	Blocking

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	6' 11" o/c	
Bottom Edge (Lu)	8' 6" o/c	

- TJI joists are only analyzed using Maximum Allowable bracing solutions.
- Maximum allowable bracing intervals based on applied load.

12#/ft (5'/2)

40#/ft (5'/2)

Vertical Load	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PLF)	0 to 8' 6"	N/A	30.0	100.0	Default Load

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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
dong shin D.S. Engineering PC (425) 338-4776 shin_don@hotmail.com	

Weyerhaeuser

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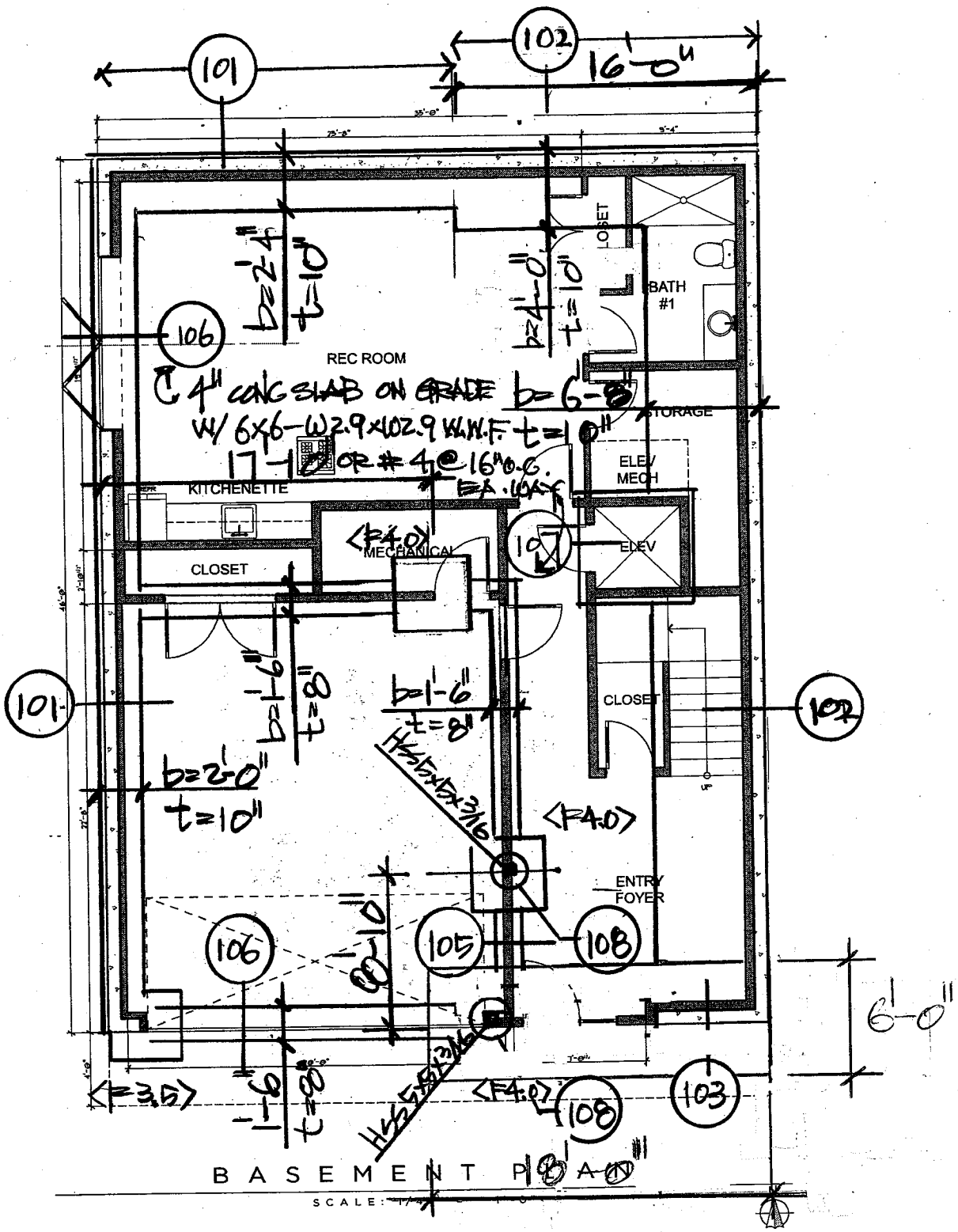
T-20



FOUNDATION PLAN

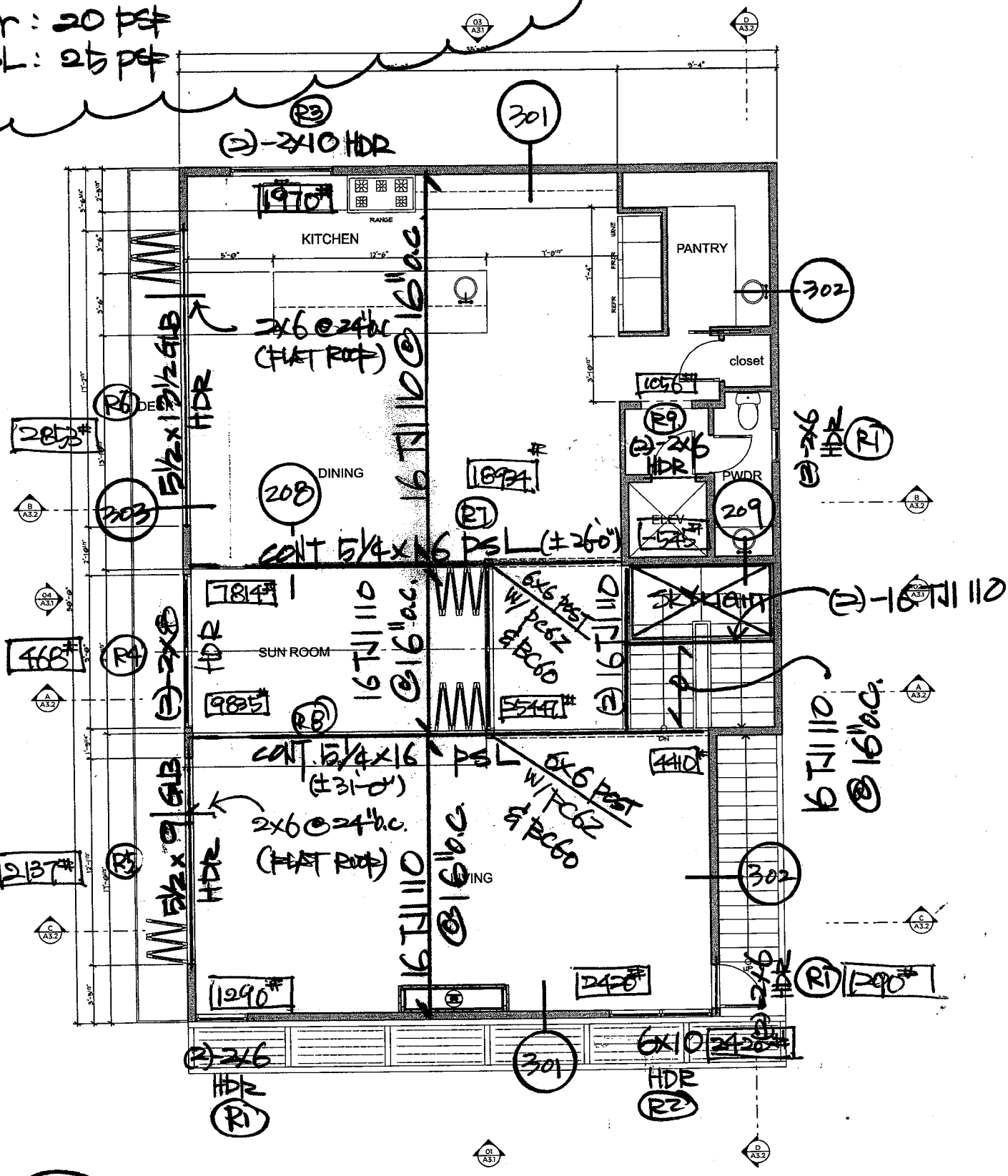
FT1

ROOF:

DL: 25 PSF (INCLUDED 10 PSF SOLAR)

LL: 20 PSF

SL: 25 PSF



SECOND FLOOR PLAN

SCALE: 1/4" = 1'-0"

DECK

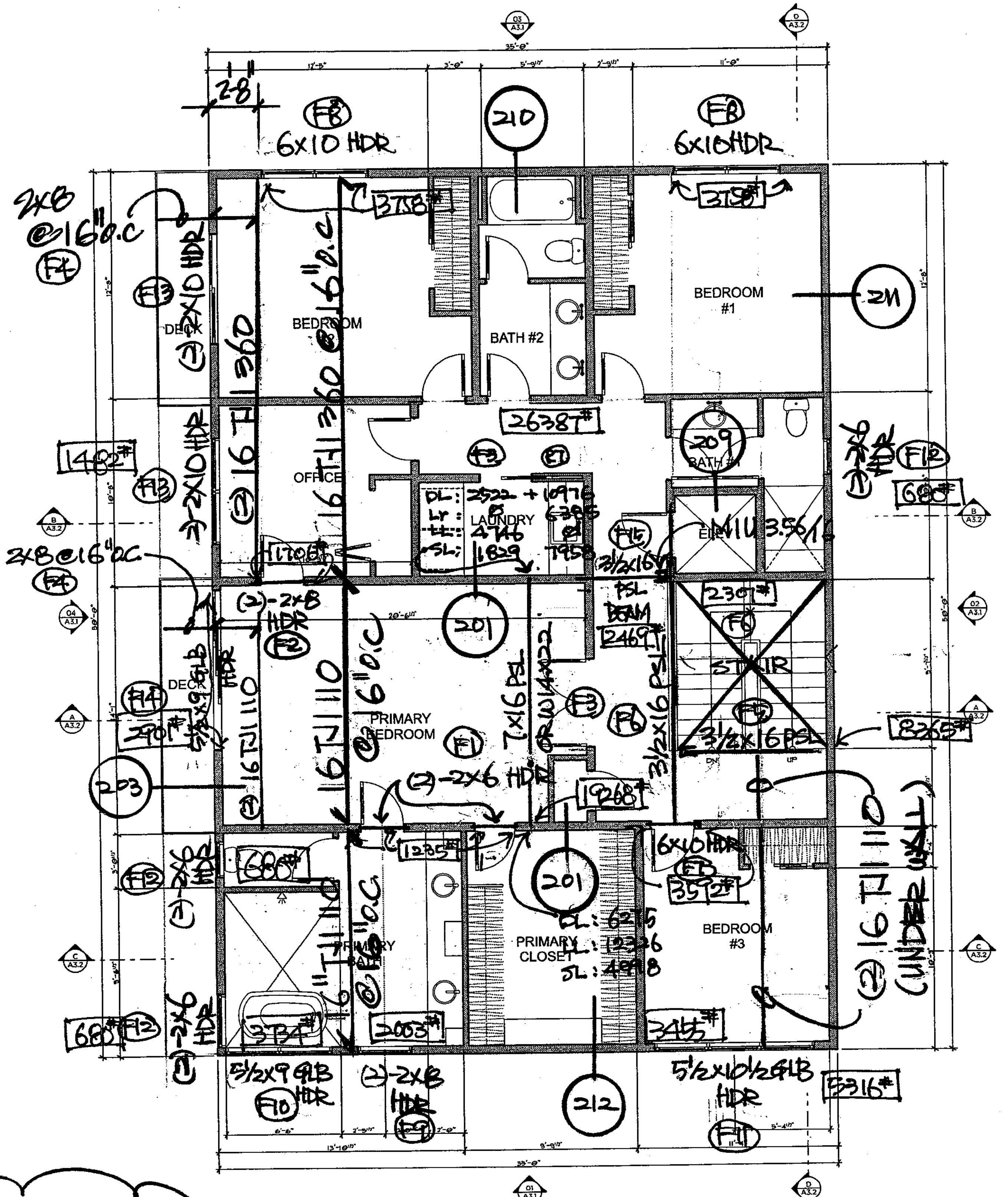
DL: 20 PSF

LL: 60 PSF

SL: 25 PSF

ROOF FRAMING PLAN

PT2



FIRST FLOOR PLAN

SCALE: 1/4" = 1'-0"

FLOOR

DL: 12 PSF
LL: 40 PSF
(60 PSF @ DECK)

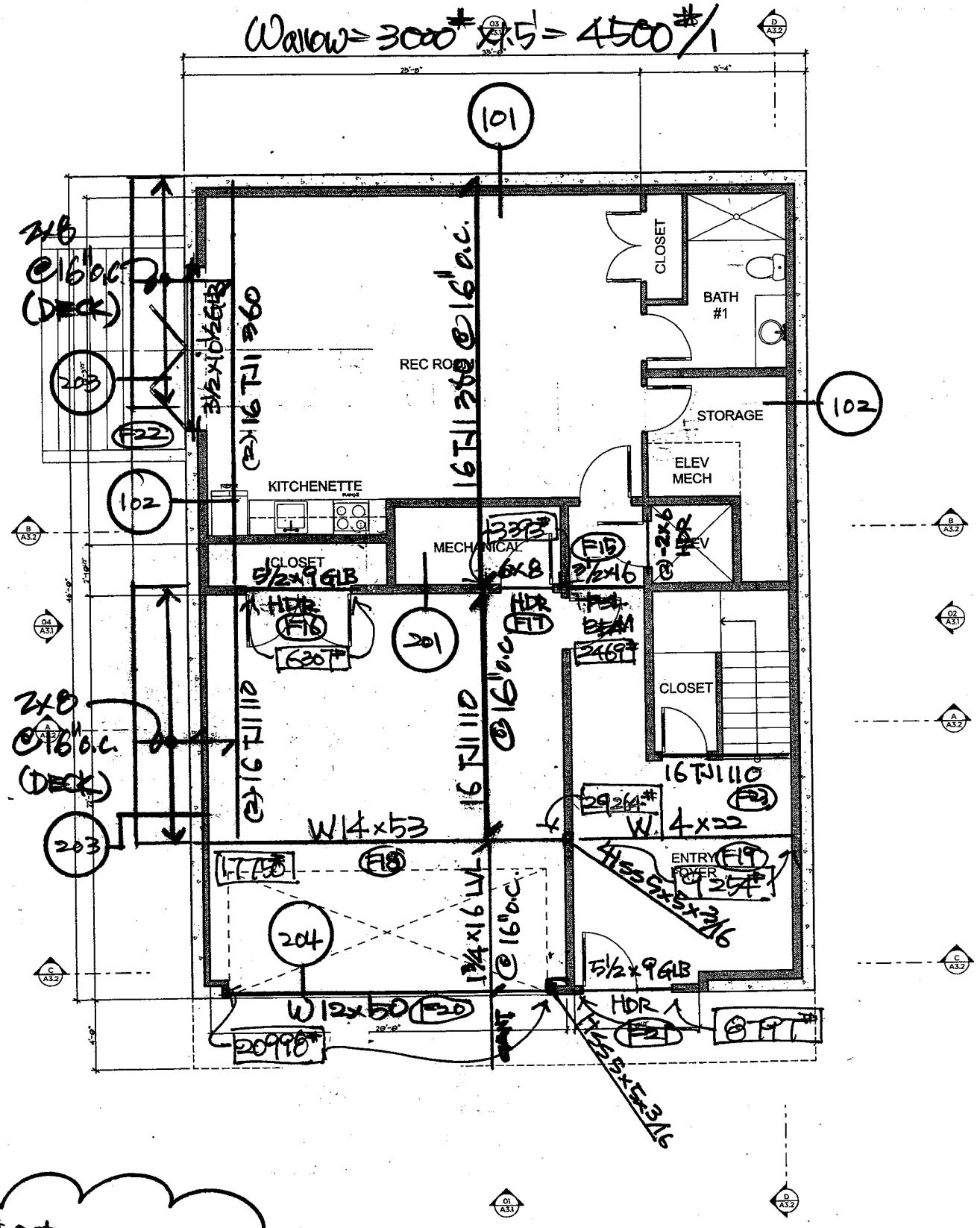
2ND FLOOR FRAMING PLAN

FT3

L = 1'-6"

Pallow = 3000 PSF × 1.5' × 3' = 13500#

Wallow = 3000# × 1.5' = 4500#/1



FLOOR

DL: 12 PSF

LL: 40 PSF

(60 PSF @ DECK)

BASEMENT PLAN

SCALE: 1/4" = 1'-0"

1ST FLOOR FRAMING PLAN

RT3

Project Name/Number :

(EAST WALL)

RetainPro (c) 1987-2019, Build 11.20.03.31
License : KW-06061521
License To : D.S. Engineering

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

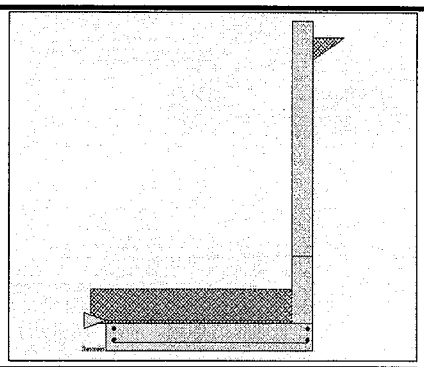
Retained Height	=	8.50 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

20#x1' + 40#(16/12)

25#x1' + 12#(16/12) + 139# WALL & MK

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	55.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.250
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
NOT Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	180.0 lbs
Axial Live Load	=	73.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	14.0 #/ft
...Height to Top	=	0.50 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Service Level)
Wind on Exposed Stem (Service Level)	=	14.0 psf

Wind acts left-to-right toward retention side.

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Square Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	1.100
(Multiplier used on soil density)		
Uniform Seismic Force	=	10.267
Total Seismic Force	=	95.822

10.33' ← > 93 (=9H)

Design Summary

Wall Stability Ratios

Overturning	=	1.50 OK

Slab Resists All Sliding !

Total Bearing Load	=	2,646 lbs
...resultant ecc.	=	20.26 in
Soil Pressure @ Toe	=	1,072 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	3,000 psf

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	1,501 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	22.2 psi OK
Footing Shear @ Heel	=	1.3 psi OK
Allowable	=	82.2 psi

Sliding Calcs

Lateral Sliding Force	=	2,462.6 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		2nd	Bottom
		Stem OK	Stem OK
Design Height Above Ftg	ft =	2.00	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Design Method	=	LRFD	LRFD
Thickness	=	8.00	8.00
Rebar Size	=	# 5	# 5
Rebar Spacing	=	14.00	7.00
Rebar Placed at	=	Edge	Edge
Design Data			
fb/FB + fa/Fa	=	**0.625**	**0.728**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	2,032.8	3,465.0
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =	4,435.0	9,863.6
Moment.....Allowable	ft-# =	7,086.1	13,547.3
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =	27.4	46.7
Shear.....Allowable	psi =	82.2	82.2
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.19	6.19
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	100.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	3,000.0	3,000.0
Fy	psi =	60,000.0	60,000.0

PT 4

Project Name/Number :

(EAST WALL)

RetainPro (c) 1987-2019, Build 11.20.03.31
License : KW-06061521
License To : D.S. Engineering

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1679 in2/ft		
(4/3) * As :	0.2239 in2/ft	Min Stem T&S Reinf Area 1.344 in2	
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.2239 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2657 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	1.0059 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.3735 in2/ft		
(4/3) * As :	0.498 in2/ft	Min Stem T&S Reinf Area 0.384 in2	
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.3735 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.5314 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	1.0059 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	6.00 ft
Heel Width	=	0.67
Total Footing Width	=	6.67
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,501	0 psf
Mu' : Upward	=	193,607	0 ft-#
Mu' : Downward	=	71,064	0 ft-#
Mu: Design	=	10,212	0 ft-#
Actual 1-Way Shear	=	22.17	1.29 psi
Allow 1-Way Shear	=	82.16	43.82 psi

Toe Reinforcing = # 5 @ 7.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 18.00 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

If torsion exceeds allowable, provide supplemental design for footing torsion.

Other Acceptable Sizes & Spacings

Toe: #4@ 6.53 in, #5@ 10.13 in, #6@ 14.38 in, #7@ 19.61 in, #8@ 25.82 in, #9@ 32
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 1.44 in2
Min footing T&S reinf Area per foot 0.22 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 11.11 in	#4@ 22.22 in
#5@ 17.22 in	#5@ 34.44 in
#6@ 24.44 in	#6@ 48.89 in

PT 5

Project Name/Number :

(EAST WALL)

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		2,395.6	3.11	7,452.8	Soil Over HL (ab. water tbl)			
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)			
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=				Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=	253.0	6.33	1,140.0
Added Lateral Load	=	7.0	1.08	7.6	* Axial Live Load on Stem	=	73.0	6.33	462.3
Load @ Stem Above Soil	=	-7.0	9.58	-67.1	Soil Over Toe	=	660.0	3.00	1,980.0
Seismic Earth Load	=	67.1	4.67	313.0	Surcharge Over Toe	=			
	=				Stem Weight(s)	=	900.0	6.33	5,700.0
					Earth @ Stem Transitions	=			
Total	=	2,462.6	**O.T.M.** =	7,706.4	Footing Weight	=	833.3	3.33	2,777.8
					Key Weight	=			
					Vert. Component	=			
					Total =		2,573.3 lbs	**R.M.**=	11,597.8

Resisting/Overturning Ratio = **1.50**
Vertical Loads used for Soil Pressure = 2,646.3 lbs

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

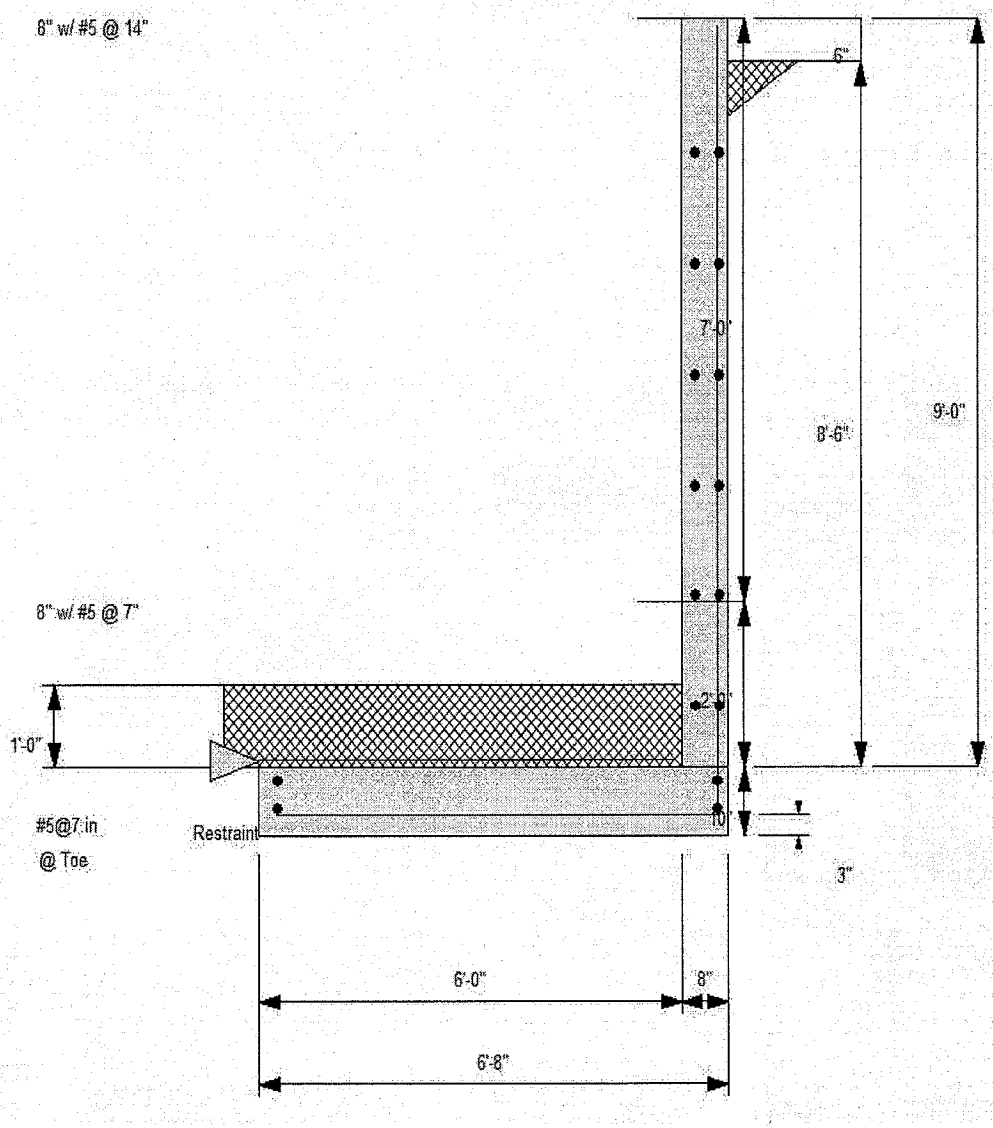
(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.040	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

PT6

(EAST WALL)



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PT7

Project Name/Number :

(WEST WALL)

RetainPro (c) 1987-2019, Build 11.20.03.31
License : KW-06061521
License To : D.S. Engineering

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

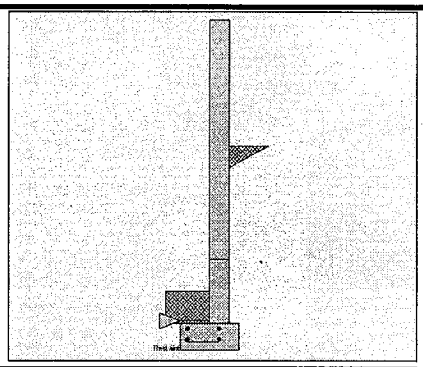
Retained Height	=	5.50 ft
Wall height above soil	=	4.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

20#x1' + 40# (16"/12)

25#x1' + 12# (11"/12) + 13# WALL & MISC

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
NOT Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	180.0 lbs
Axial Live Load	=	73.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Service Level)
Wind on Exposed Stem (Service Level)	=	14.0 psf

Wind acts left-to-right toward retention side.

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Square Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	2.500

(Multiplier used on soil density)

Uniform Seismic Force	=	15.833
Total Seismic Force	=	100.278

> 93 (=9H)

10.33'

Design Summary

Wall Stability Ratios

Overturning	=	1.76 OK

Slab Resists All Sliding !

Total Bearing Load	=	1,765 lbs
...resultant ecc.	=	4.92 in
Soil Pressure @ Toe	=	1,994 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	3,000 psf

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	2,791 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	12.2 psi OK
Footing Shear @ Heel	=	3.5 psi OK
Allowable	=	82.2 psi

Sliding Calcs

Lateral Sliding Force	=	716.1 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		2nd	Bottom
		Stem OK	Stem OK
Design Height Above Ftg	ft =	2.00	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Design Method	=	LRFD	LRFD
Thickness	=	8.00	8.00
Rebar Size	=	# 5	# 5
Rebar Spacing	=	16.00	16.00
Rebar Placed at	=	Center	Center
Design Data			
fb/FB + fa/Fa	=	**0.030**	**0.340**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	347.1	914.2
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =	121.8	1,343.4
Moment.....Allowable	ft-# =	3,945.8	3,945.8
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =	7.2	19.0
Shear.....Allowable	psi =	82.2	82.2
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	4.00	4.00
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	100.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	3,000.0	3,000.0
Fy	psi =	60,000.0	60,000.0

FTG

(WEST WALL)

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License : KW-06061521
License To : D.S. Engineering

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0073 in2/ft		
(4/3) * As :	0.0098 in2/ft	Min Stem T&S Reinf Area 1.440 in2	
200bd/fy : 200(12)(4)/60000 :	0.16 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2325 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.6503 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0811 in2/ft		
(4/3) * As :	0.1081 in2/ft	Min Stem T&S Reinf Area 0.384 in2	
200bd/fy : 200(12)(4)/60000 :	0.16 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2325 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.6503 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	1.00 ft
Heel Width	=	1.00
Total Footing Width	=	2.00
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	2,791	0 psf
Mu' : Upward	=	13,594	0 ft-#
Mu' : Downward	=	1,974	57 ft-#
Mu: Design	=	968	57 ft-#
Actual 1-Way Shear	=	12.15	3.55 psi
Allow 1-Way Shear	=	82.16	43.82 psi

Toe Reinforcing = # 5 @ 16.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 18.00 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

If torsion exceeds allowable, provide supplemental design for footing torsion.

Other Acceptable Sizes & Spacings

Toe: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 0.43 in2
Min footing T&S reinf Area per foot 0.22 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 11.11 in	#4@ 22.22 in
#5@ 17.22 in	#5@ 34.44 in
#6@ 24.44 in	#6@ 48.89 in

FT9

Project Name/Number :

(WEST WALL)

RetainPro (c) 1987-2019, Build 11.20.03.31
License : KW-06061521
License To : D.S. Engineering

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		701.9	2.11	1,481.9	Soil Over HL (ab. water tbl)	201.7	1.83	369.7
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		1.83	369.7
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=				Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 253.0	1.33	240.0
Added Lateral Load	=				* Axial Live Load on Stem	= 73.0	1.33	97.3
Load @ Stem Above Soil	=	-56.0	8.33	-466.7	Soil Over Toe	= 110.0	0.50	55.0
Seismic Earth Load	=	70.2	3.17	222.3	Surcharge Over Toe	=		
	=				Stem Weight(s)	= 950.0	1.33	1,266.7
					Earth @ Stem Transitions	=		
Total	=	716.1	**O.T.M.** =	1,237.5	Footing Weight	= 250.0	1.00	250.0
					Key Weight	=		
					Vert. Component	=		
					Total =	1,691.7 lbs	**R.M.**=	2,181.4

Resisting/Overturning Ratio = **1.76**
Vertical Loads used for Soil Pressure = 1,764.7 lbs

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

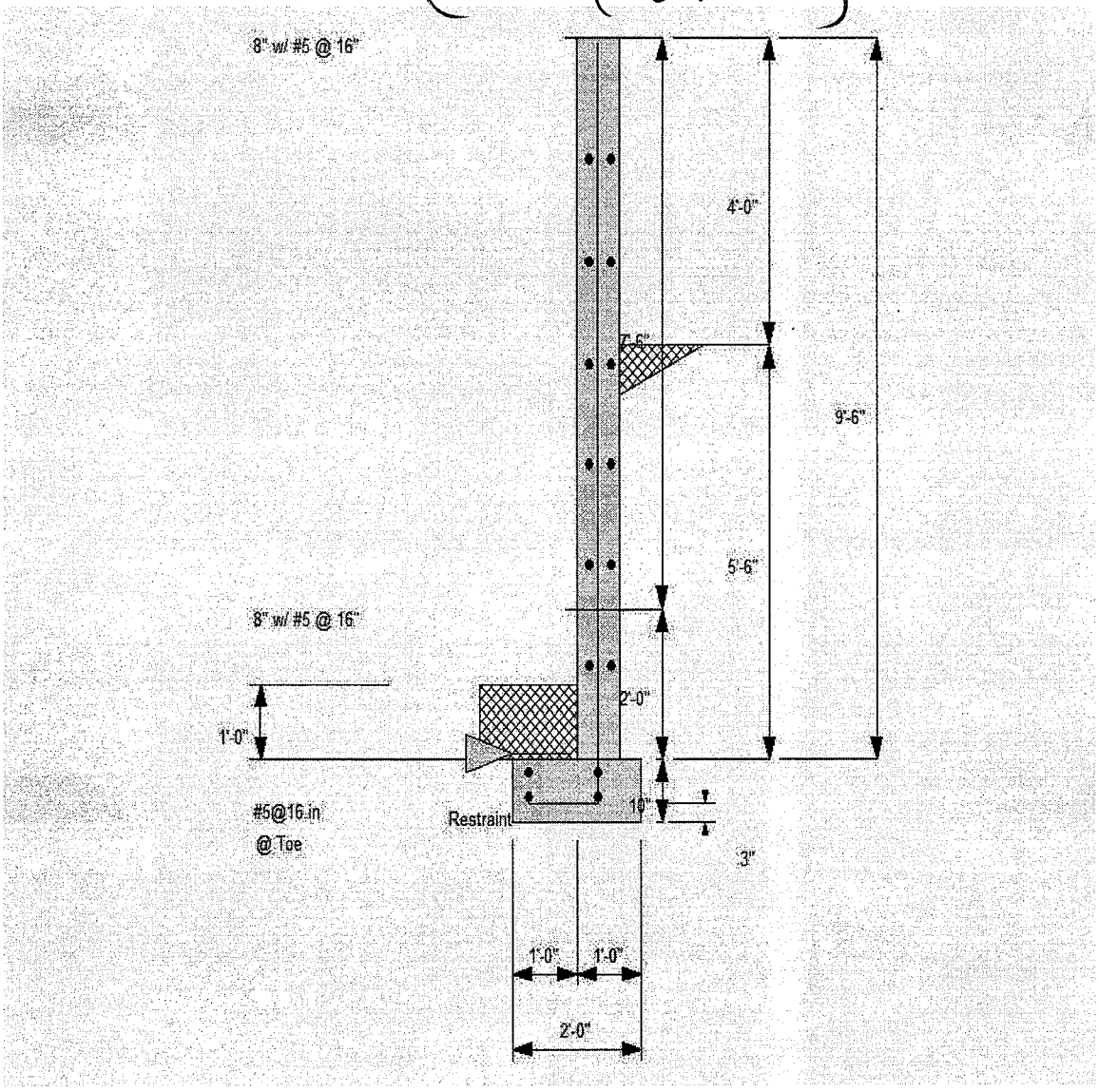
(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.263	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

FT16

(WEST WALL)



PT11

Project Name/Number :

(NORTH WALL)

RetainPro (c) 1987-2019, Build 11.20.03.31
License : KW-06061521
License To : D.S. Engineering

Cantilevered Retaining Wall

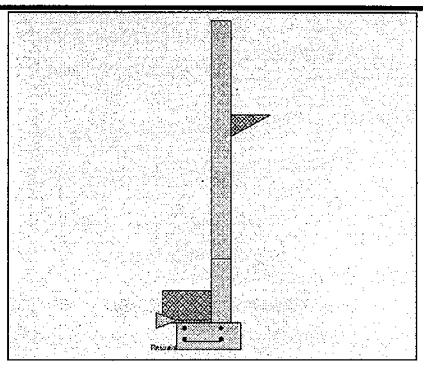
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	6.50 ft
Wall height above soil	=	3.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing/Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
NOT Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Service Level)
Wind on Exposed Stem (Service Level)	=	14.0 psf

Wind acts left-to-right toward retention side.

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Square Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	690.0 lbs
Axial Live Load	=	1,150.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	1.900

(Multiplier used on soil density)

Uniform Seismic Force	=	13.933
Total Seismic Force	=	102.178

Design Summary

Wall Stability Ratios

Overturning	=	1.51 OK

Slab Resists All Sliding !

Total Bearing Load	=	3,428 lbs
...resultant ecc.	=	3.05 in
Soil Pressure @ Toe	=	2,688 psf OK
Soil Pressure @ Heel	=	471 psf OK
Allowable	=	3,000 psf

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	3,764 psf
ACI Factored @ Heel	=	660 psf
Footing Shear @ Toe	=	23.8 psi OK
Footing Shear @ Heel	=	4.1 psi OK
Allowable	=	82.2 psi

Sliding Calcs

Lateral Sliding Force	=	970.6 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		2nd	Bottom
		Stem OK	Stem OK
Design Height Above Ftg	ft =	2.00	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Design Method	=	LRFD	LRFD
Thickness	=	8.00	8.00
Rebar Size	=	# 5	# 5
Rebar Spacing	=	16.00	16.00
Rebar Placed at	=	Center	Center
Design Data			
fb/FB + fa/Fa	=	**0.181**	**0.654**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	610.5	1,292.9
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =	717.1	2,580.9
Moment.....Allowable	ft-# =	3,945.8	3,945.8
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =	12.7	26.9
Shear.....Allowable	psi =	82.2	82.2
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	4.00	4.00
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	100.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	3,000.0	3,000.0
Fy	psi =	60,000.0	60,000.0

Project Name/Number :

(NORTH WALL)

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0433 in2/ft		
(4/3) * As :	0.0577 in2/ft	Min Stem T&S Reinf Area 1.440 in2	
200bd/fy : 200(12)(4)/60000 :	0.16 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2325 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.6503 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1558 in2/ft		
(4/3) * As :	0.2077 in2/ft	Min Stem T&S Reinf Area 0.384 in2	
200bd/fy : 200(12)(4)/60000 :	0.16 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.16 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2325 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.6503 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	1.17 ft
Heel Width	=	1.00
Total Footing Width	=	2.17
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	3,764	660	psf
Mu' : Upward	=	26,332	0	ft-#
Mu' : Downward	=	2,702	65	ft-#
Mu: Design	=	1,969	65	ft-#
Actual 1-Way Shear	=	23.78	4.08	psi
Allow 1-Way Shear	=	82.16	43.82	psi

Toe Reinforcing = # 5 @ 12.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 18.00 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

If torsion exceeds allowable, provide supplemental design for footing torsion.

Other Acceptable Sizes & Spacings

Toe: #4@ 11.11 in, #5@ 17.22 in, #6@ 24.44 in, #7@ 33.33 in, #8@ 43.88 in, #9@ 5
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area 0.47 in2
Min footing T&S reinf Area per foot 0.22 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 11.11 in	#4@ 22.22 in
#5@ 17.22 in	#5@ 34.44 in
#6@ 24.44 in	#6@ 48.89 in

PT 13

(NORTH WALL)

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License To : D.S. Engineering

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		941.1	2.44	2,300.5	Soil Over HL (ab. water tbl)	238.3	2.00	477.5
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		2.00	477.5
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=				Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 1,840.0	1.50	1,037.3
Added Lateral Load	=				* Axial Live Load on Stem	= 1,150.0	1.50	1,728.8
Load @ Stem Above Soil	=	-42.0	8.83	-371.0	Soil Over Toe	= 128.7	0.59	75.3
Seismic Earth Load	=	71.5	3.67	262.3	Surcharge Over Toe	=		
	=				Stem Weight(s)	= 950.0	1.50	1,428.2
					Earth @ Stem Transitions	=		
Total	=	970.6	**O.T.M.** =	2,191.8	Footing Weight	= 271.3	1.09	294.3
					Key Weight	=		
					Vert. Component	=		
					Total =	2,278.3 lbs	**R.M.**=	3,312.5

Resisting/Overturning Ratio = **1.51**
Vertical Loads used for Soil Pressure = 3,428.3 lbs

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

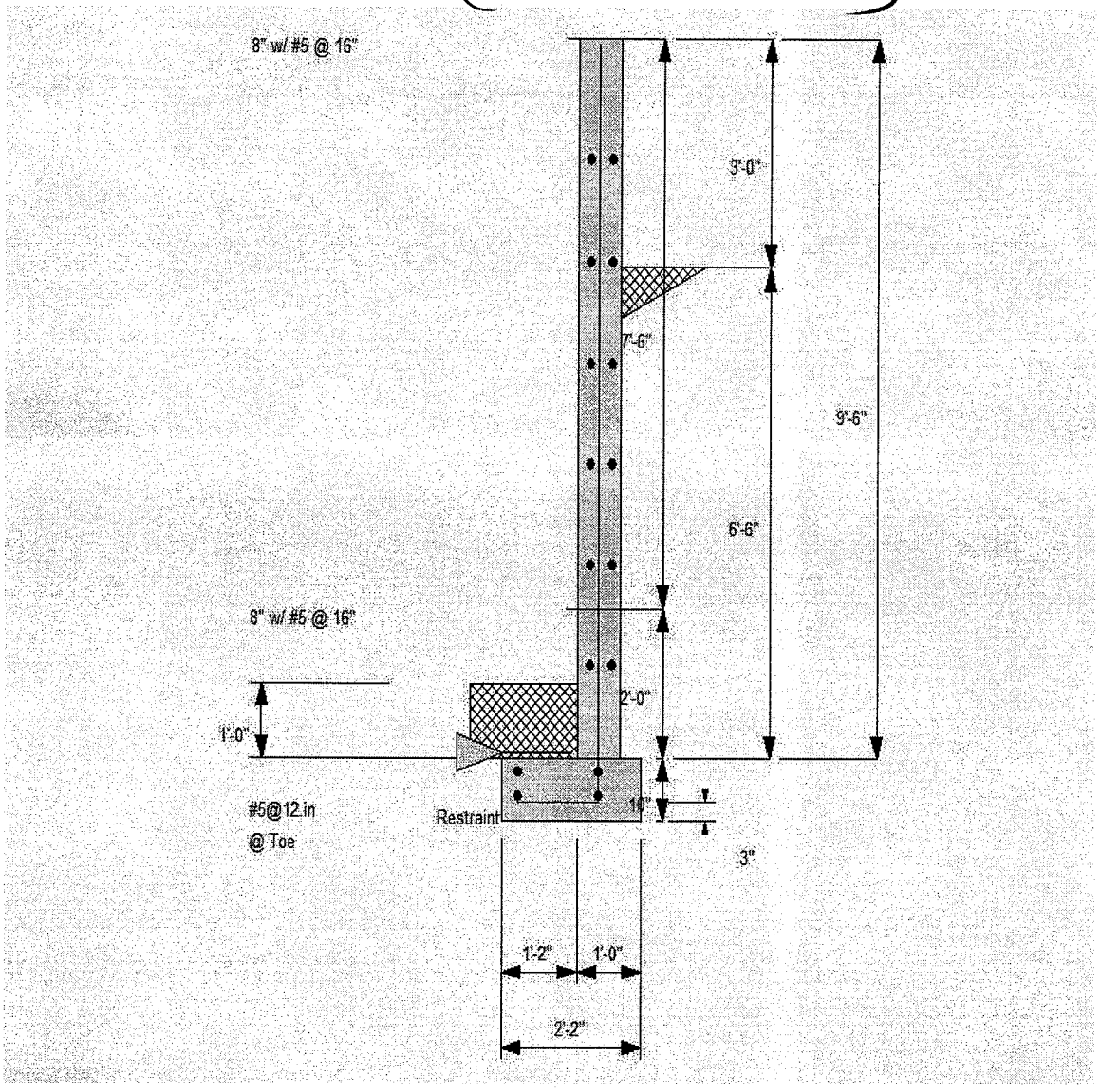
Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.327	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

(NORTH WALL)



PT 15

Project Name/Number :

(NORTH WALL)

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Cantilevered Retaining Wall

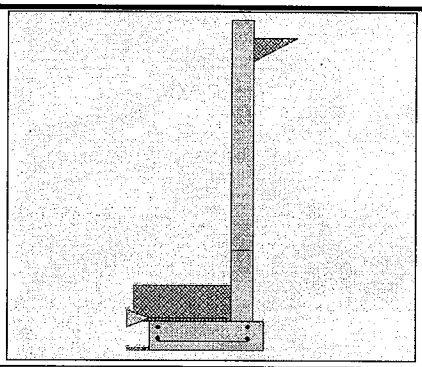
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	8.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	12.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
NOT Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	690.0 lbs
Axial Live Load	=	1,150.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Service Level)
Wind on Exposed Stem (Service Level)	=	14.0 psf

Wind acts left-to-right toward retention side.

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Square Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	1.330

(Multiplier used on soil density)

Uniform Seismic Force	=	11.748
Total Seismic Force	=	103.777

Design Summary

Wall Stability Ratios

Overturning	=	1.51 OK

Slab Resists All Sliding !

Total Bearing Load	=	3,696 lbs
...resultant ecc.	=	3.37 in
Soil Pressure @ Toe	=	1,564 psf OK
Soil Pressure @ Heel	=	548 psf OK
Allowable	=	3,000 psf

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	2,189 psf
ACI Factored @ Heel	=	767 psf
Footing Shear @ Toe	=	35.9 psi OK
Footing Shear @ Heel	=	4.9 psi OK
Allowable	=	82.2 psi

Sliding Calcs

Lateral Sliding Force	=	1,431.1 lbs

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.400
Live Load	1.700
Earth, H	1.700
Wind, W	1.300
Seismic, E	1.000

Stem Construction

		2nd	Bottom
		Stem OK	Stem OK
Design Height Above Ftg	ft =	2.00	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Design Method	=	LRFD	LRFD
Thickness	=	8.00	8.00
Rebar Size	=	# 5	# 5
Rebar Spacing	=	18.00	12.00
Rebar Placed at	=	Edge	Edge
Design Data			
fb/FB + fa/Fa	=	**0.412**	**0.655**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	1,132.4	1,988.9
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =	2,296.6	5,378.2
Moment.....Allowable	ft-# =	5,565.4	8,206.3
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =	15.3	26.8
Shear.....Allowable	psi =	82.2	82.2
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.19	6.19
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	100.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	3,000.0	3,000.0
Fy	psi =	60,000.0	60,000.0

FT 16

Project Name/Number :

(NORTH WALL)

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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Concrete Stem Rebar Area Details

2nd Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.087 in2/ft		
(4/3) * As :	0.1159 in2/ft	Min Stem T&S Reinf Area 1.248 in2	
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2067 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	1.0059 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.2036 in2/ft		
(4/3) * As :	0.2715 in2/ft	Min Stem T&S Reinf Area 0.384 in2	
200bd/fy : 200(12)(6.1875)/60000 :	0.2475 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.2475 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.31 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	1.0059 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	2.50 ft
Heel Width	=	1.00
Total Footing Width	=	3.50
Footing Thickness	=	10.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	2,189	767	psf
Mu' : Upward	=	69,402	0	ft-#
Mu' : Downward	=	12,338	78	ft-#
Mu: Design	=	4,755	78	ft-#
Actual 1-Way Shear	=	35.89	4.89	psi
Allow 1-Way Shear	=	82.16	43.82	psi

Toe Reinforcing = # 5 @ 8.00 in
Heel Reinforcing = None Spec'd
Key Reinforcing = # 4 @ 18.00 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

If torsion exceeds allowable, provide supplemental design for footing torsion.

Other Acceptable Sizes & Spacings

Toe: #4@ 10.52 in, #5@ 16.31 in, #6@ 23.16 in, #7@ 31.58 in, #8@ 41.58 in, #9@ 5
Heel: phiMn = phi'5'lambda'sqrt(fc)'Sm
Key: No key defined

Min footing T&S reinf Area	0.76	in2
Min footing T&S reinf Area per foot	0.22	in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 11.11 in	#4@ 22.22 in
#5@ 17.22 in	#5@ 34.44 in
#6@ 24.44 in	#6@ 48.89 in

USE 4-0 W

FT 17

(NORTH WALL)

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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		1,365.5	2.94	4,020.6	Soil Over HL (ab. water tbl)	293.3	3.33	977.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.33	977.8
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=				Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 1,840.0	2.83	1,955.0
Added Lateral Load	=				* Axial Live Load on Stem	= 1,150.0	2.83	3,258.3
Load @ Stem Above Soil	=	-7.0	9.08	-63.6	Soil Over Toe	= 275.0	1.25	343.8
Seismic Earth Load	=	72.6	4.42	320.8	Surcharge Over Toe	=		
	=				Stem Weight(s)	= 850.0	2.83	2,408.3
					Earth @ Stem Transitions	=		
Total	=	1,431.1	**O.T.M.** =	4,277.9	Footing Weight	= 437.5	1.75	765.6
					Key Weight	=		
					Vert. Component	=		
					Total =	2,545.8 lbs	**R.M.**=	6,450.5

Resisting/Overturning Ratio = **1.51**
Vertical Loads used for Soil Pressure = 3,695.8 lbs

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

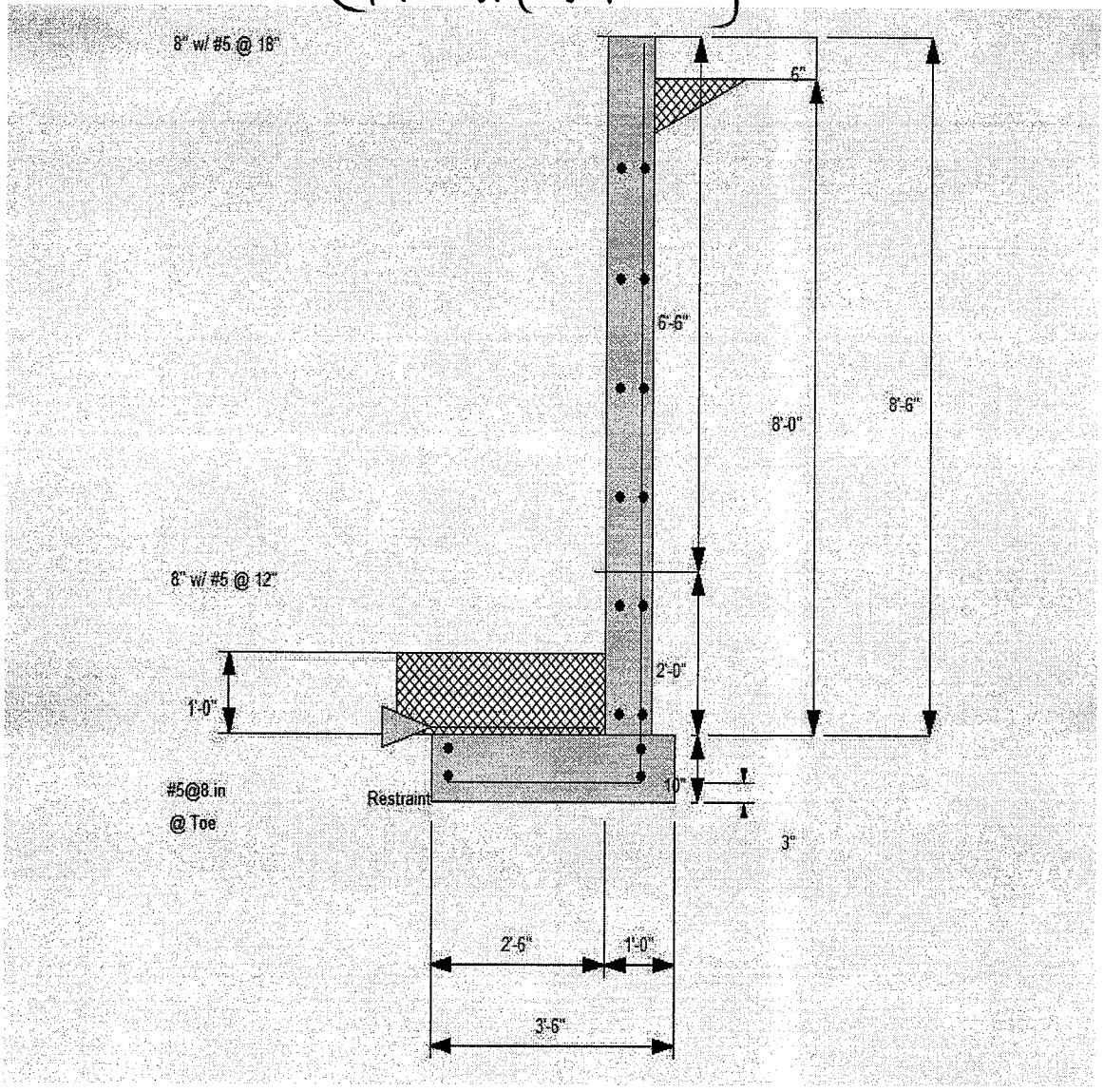
(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.105	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

FT18

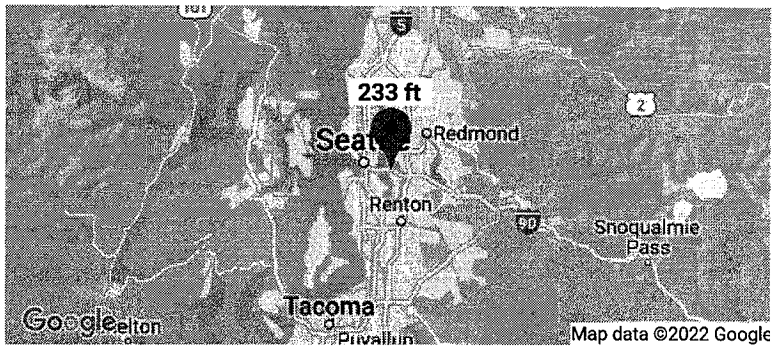
NORTH ABUT



PT 19

ATC Hazards by Location

Search Information



Address:	6950 SE Maker St, Mercer Island, WA 98040, USA
Coordinates:	47.5786938, -122.2436788
Elevation:	233 ft
Timestamp:	2022-05-09T08:26:45.273Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	II
Site Class:	D

Basic Parameters

Name	Value	Description
S_S	1.414	MCE_R ground motion (period=0.2s)
S_1	0.492	MCE_R ground motion (period=1.0s)
S_{MS}	1.414	Site-modified spectral acceleration value
S_{M1}	~~* null~~ 0.89	Site-modified spectral acceleration value $= F_v S_1 = 1.808 \times 0.492 = 0.89$
S_{DS}	0.943	Numeric seismic design value at 0.2s SA
S_{D1}	~~* null~~ 0.593	Numeric seismic design value at 1.0s SA $= \frac{2}{3} S_{M1} = 0.593$

* See Section 11.4.8

Additional Information

Name	Value	Description
SDC	~~* null~~ D	Seismic design category
F_a	1	Site amplification factor at 0.2s
F_v	~~* null~~ 1.808	Site amplification factor at 1.0s
CR_S	0.902	Coefficient of risk (0.2s)
CR_1	0.897	Coefficient of risk (1.0s)
PGA	0.605	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.666	Site modified peak ground acceleration
T_L	6	Long-period transition period (s)
SsRT	1.414	Probabilistic risk-targeted ground motion (0.2s)
SsUH	1.567	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	3.44	Factored deterministic acceleration value (0.2s)
S1RT	0.492	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.549	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	1.386	Factored deterministic acceleration value (1.0s)
PGAd	1.179	Factored deterministic acceleration value (PGA)

L1

Design Lateral Seismic Load per "IBC 2018' & 'ASCE/SEI 7-16":

The total design lateral seiamic force is determined from:

$V = C_s \times W$ = **0.1015** x W = **8670** lb. : **ASD**

From:

S_s =	**1.414** g (=0.2 sec response)	Seismic Design Category :	**D**	
S_1 =	**0.492** g (=1.0 sec response)	Occupancy Category :	**II**	
F_a =	**1.000** (=site Coefficients: site classification 'D')	Seismic Use Group :	**I**	
F_v =	**1.808** (=site Coefficients: site classification 'D')			
S_{MS} =	**1.414** (= $F_a \times S_s$)			
S_{M1} =	**0.890** (= $F_v \times S_1$)			
S_{DS} =	**0.943** [= S_{MS} x (2/3)]			
S_{D1} =	**0.593** [= S_{M1} x (2/3)]			
C_t =	**0.020**	T_L =	**6.00**	sec.
h_n =	**21.00** ft.(=Mean Height of Roof)	T =	**0.20**	sec.
I_e =	**1.00**			
R =	**6.50**			
C_s =	**0.1015** ($=S_{DS}/(R/I_e)$x0.7) : **ASD**			
W =	**85400** lb. (=Included Exterior & Interior Partition Wall)			

ASCE/SEI 7-16' Section 12.8.1 has a requirement that V be not less than 0.01 W
BUT not more than $\{(S_{D1} \times I)/(R \times T)\} \times W$

Check: $(0.01) \times W < V < \{(S_{D1} \times I_e)/(R \times T)\} \times W$

598 lb.< **V** < 27798 lb. : **O. K.**

Ditribution of Base Shear (ASD):

Level	W_i(lb)	h_i(ft)	$(W_i)(h_i)$	(Wihi)/Sum(W_ih_i)	F_x	Sum (F_x)	
Roof	**46900**	**21.00**	984900	0.709	6147	6147	**lb.**
2nd Floor	**38500**	**10.50**	404250	0.291	2523	8670	**lb.**
	85400		1389150	1.000			

From **Roof** : $(25+4)^{\#} \times 35' \times 28' + (20+4)^{\#} \times 35' \times 22' = 46900^{\#}$

2nd Floor : $(12+10)^{\#} \times 35' \times 50' = 38500^{\#}$

Diaphragm Load (ASD):

Level	F_i(lb)	sum:F_i	W_i	sum:F_i/sum:W_i	Adjust	F_{px}	
Roof	6147	6147	46900	0.131	**0.132**	6191	**lb.**
2nd Floor	2523	8670	38500	0.102	**0.132**	5082	**lb.**
			85400				

$F_x(max) = 0.4\ S_{DS}\ I_e\ W_{px}\ (0.7)$ = 0.264

$F_x(min) = 0.2\ S_{DS}\ I_e\ W_{px}\ (0.7)$ = 0.132

1ST FLOOR : $(12+15)^{\#} \times 35' \times 50' \times 0.101 = 3020^{\#}$

(SUPPORT BY CONC. WALL)

ATC Hazards by Location

Search Information

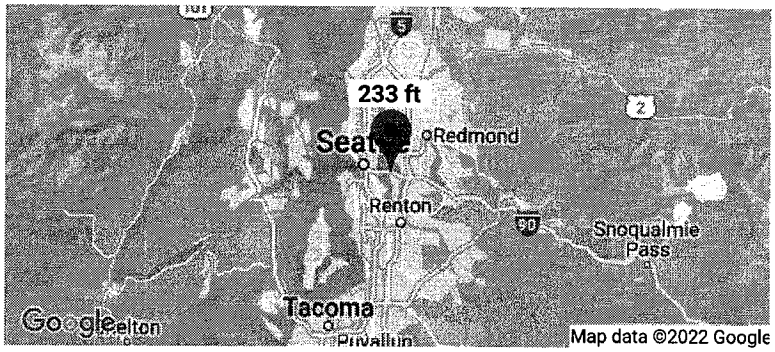
Address: 6950 SE Maker St, Mercer Island, WA 98040, USA

Coordinates: 47.5786938, -122.2436788

Elevation: 233 ft

Timestamp: 2022-05-09T18:58:24.599Z

Hazard Type: Wind



ASCE 7-16

MRI 10-Year	67 mph
MRI 25-Year	73 mph
MRI 50-Year	78 mph
MRI 100-Year	83 mph
Risk Category I	92 mph
Risk Category II	97 mph
Risk Category III	104 mph
Risk Category IV	108 mph

ASCE 7-10

MRI 10-Year	72 mph
MRI 25-Year	79 mph
MRI 50-Year	85 mph
MRI 100-Year	91 mph
Risk Category I	100 mph
Risk Category II	110 mph
Risk Category III-IV	115 mph

ASCE 7-05

ASCE 7-05 Wind Speed	85 mph

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

110 MPH, EXPOSURE 'B', K_{zt}=1.38

Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

PER FIG 26.8-1
(EXPOSURE 'C')

H/L_h : 230/400 = 0.58 : K_1 = 0.43
x/L_h : 35/400 = 0.10 K_2 = 0.98
z/L_h : 25/400 = 0.06 K_3 = 0.90

$K_{zt} = (1 + K_1 K_2 K_3)^2$ × 0.71 EXPOSURE 'B'
= 1.33
SAY K_z = 1.38

L3

1.0

27 Directional Procedure, Part 1:Enclosed and Partially Enclosed Rigid Buildings. (All Heights)

27.4. MWFRS

Velocity pressure q_z = .00256 K_z K_{zt} K_d V^2 Ke ~~(27.3-1)~~ 26.10-1

Exposure B Roof Height h = 31.5 feet

Roof Pitch = 0.00 :12

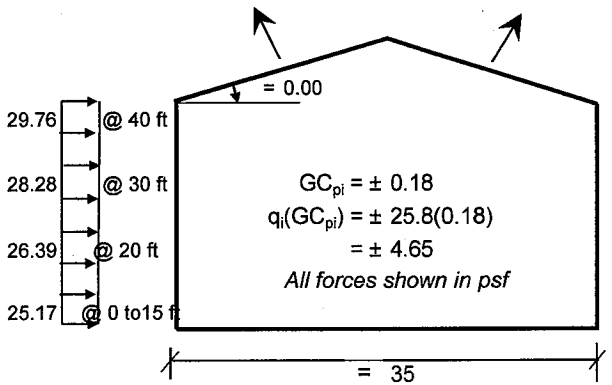
Exposure coefficient K_z = ~~Section 27.3.1~~ 26.10-1, shall be determined from Table 27.3-1

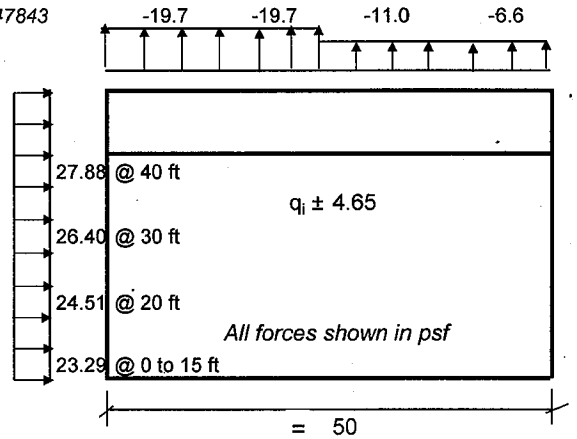
Topography factor K_{zt} =	1.38	26.8.2, Figure 26.8-1
Directionality factor K_d =	0.85	26.6, Table 26.6-1
Building & Structure Risk Category =	II, standard	IBC T-1604.5
Wind Speed V =	110 mph	Fig. 26.5-1B, MRI = 700 yrs
q_z =	36.33 K_z psf	
Internal Pressure Coefficient (GC_{pi}) =	± 0.18	Table 26.11-1, for Enclosed Building
Gust effect factor G =	0.85	~~26.9~~ 26.11-1
Pressures for MWFRS p =	$qGC_p - q_i(GC_{pi})$	(27.3-1)

Wall and Roof External pressure Coefficients C_p from Fig. 27.4-1

Wind Normal to Ridge (⊥ to 35) L/B =	0.70		h/L = 31.5/35 = 0.90		θ= 0.0		
Windward wall C_p =	0.80		Windward roof C_p =				
Leeward wall C_p =	-0.50	for L/B = 0.70	Leeward roof C_p =				
Side wall C_p =	-0.70		or Roof C_p =	-1.22	0.86	-0.66	
Wind Parallel to Ridge (⊥ to 50) L/B =	1.43						
Windward wall C_p =	0.80		h/L = 31.5/50 = 0.63				
Leeward wall C_p =	-0.41	for L/B = 1.43	Roof C_p =	-0.90	-0.90	-0.50	
Side wall C_p =	-0.70		for dist	0	16	32	

-26.8 18.9 -14.4812124757381 -13.6035632347843





$p = qGC_p - q_i(GC_{pi})$ (27.3-1) For Exp B

where $q = q_z$ for windward at height z $z_g = 1200$ $\alpha = 7.0$

$q = q_h$ for leeward wall, side wall and roof @31.5 ft $K_z = 2.01(z/z_g)^{2/\alpha}$

$q_i = q_h$ for enclosed building @31.5 ft K_z (min) $= 2.01(15/z_g)^{2/\alpha}$

Roof Ht, h = 31.5 ft				Normal to Ridge ⊥ to 35			Parallel to ridge ⊥ to 50		
	Height	K_h	q_h	C_p	q_hGC_p		C_p	q_hGC_p	
Leeward wall	all	0.710	25.81	-0.5	-10.97		-0.41	-9.09	
Side wall	all	0.710	25.81	-0.70	-15.36		-0.70	-15.36	
Roof	ww		Or	-1.22	-26.8	fr 0 - 15.75	-0.90	-19.75	fr 0 - 15.75
	Lw			0.86	18.9	fr >15.75	-0.90	-19.75	fr >15.75
				-0.66	-14.48	fr 31.5-63	-0.50	-10.97	fr 31.5-63
				-0.62	-13.60	fr 63	-0.30	-6.58	fr 63

				Normal to Ridge ⊥ to 35			Parallel to ridge ⊥ to 50		
	z, Ht. (ft)	K_z	q_z	C_p	$p = q_zGC_p$	WW+LW	C_p	$p = q_zGC_p$	WW+LW
Windward wall	0 to 15	0.575	20.88	0.80	14.20	25.17	0.80	14.20	23.29
	20.0	0.624	22.67	0.80	15.42	26.39	0.80	15.42	24.51
	30.0	0.701	25.46	0.80	17.31	28.28	0.80	17.31	26.40
	40.0	0.761	27.64	0.80	18.79	29.76	0.80	18.79	27.88

GRID (S)

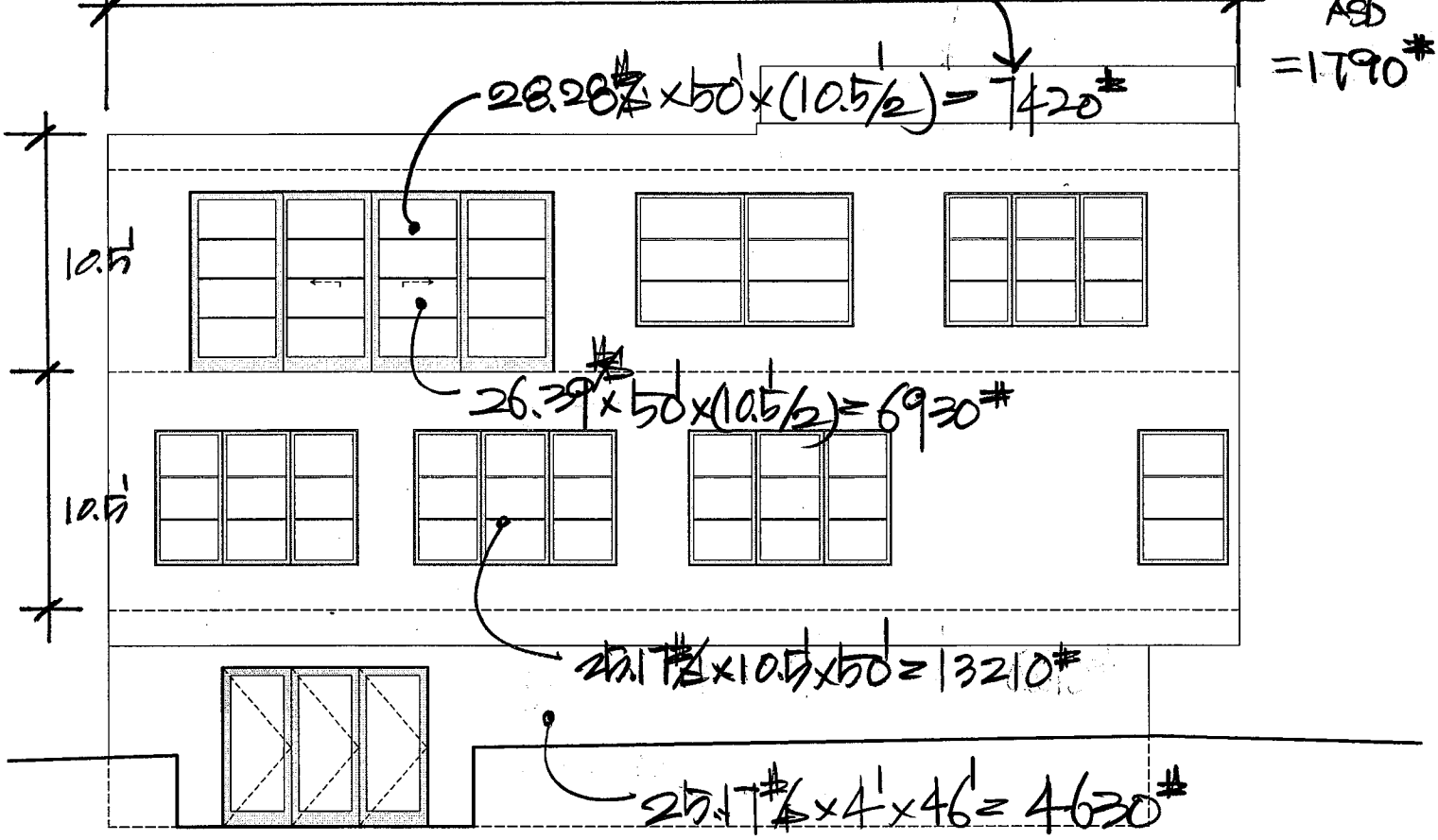
$F_{ROOF} = 2230^{\#} + 1790^{\#} = 4020^{\#}$

$F_{2ND} = 4060^{\#}$ ($\Sigma 8080^{\#}$)

$F_{1ST} = 2680^{\#}$ ($\Sigma 10760^{\#}$)

Table 27.5-1 : 30'

$\left(\frac{19.6+16.9}{2}\right)^{\#} \times 2.25 \times 2.5' \times 21' = 2160^{\#} \times 1.38$ (Fig 27.5-2) $\times 0.6$ (ASD) $= 1790^{\#}$



WEST ELEVATION 04

SCALE: 1/4" = 1'-0"

GRID (N) :

$F_{ROOF} = 7420^{\#}/2 = 3710^{\#} \times 0.6$ (ASD) $= 2230^{\#}$

$F_{2ND} = 6930^{\#}/2 + 13210^{\#}/4 = 6770^{\#} \times 0.6$ (ASD) $= 4060^{\#}$

$F_{1ST} = 13210^{\#}/4 + 4630^{\#}/4 = 4460^{\#} \times 0.6$ (ASD) $= 2680^{\#}$ ($\Sigma 6290^{\#}$)

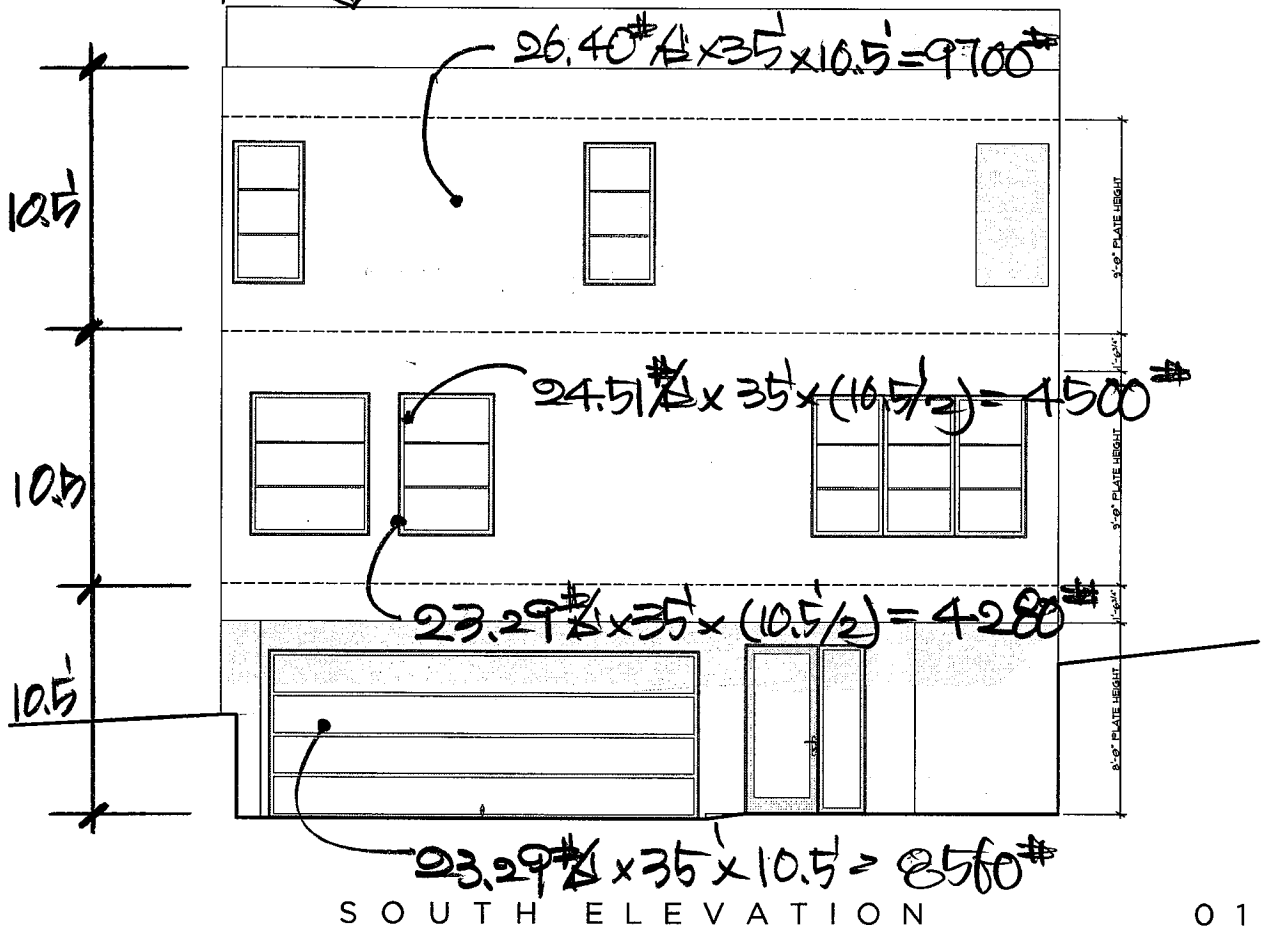
($\Sigma 8970^{\#}$) L6

Table 27.5-1

$\left(\frac{19.6+16.9}{2}\right)^{\#/ft^2} \times 2.25 \times 2.5' \times 35' = 359^{\#} \times 1.38 \times 0.6$ (Exc ASD)

FIG 27.5-2

(W) 35' (E) = 2970#



SOUTH ELEVATION 01

SCALE: 1/4" = 1'-0"

- GRID (E) & (W):

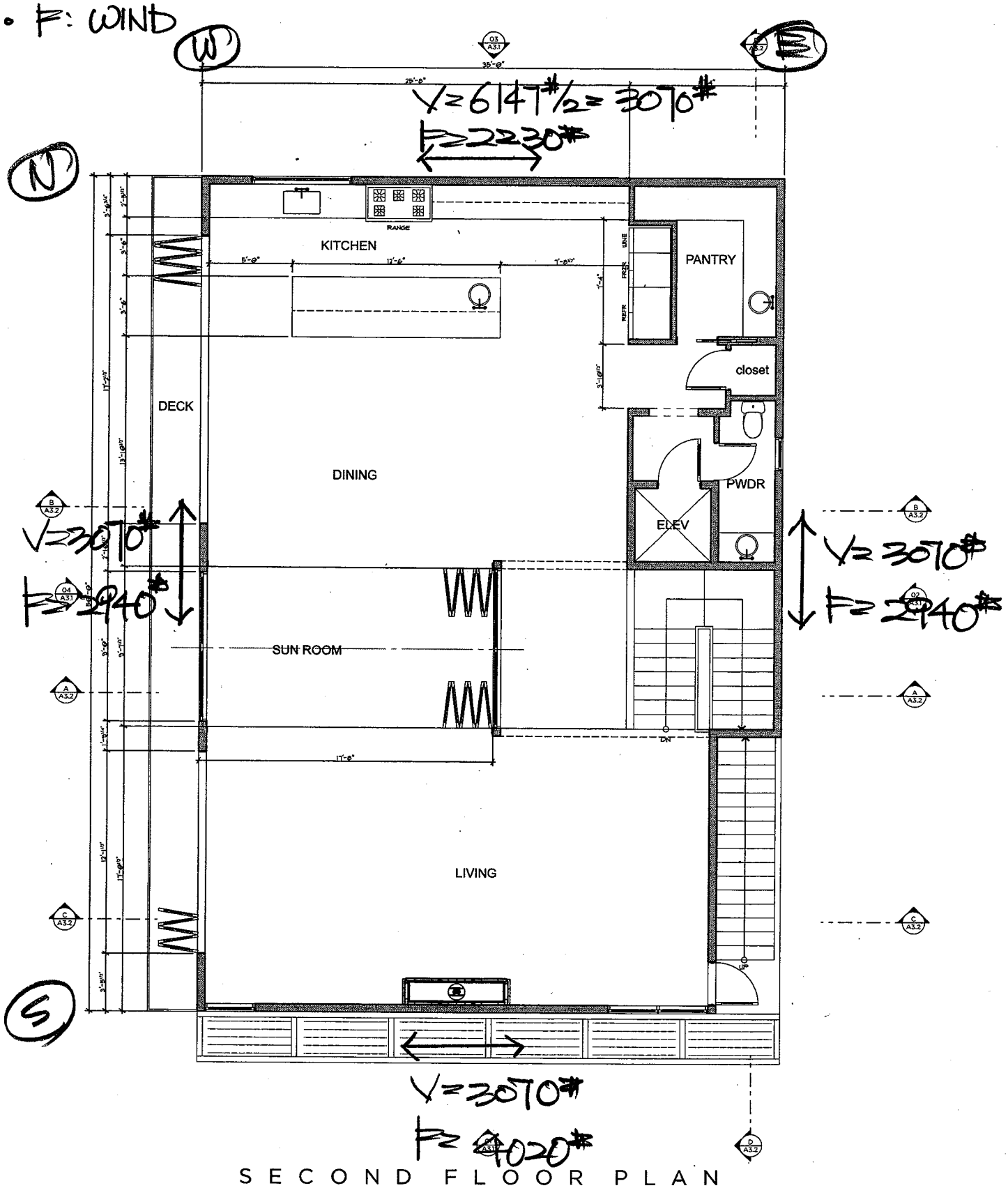
$F_{ROOF} = 9700^{\#}/4 = 2425^{\#} \times 0.6$ (ASD) $= 1455^{\#} + 2970^{\#}/2 = 2940^{\#}$

$F_{2ND} = 9700^{\#}/4 + 4500^{\#}/2 = 4675^{\#} \times 0.6$ (ASD) $= 2805^{\#}$ ($\Sigma 5745^{\#}$)

$F_{1ST} = 4280^{\#}/4 + 8560^{\#}/4 = 3210^{\#} \times 0.6$ (ASD) $= 1926^{\#}$ ($\Sigma 7670^{\#}$)

LT

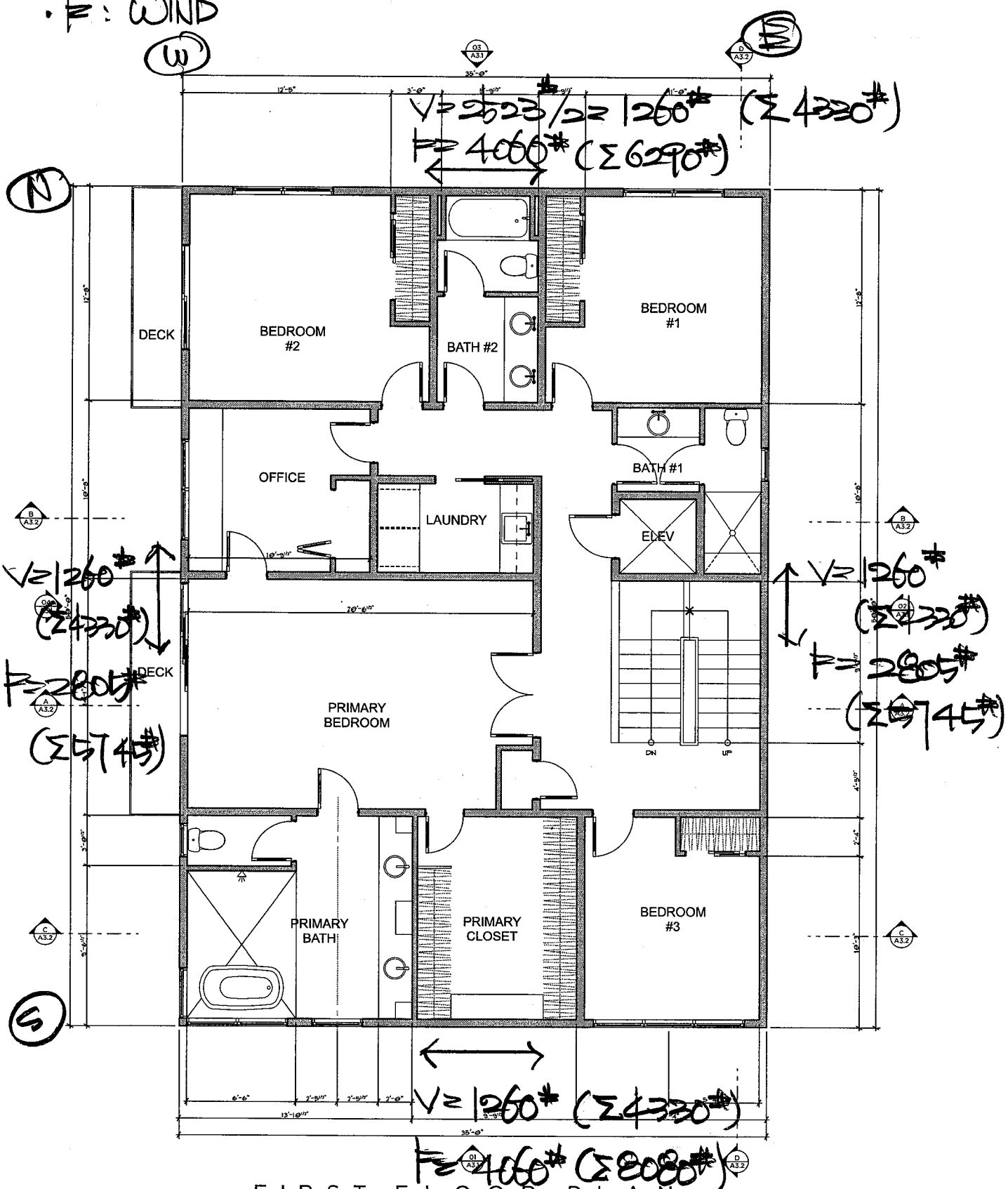
- V: SEIS
- F: WIND



SECOND FLOOR PLAN

SCALE: 1/4" = 1'-0"

L8



FIRST FLOOR PLAN

SCALE: 1/4" = 1'-0"

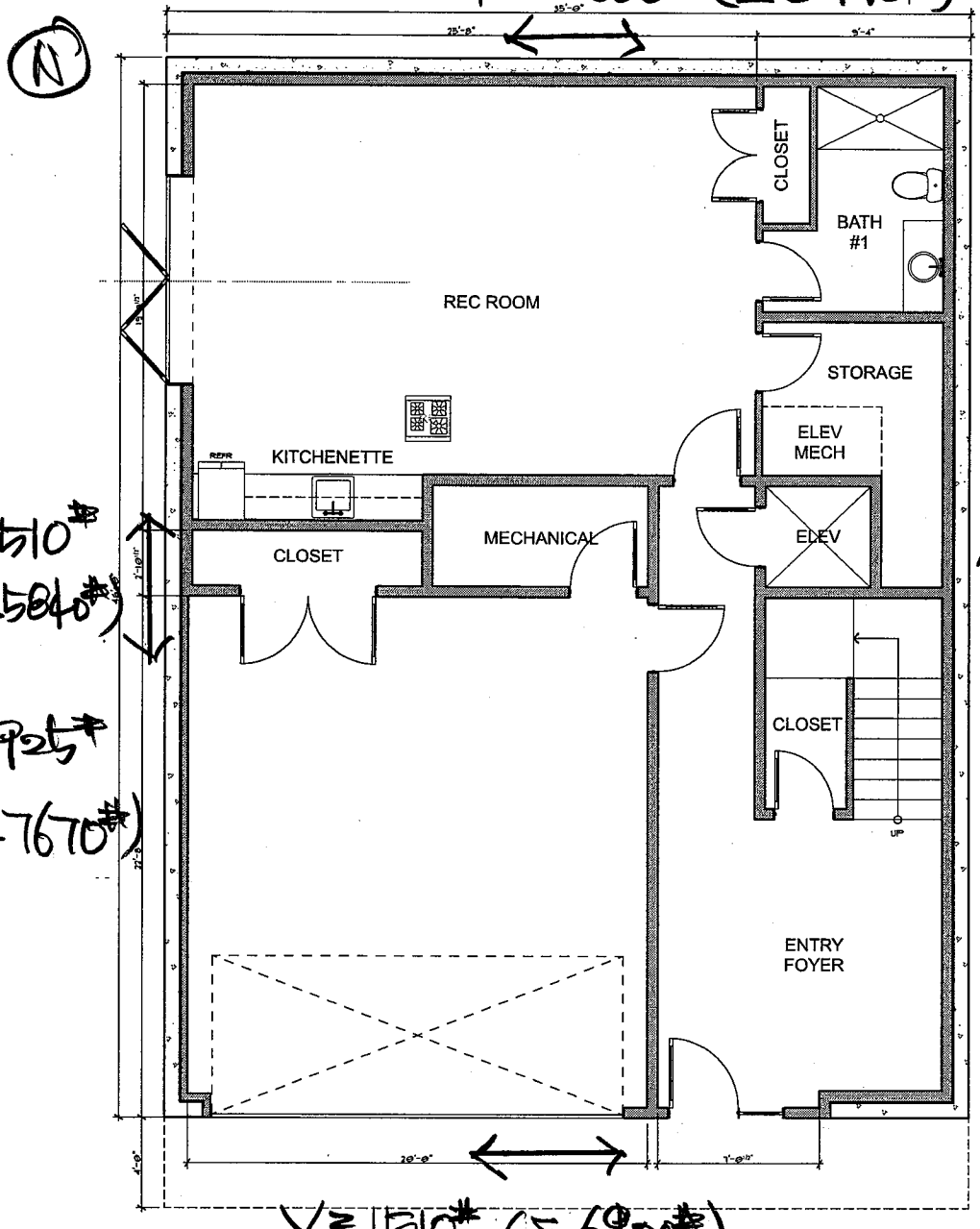
(2ND)

L9

V: ~~SEIS~~
F: WIND

V = 3020#/2 = 1510# (Σ 5840#)

F = 2680# (Σ 8970#)



V = 1510# (Σ 5840#)

F = 1925# (Σ 7670#)

V = 1510# (Σ 5840#)

F = 1925# (Σ 7670#)

V = 1510# (Σ 6920#)

BASEMENT PLAN

SCALE: 1/4" = 1'-0"

F = 2680# (Σ 10760#)

1510# + 1.25 x 4330#

(FIRST)

L10

Table 4.3A Nominal Unit Shear Capacities for Wood-Frame Shear Walls[1,3,6,7]

Wood-based Panels[4]

Sheathing Material	Minimum Nominal Panel Thickness (in.)	Minimun Fastener Penetration in Framing Member or Blocking (in.)	Fastener Type & Size	A SEISMIC										B WIND			
				Panel Edge Fastener Spacing (in.)										Panel Edge Fastener Spacing (in.)			
				6			4			3			2				
				v_s (plf)	G_a (kips/in.)		v_s (plf)	G_a (kips/in.)		v_s (plf)	G_a (kips/in.)		v_s (plf)	G_a (kips/in.)		6 v_w (plf)	4 v_w (plf)	3 v_w (plf)	2 v_w (plf)
					OSB	PLY		OSB	PLY		OSB	PLY		OSB	PLY				
Wood Structural Panels - Structural I[4,5]	5/16	1-1/4	Nail (common or galvanized box) 6d	400	13	10	600	18	13	780	23	16	1020	35	22	560	840	1090	1430
	3/8[2]	1-3/8	8d	460	19	14	720	24	17	920	30	20	1220	43	24	645	1010	1290	1710
	7/16[2]			510	16	13	790	21	16	1010	27	19	1340	40	24	715	1105	1415	1875
	15/32			560	14	11	860	18	14	1100	24	17	1460	37	23	785	1205	1540	2045
	15/32	1-1/2	10d	680	22	16	1020	29	20	1330	36	22	1740	51	28	950	1430	1860	2435
Wood Structural Panels – Sheathing[4,5]	5/16	1-1/4	6d	360	13	9.5	540	18	12	700	24	14	900	37	18	505	755	980	1260
	3/8			400	11	8.5	600	15	11	780	20	13	1020	32	17	560	840	1090	1430
	3/8[2]	1-3/8	8d	440	17	12	640	25	15	820	31	17	1060	45	20	615	895	1150	1485
	7/16[2]			480	15	11	700	22	14	900	28	17	1170	42	21	670	980	1260	1640
	15/32			520	13	10	760	19	13	980	25	15	1280	39	20	730	1065	1370	1790
	15/32	1-1/2	10d	620	22	14	920	30	17	1200	37	19	1540	52	23	870	1290	1680	2155
	19/32			680	19	13	1020	26	16	1330	33	18	1740	48	22	950	1430	1860	2435
Plywood Siding	5/16	1-1/4	Nail (galvanized casing) 6d	280	13		420	16		550	17		720	21		390	590	770	1010
	3/8	1-3/8	8d	320	16		480	18		620	20		820	22		450	670	870	1150
Particleboard Sheathing - (M-S "Exterior Glue" and M-2 "Exterior Glue")	3/8		Nail (common or galvanized box) 6d	240	15		360	17		460	19		600	22		335	505	645	840
	3/8		8d	260	18		380	20		480	21		630	23		365	530	670	880
	1/2			280	18		420	20		540	22		700	24		390	590	755	980
	1/2		10d	370	21		550	23		720	24		920	25		520	770	1010	1290
	5/8			400	21		610	23		790	24		1040	26		560	855	1105	1455
Structural Fiberboard Sheathing	1/2		Nail (galvanized roofing) 11 ga. galv. roofing nail (0.120" x 1-1/2" long x 7/16" head)				340	4.0		460	5.0		520	5.5			475	645	730
	25/32		11 ga. galv. roofing nail (0.120" x 1-3/4" long x 3/8" head)				340	4.0		460	5.0		520	5.5			475	645	730

1. Nominal unit shear capacities shall be adjusted in accordance with 4.3.3 to determine ASD allowable unit shear capacity and LRFD factored unit resistance. For general construction requirements see 4.3.6. For specific requirements, see 4.3.7.1 for wood structural panel shear walls, 4.3.7.2 for particleboard shear walls, and 4.3.7.3 for fiberboard shear walls. See Appendix A for common and box nail dimensions.
2. Shears are permitted to be increased to values shown for 15/32 inch (nominal) sheathing with same nailing provided (a) studs are spaced a maximum of 16 inches on center, or (b) panels are applied with long dimension across studs.
3. For species and grades of framing other than Douglas-Fir-Larch or Southern Pine, reduced nominal unit shear capacities shall be determined by multiplying the tabulated nominal unit shear capacity by the Specific Gravity Adjustment Factor = [1-(0.5-G)], where G = Specific Gravity of the framing lumber from the NDS (Table 12.3.3A). The Specific Gravity Adjustment Factor shall not be greater than 1.
4. Apparent shear stiffness values G_a, are based on nail slip in framing with moisture content less than or equal to 19% at time of fabrication and panel stiffness values for shear walls constructed with either OSB or 3-ply plywood panels. When 4-ply or 5-ply plywood panels or composite panels are used, G_a values shall be permitted to be multiplied by 1.2.
5. Where moisture content of the framing is greater than 19% at time of fabrication, G_a values shall be multiplied by 0.5.
6. Where panels are applied on both faces of a shear wall and nail spacing is less than 6" on center on either side, panel joints shall be offset to fall on different framing members as shown below. Alternatively, the width of the nailed face of framing members shall be 3" nominal or greater at adjoining panel edges and nails at all panel edges shall be staggered.
7. Galvanized nails shall be hot-dipped or tumbled.

Reliability/Redundancy Factor: SEISMIC

Use R.F. = 1.00 S_{DS} = 0.943

0.6D + 0.6W (Eq. 16-15)
0.6D + 0.7E (Eq. 16-16) & E = Q_E - 0.2 S_{DS} D
-----> 0.47 D + 0.7 Q_E

SEISMIC:
@ Grid 'N': Roof : V = 3070 #
L = 25.5'

V_{wall} =	3070	lb.
V_{wall}' =	3070	lb (V_{wall} x R.F.)
L =	25.50	ft.
H =	10.50	ft.
v_{shear} =	120	plf
T=C=	1289	lb.

<TYP

WIND:
@ Grid 'N': Roof : F = 2230 #
L = 25.5'

F_{wall} =	2230	lb.
L =	25.50	ft.
H =	10.50	ft.
v_{shear} =	87	plf
T=C=	937	lb.

<TYP

HBS: [21#/1'(23'/2) + 60#/1'](25.5'/2) = 4430# x 0.47 = 2082# > 1289#
x 0.60 = 2658# > 937#
(=348#/1') NO UPLIFT

SEISMIC:
@ Grid 'N': 2nd Flr : V = 4330 #
L = 17'

V_{wall} =	4330	lb.
V_{wall}' =	4330	lb (V_{wall} x R.F.)
L =	17.00	ft.
H =	10.50	ft.
v_{shear} =	255	plf
T=C=	2755	lb.

<W6

WIND:
@ Grid 'N': 2nd Flr : F = 6290 #
L = 17'

F_{wall} =	6290	lb.
L =	17.00	ft.
H =	10.50	ft.
v_{shear} =	370	plf
T=C=	4003	lb.

<W6

HDU2.

HBS = [348#/1' + 12#/1'(23'/2) + 60#/1'](17'/2) = 4641# x 0.47 = 2181#. T_{NET} = 574#
x 0.60 = 2785#. T_{NET} = 1218#

SEISMIC:
@ Grid 'N': 1st Flr : V = 5840 #
L = 35' (8" Concrete Shearwall)

V = 8970#/35'
= 256#/1' → 8" CONC WALL W/ #5@16" o.c (HORZ)

WIND:
@ Grid 'N': 1st Flr : F = 8970 #
L = 35' (8" Concrete Shearwall)

F/P

SEISMIC:

@ Grid 'S': Roof : V = 3070 #

L = 21'

V_{wall} =	3070	lb.
V_{wall}' =	3070	lb (V_{wall} x R.F.)
L =	21.00	ft.
H =	10.50	ft.
v_{shear} =	146	plf
T=C=	1572	lb.

WIND:

@ Grid 'S': Roof : F = 4020 #

L = 21'

F_{wall} =	4020	lb.
L =	21.00	ft.
H =	10.50	ft.
v_{shear} =	191	plf
T=C=	2059	lb.

'MST37' (1720#) <TYP. <TYP.

REQ: [20#/(17½) + 60#/] (21½) = 2415# x 0.47 = 1135# · T_{NET} = 437#

(=230#/)

x 0.60 = 1449# · T_{NET} = 610#

SEISMIC:

@ Grid 'S': 2nd Flr : V = 4330 #

L = 13.75'

V_{wall} =	4330	lb.
V_{wall}' =	4330	lb (V_{wall} x R.F.)
L =	13.75	ft.
H =	10.50	ft.
v_{shear} =	315	plf
T=C=	3431	lb.

WIND:

@ Grid 'S': 2nd Flr : F = 8080 #

L = 13.75'

F_{wall} =	8080	lb.
L =	13.75	ft.
H =	10.50	ft.
v_{shear} =	588	plf
T=C=	6403	lb.

REQ: [230#/ + 12#/(17½) + 60#/] (13.75½) = 2695# x 0.47 = 1267# · T_{NET} = 2164#

x 0.60 = 1617# · T_{NET} = 4786#

SEISMIC:

@ Grid 'S': 1st Flr : V = 6920 #

L = 6' (8" Concrete Shearwall)

V_{ADJ} = 6920# (6.5/5) Radj

= 9000#

WIND:

@ Grid 'S': 1st Flr : F = 10760 (#)

L = 6' (8" Concrete Shearwall)

'MSTC66B3Z' (4490#)

656# x 0.6

(F9)

T_{NET} = 4392#

Concrete Shear Wall

File: examples.ec6

Lic. # : KW-06010224
D.S. ENGINEERING PC

DESCRIPTION: Concrete Shear Wall (South)

Code References

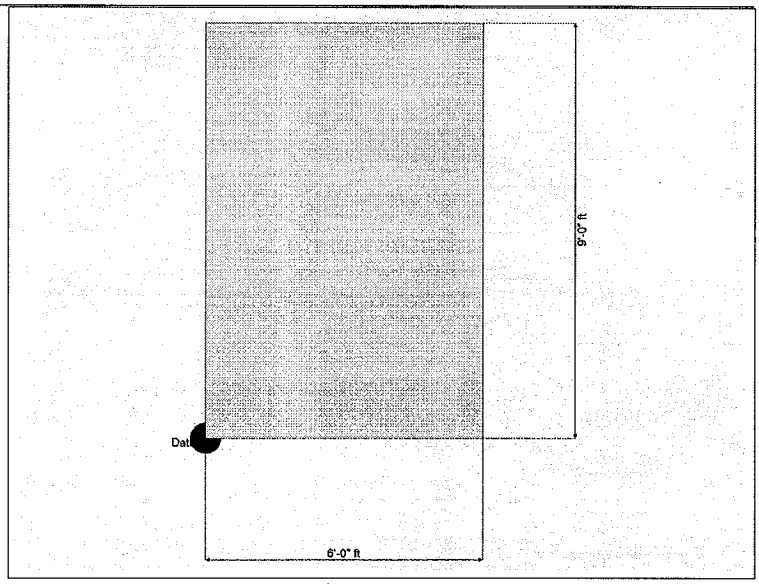
Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Wall Material	CONCRETE	**Material Properties**			
Sds	0.9430	f'c	3.0 ksi	Ec	3,120.0 ksi
		fy	60.0 ksi	Ev	1,248.0 ksi
		Density	150.0 pcf	Phi - Shear	0.650

Wall Data

	Bottom
Analysis Height	0.00 ft
Wall Offset	(datum) ft
Wall Length	6 ft
Wall Thickness	8.0 in
Structural Depth	5.750 ft



Applied Distributed Vertical Loads

Load Location (ft)			Load Magnitude (kips)				
Start Location	End Location	Height of Application	Dead Load	Roof Live Load	Live Load	Snow Load	Earth Load
0.0	6.0	9.0	0.0940	0.0	0.3350	0.0	0.0

Applied Concentrated Lateral Loads

	Load Magnitude (kips)					
Load "Y" Location (ft)	Dead Load	Roof Live Load	Floor Live Load	Wind Load	Seismic Load	Earth Load
9.0	0.0	0.0	0.0	10.760	9.0	0.0

DESIGN SUMMARY

	Bottom Level	
Vu : Story Shear	26.183	+1.336D+0.50L+2
Mu : Story Moment	202.50	+1.336D+0.50L+2
Nu : Axial	10.373	+1.20D+1.60L
Uplift @ Left End	32.841	+0.7636D+2.50E
Uplift @ Right End	32.841	+0.7636D+2.50E
vu : Applied	47.433 psi	
vc * Phi	71.204 psi	
vn:max=Phi*10*sqrt(f'c)	356.020 psi	
Horizontal As Req'd	0.240 in^2	
Vertical As Req'd	0.1152 in^2	
Bending As Req'd	0.9936 in^2	

→ (1) #9 OR (2)-#7

LA

DESCRIPTION: Concrete Shear Wall (South)

Force Summary

Load Combination / Wall Level	Values for Wall section Vu (k)	Mu (k)	Pu (k)	Resultant Ecc (ft)	Overturning Ratio	Uplift (k) Left	Right
+1.40D							
Wall Level : 1			8.350				
+1.20D+1.60L							
Wall Level : 1			10.373				
+1.20D+0.50L							
Wall Level : 1			8.162				
+1.20D+0.50W							
Wall Level : 1	5.380	48.420	7.157	6.766	0.443	4.687	4.687
+1.20D-0.50W							
Wall Level : 1	5.380	48.420	7.157	6.766	0.443	4.687	4.687
+1.20D+0.50L+W							
Wall Level : 1	10.760	96.840	8.162	11.865	0.253	12.583	12.583
+1.20D+0.50L-W							
Wall Level : 1	10.760	96.840	8.162	11.865	0.253	12.583	12.583
+1.336D+0.50L+2.50E							
Wall Level : 1	26.183	202.500	8.975	22.562	0.133	30.535	30.535
+1.336D+0.50L-2.50E							
Wall Level : 1	26.183	202.500	8.975	22.562	0.133	30.535	30.535
+0.90D+W							
Wall Level : 1	10.760	96.840	5.368	18.042	0.166	14.041	14.041
+0.90D-W							
Wall Level : 1	10.760	96.840	5.368	18.042	0.166	14.041	14.041
+0.7636D+2.50E							
Wall Level : 1	26.183	202.500	4.554	44.465	0.067	32.841	32.841
+0.7636D-2.50E							
Wall Level : 1	26.183	202.500	4.554	44.465	0.067	32.841	32.841

Footing Information

Footing Dimensions

Dist. Left	12.0 ft	f'c	3.0 ksi	Rebar Cover	3.0 in
Wall Length	6 ft	Fy	60.0 ksi	Footing Thickness	18.0 in
Dist. Right	0.0 ft			Width	5.0 ft
Total Ftg Length	18.0 ft				

Max Factored Soil Pressures

@ Left Side of Footing)99999,856 psf
.... governing load comb +1.336D+0.50L+2.50E

@ Right Side of Footing)99999,856 psf
.... governing load comb +1.336D+0.50L+2.50E

Max UNfactored Soil Pressures

@ Left Side of Footing 98.784 psf
.... governing load comb D Only

@ Right Side of Footing 1,031.96 psf
.... governing load comb +0.60D+0.70E

+583 PSF = 1615 PSF < 3666 PSF

Footing One-Way Shear Check...

vu @ Left End of Footing	37.682 psi
vu @ Right End of Footing	0.0 psi
vn * phi : Allowable	93.113 psi

Overturning Stability...

	@ Left End of Ftg	@ Right End of Ftg
Overturning Moment	70.790 k-ft	70.790 k-ft
Resisting Moment	211.626 k-ft	129.805 k-ft
Stability Ratio	2.989 : 1	1.834 : 1
.... governing load comb	+0.60D+0.70E	+0.60D+0.70E

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Footing Bending Design...

	@ Left End	@ Right End
Mu	439.741 k-ft	0.0 k-ft
Ru	434.312 psi	0.0 psi
As % Req'd	0.01065 in^2	0.00180 in^2
As Req'd in Footing Width	9.587 in^2	1.944 in^2

P = 20998# (+20)

20998#/(6'x6') = 583 PSF

O.K FOR POINT LOAD

(L): (10)#9

(S): #5 @ 12" O.C.

L15

SEISMIC:

@ Grid 'E': Roof : V = 3070 #

L = 15.33'

V_{wall} = 3070 lb.

V_{wall}' = 3070 lb (V_{wall} x R.F.)

L = 15.33 ft.

H = 10.50 ft.

v_{shear} = 200 plf <TYP

T=C= 2174 lb.

WIND:

@ Grid 'E': Roof : F = 2940 #

L = 15.33'

F_{wall} = 2940 lb.

L = 15.33 ft.

H = 10.50 ft.

v_{shear} = 192 plf <TYP

T=C= 2082 lb.

'MST48'

(3210#)

SEISMIC:

@ Grid 'E': 2nd Flr : V = 4330 #

L = 15.33' + 16.5'

V_{wall} =	2085	lb.	V_{wall} =	2245	lb.
V_{wall}' =	2085	lb (V_{wall} x R.F.)	V_{wall}' =	2245	lb (V_{wall} x R.F.)
L =	15.33	ft.	L =	16.50	ft.
H =	10.50	ft.	H =	10.50	ft.
v_{shear} =	136	plf <TYP	v_{shear} =	136	plf <TYP
T=C=	1476	lb.	T=C=	1473	lb.

WIND:

@ Grid 'E': 2nd Flr : F = 5745 #

L = 15.33' + 16.5'

F_{wall} =	2767	lb.	F_{wall} =	2978	lb.
L =	15.33	ft.	L =	16.50	ft.
H =	10.50	ft.	H =	10.50	ft.
v_{shear} =	180	plf <TYP	v_{shear} =	180	plf <TYP
T=C=	1959	lb.	T=C=	1954	lb.

'HDU2'

(3075#)

SEISMIC:

@ Grid 'E': 1st Flr : V = 5840 #

L = 46' (8" Concrete Shearwall)

WIND:

@ Grid 'E': 1st Flr : F = 7670 #

L = 46' (8" Concrete Shearwall)

$v = 7670^{\#}/46' = 167^{\#}/'$

$V = 5840^{\#}(6.5/5)$ Radj

$= 7590^{\#}$

T/C

: 8" CMC WALL W/ #5@16" O.C. (HOLD)

SEISMIC:

@ Grid 'W': Roof : V = 3070 #

L = 3.46' + 3.56'

V_{wall} =	1513	lb.	V_{wall} =	1557	lb.
V_{wall}' =	1513	lb (V_{wall} x R.F.)	V_{wall}' =	1557	lb (V_{wall} x
L =	3.46	ft.	L =	3.56	ft.
H =	10.50	ft.	H =	10.50	ft.
v_{shear} =	437	plf <W2	v_{shear} =	437	plf <W2
T=C=	5367	lb.	T=C=	5343	lb.

T10#/1 x 2 x 3.46/10.5 = 507#/1 > 437#/1 o.k.

'MST60' (5240#) : CLOSE ENOUGH @ SEIS

WIND:

@ Grid 'W': Roof : F = 2940 #

L = 3.46' + 3.56'

F_{wall} =	1449	lb.	F_{wall} =	1491	lb.
L =	3.46	ft.	L =	3.56	ft.
H =	10.50	ft.	H =	10.50	ft.
v_{shear} =	419	plf <W2	v_{shear} =	419	plf <W2
T=C=	5140	lb.	T=C=	5116	lb.

SEISMIC:

@ Grid 'W': 2nd Flr : V = 4330 #

L = 5.25' + 5.25' + 6.5'

V_{wall} =	1337	lb.	V_{wall} =	1656	lb.
V_{wall}' =	1337	lb (V_{wall} x R.F.)	V_{wall}' =	1656	lb (V_{wall} x R.F.)
L =	5.25	ft.	L =	6.50	ft.
H =	10.50	ft.	H =	10.50	ft.
v_{shear} =	255	plf <TYP	v_{shear} =	255	plf <TYP
T=C=	2955	lb.	T=C=	2898	lb.

'HDU4'

WIND:

@ Grid 'W': 2nd Flr : F = 5745 #

L = 5.25' + 5.25' + 6.5'

F_{wall} =	1774	lb.	F_{wall} =	2197	lb.
L =	5.25	ft.	L =	6.50	ft.
H =	10.50	ft.	H =	10.50	ft.
v_{shear} =	338	plf <TYP	v_{shear} =	338	plf <TYP
T=C=	3921	lb.	T=C=	3845	lb.

SEISMIC:

@ Grid 'W': 1st Flr : V = 5840 #

L = 32' (8" Concrete Shearwall)

V = 5840# (6.5/5) = 7590# Reqd

WIND:

@ Grid 'W': 1st Flr : F = 7670 #

L = 32' (8" Concrete Shearwall)

7670#/32' = 240#/1

: 8" CONC WALL w/ #5 @ 16" O.C (HORIZ)

17

22007 - Strand

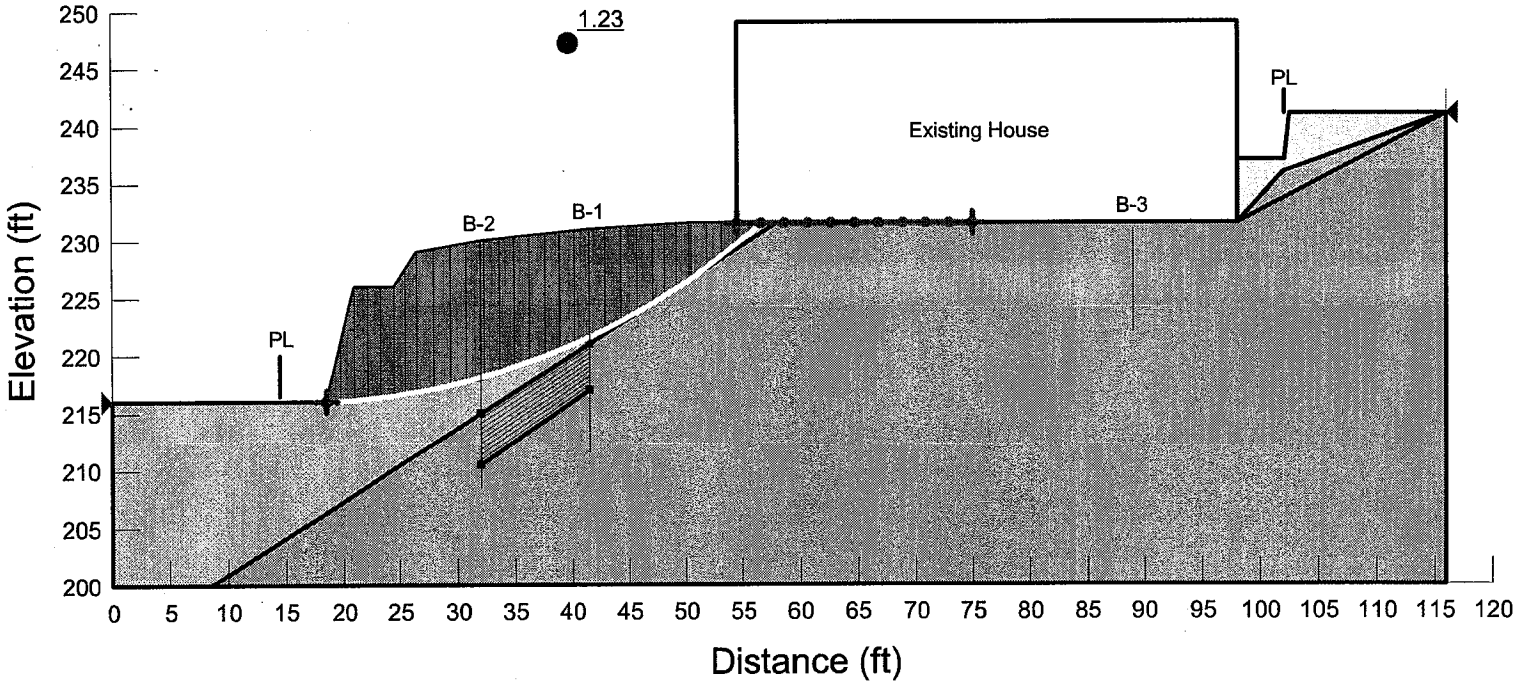
Seismic

Materials
- Loose FILL
- Medium-Dense Silty SAND
- Dense GLACIAL TILL

Name: Loose FILL
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Medium-Dense Silty SAND
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Dense GLACIAL TILL
Unit Weight: 140 pcf
Cohesion': 100 psf
Phi': 40 °



Misc 1

SEISMIC CONSIDERATIONS

In accordance with the International Building Code (IBC), the site class within 100 feet of the ground surface is best represented by Site Class Type D (Stiff Soil). As noted in the USGS website, the mapped spectral acceleration value for a 0.2 second (S_s) and 1.0 second period (S_1) equals 1.41g and 0.49g, respectively.

The IBC and ASCE 7 require that the potential for liquefaction (soil strength loss) during an earthquake be evaluated for the peak ground acceleration of the Maximum Considered Earthquake (MCE), which has a probability of occurring once in 2,475 years (2 percent probability of occurring in a 50-year period). The MCE peak ground acceleration adjusted for site class effects (F_{PGA}) equals 0.67g. The soils beneath the site are not susceptible to seismic liquefaction under the ground motions of the MCE because of their dense nature and the absence of a defined near-surface water table.

Sections 1803.5 of the IBC and 11.8 of ASCE 7 require that other seismic-related geotechnical design parameters (seismic surcharge for retaining wall design and slope stability) include the potential effects of the Design Earthquake. The peak ground acceleration for the Design Earthquake is defined in Section 11.2 of ASCE 7 as two-thirds (2/3) of the MCE peak ground acceleration, or 0.44g.

CONVENTIONAL FOUNDATIONS

The proposed residence can be supported on conventional continuous and spread footings bearing on undisturbed, dense to very dense glacial till. We recommend that continuous and individual spread footings have minimum widths of 12 and 16 inches, respectively. Exterior footings should also be bottomed at least 18 inches below the lowest adjacent finish ground surface for protection against frost and erosion. The local building codes should be reviewed to determine if different footing widths or embedment depths are required. Footing subgrades must be cleaned of loose or disturbed soil prior to pouring concrete. Depending upon site and equipment constraints, this may require removing the disturbed soil by hand.

Thickened slabs are sometimes included in the design to support interior walls. It is important to remember that thickened slab areas support building loads, just like conventional footings do. For this reason, the subgrade below thickened slabs must be prepared in the same way as for conventional footings. All unsuitable soils have to be removed and any structural fill compacted in accordance with the recommendations of this report. We recommend against the use of thickened slabs for most projects, particularly single-family residential, as it is difficult to ensure that the subgrades have been appropriately prepared. Also, the compacted slab fill has to be protected from disturbance by the earthwork, foundation, and utility contractors.

An allowable bearing pressure of 3,000 pounds per square foot (psf) is appropriate for footings supported on dense to very dense glacial till. A one-third increase in this design bearing pressure may be used when considering short-term wind or seismic loads. For the above design criteria, it is anticipated that the total post-construction settlement of footings founded on competent native soil, will be about one inch, with differential settlements on the order of one half-inch in a distance of 50 feet along a continuous footing with a uniform load.

Lateral loads due to wind or seismic forces may be resisted by friction between the foundation and the bearing soil, or by passive earth pressure acting on the vertical, embedded portions of the

foundation. For the latter condition, the foundation must be either poured directly against relatively level, undisturbed soil or be surrounded by level, well-compacted fill. We recommend using the following ultimate values for the foundation's resistance to lateral loading:

PARAMETER	ULTIMATE VALUE
Coefficient of Friction	0.50
Passive Earth Pressure	300 pcf

Where: pcf is Pounds per Cubic Foot, and Passive Earth Pressure is computed using the Equivalent Fluid Density.

If the ground in front of a foundation is loose or sloping, the passive earth pressure given above will not be appropriate. The above ultimate values for passive earth pressure and coefficient of friction do not include a safety factor.

FOUNDATION AND RETAINING WALLS

Retaining walls backfilled on only one side should be designed to resist the lateral earth pressures imposed by the soil they retain. The following recommended parameters are for walls that restrain level backfill:

PARAMETER	VALUE
Active Earth Pressure *	
- Level Backfill	35 pcf
- Eastern Foundation Wall With Adjacent Upslope Walls	55 pcf
Passive Earth Pressure	300 pcf
Coefficient of Friction	0.50
Soil Unit Weight	130 pcf

Where: pcf is Pounds per Cubic Foot, and Active and Passive Earth Pressures are computed using the Equivalent Fluid Pressures.

*** For a restrained wall that cannot deflect at least 0.002 times its height, a uniform lateral pressure equal to 10 psf times the height of the wall should be added to the above active equivalent fluid pressure. This applies only to walls with level backfill.**

The design values given above do not include the effects of any hydrostatic pressures behind the walls and assume that no surcharges, such as those caused by slopes, vehicles, or adjacent foundations will be exerted on the walls. If these conditions exist, those pressures should be added to the above lateral soil pressures. Where sloping backfill is desired behind the walls, we will need to be given the wall dimensions and the slope of the backfill in order to provide the appropriate design earth pressures. The surcharge due to traffic loads behind a wall can typically be accounted for by adding a uniform pressure equal to 2 feet multiplied by the above active fluid density. Heavy construction equipment should not be operated behind retaining and foundation walls within a distance equal to the height of a wall, unless the walls are designed for the additional lateral pressures resulting from the equipment.

MISC3

The values given above are to be used to design only permanent foundation and retaining walls that are to be backfilled, such as conventional walls constructed of reinforced concrete or masonry. It is not appropriate to use the above earth pressures and soil unit weight to back-calculate soil strength parameters for design of other types of retaining walls, such as soldier pile, reinforced earth, modular or soil nail walls. We can assist with design of these types of walls, if desired.

The passive pressure given is appropriate only for a shear key poured directly against undisturbed native soil, or for the depth of level, well-compacted fill placed in front of a retaining or foundation wall. The values for friction and passive resistance are ultimate values and do not include a safety factor. Restrained wall soil parameters should be utilized the wall and reinforcing design for a distance of 1.5 times the wall height from corners or bends in the walls, or from other points of restraint. This is intended to reduce the amount of cracking that can occur where a wall is restrained by a corner.

Wall Pressures Due to Seismic Forces

Per IBC Section 1803.5.12, a seismic surcharge load need only be considered in the design of walls over 6 feet in height. A seismic surcharge load would be imposed by adding a uniform lateral pressure to the above-recommended active pressure. The recommended seismic surcharge pressure for this project is 9**H** pounds per square foot (psf), where **H** is the design retention height of the wall. Using this increased pressure, the safety factor against sliding and overturning can be reduced to 1.2 for the seismic analysis.

Retaining Wall Backfill and Waterproofing

Backfill placed behind retaining or foundation walls should be coarse, free-draining structural fill containing no organics. This backfill should contain no more than 5 percent silt or clay particles and have no gravel greater than 4 inches in diameter. The percentage of particles passing the No. 4 sieve should be between 25 and 70 percent. Drainage composite similar to Miradrain 6000 should be placed against the backfilled retaining walls. The drainage composites should be hydraulically connected to the foundation drain system. Free-draining backfill should be used for the entire width of the backfill where seepage is encountered. For increased protection, drainage composites should be placed along cut slope faces, and the walls should be backfilled entirely with free-draining soil. The later section entitled ***Drainage Considerations*** should also be reviewed for recommendations related to subsurface drainage behind foundation and retaining walls.

The purpose of these backfill requirements is to ensure that the design criteria for a retaining wall are not exceeded because of a build-up of hydrostatic pressure behind the wall. Also, subsurface drainage systems are not intended to handle large volumes of water from surface runoff. The top 12 to 18 inches of the backfill should consist of a compacted, relatively impermeable soil or topsoil, or the surface should be paved. The ground surface must also slope away from backfilled walls at one to 2 percent to reduce the potential for surface water to percolate into the backfill.

Water percolating through pervious surfaces (pavers, gravel, permeable pavement, etc.) must also be prevented from flowing toward walls or into the backfill zone. Foundation drainage and waterproofing systems are not intended to handle large volumes of infiltrated water. The compacted subgrade below pervious surfaces and any associated drainage layer should therefore be sloped away. Alternatively, a membrane and subsurface collection system could be provided below a pervious surface.