

# Structural Calculations Cover Sheet

**Project Number:** 2020.081  
**Project Name:** Trumble residence

**Date:** November 2, 2020  
**Architect:** Suzanne Zahr

**Structural Design For:** Structural design for a new two story garage structure.

**Construction Type:** Conventional wood framed construction with pipe pile foundation.

## CODES

2015 International Building Code (IBC)  
2015 NDS  
ASCE 7-10



## LOADS

Floor Live Load 40 psf

Deck Live Load 60 psf

Dead Loads As required

Roof snow Load 25 psf

Wind 110 mph, Exposure C, Per ASCE 7-10 Section 28,  $K_{zt} = 1.0$

Seismic Per ASCE 7-10 Section 12

Peak Ground Accelerations (PGA) based on USGS Hazards Program 2003, by Lat/Lon.

PGA 1 sec = 0.494    PGA .2 sec = 1.423    %V = .146 \* DL

## Material Design Values

Soils Per Geotech Report by PanGeo, Dated October 30, 2020.

Concrete  $f'_c=2,500$  psi; 5-1/2 sack mix, or alternate mix pre-approved by bldg. dept.

Reinforcing Grade 60;  $F_y=60,000$  psi minimum

Sawn Lumber Joists, Rafters: Hem-Fir #2 and better

Beams: 4x\_: DF-L #2

6x\_: DF-L #2

Posts: DF-L #2

Studs & Plates: Hem-Fir Standard

Glu-Lam Beams 24F-V4 for simple span beams, 24F-V8 for cantilevered beams

Parallam Beams 2.0E PSL,  $F_b=2,900$  psi,  $F_v=290$  psi,  $E=2.0 \times 10^6$  psi (minimum)

Microllam Beams 1.9E LVL,  $F_b=2,600$  psi,  $F_v=285$  psi,  $E=1.9 \times 10^6$  psi (minimum)

Structural Steel ASTM A36,  $F_y=36$  ksi

Steel Pipe ASTM A53, Grade A,  $F_y=35$  ksi

Steel Shapes ASTM A992,  $F_y=50$  ksi

Anchor Bolts F1554 Anchor Bolts, A307 other bolts

CONSULTING STRUCTURAL ENGINEERING SERVICES, INC.

6311 - 17th Avenue NE, Seattle WA 98115 (206) 527-1288 email [john@cses-engineering.com](mailto:john@cses-engineering.com)

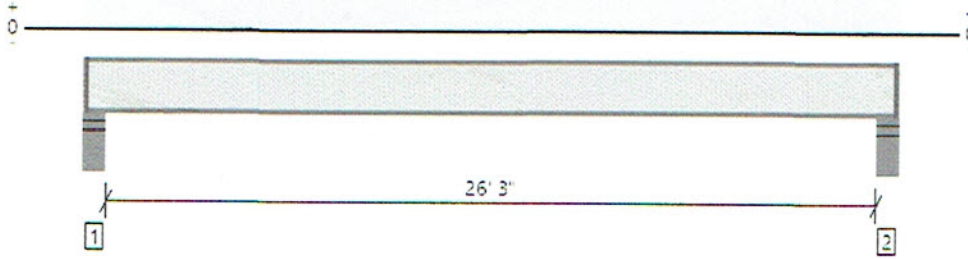
Structural Engineering Consulting and Design



Roof Framing, Roof Deck Joists  
**2 piece(s) 14" TJI® 360 @ 16" OC**

RI

Overall Length: 27' 2"



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)	1887 @ 4 1/2"	3010 (3.50")	Passed (63%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1838 @ 5 1/2"	3910	Passed (47%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	12212 @ 13' 7"	14670	Passed (83%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.704 @ 13' 7"	0.881	Passed (L/451)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	1.231 @ 13' 7"	1.321	Passed (L/257)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	34	Any	Passed	--	--

System : Floor  
 Member Type : Joist  
 Building Use : Residential  
 Building Code : IBC 2015  
 Design Methodology : ASD

- Deflection criteria: LL (L/360) 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 - SPF	5.50"	4.25"	1.75"	815	1087	1902	1 1/4" Rim Board
2 - Stud wall - SPF	5.50"	4.25"	1.75"	815	1087	1902	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' 11" o/c	
Bottom Edge (Lu)	27' o/c	

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

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 27' 2"	16"	45.0	60.0	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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File Name: Trumble

John S. Apolis, P.E. CSES, Inc.

Job number: 2020.081

Project: Trumble

Date: 21-Oct-20

Architect: Suzanne Zahr

Page number: R2

**BEAM DESIGN (Uniform Load+Concentrated Load)**

2015 International Building Code (IBC)

2015 NDS

Beam Description: EAST HEADER

Fully Supported:	1	Snow Load:		Wind Load:	
Repetitive Member:		P.T. Lumber:		Wet Use:	

**Geometry and Loads:**

Span:	15.5 ft	Tributary Width:	14 ft	P@x > (L-x)=	15.5 ft
Add'l uniform DL:		DL unit load:	45 psf	Concentrated DL:	
Add'l uniform LL:		LL unit load:	60 psf	Concentrated LL:	
Add'l uniform SL:		SL unit load:		Concentrated SL:	
Add'l uniform WL:		WL unit load:		Concentrated WL:	

DL Reaction 1:	4883 lbs	DL Reaction 2:	4883 lbs	Note: Design automatically uses load combinations
LL Reaction 1:	6510 lbs	LL Reaction 2:	6510 lbs	
SL Reaction 1:	0 lbs	SL Reaction 2:	0 lbs	
WL Reaction 1:	0 lbs	WL Reaction 2:	0 lbs	
Total Reaction 1:	11393 lbs	Total Reaction 2:	11393 lbs	

**Material Properties:**

E	1.8 msi	E'	1.8 msi
Fb	2400 psi	Fb'	2380 psi
Fv	265 psi	Fv'	265 psi
Fc perp	650 psi	Fc perp'	650 psi
Emin	0.95 msi	Emin'	0.95 msi

**Deflection analysis:**

For total load: Allowed deflection criteria, span/	360		
For LL only: Allowed deflection criteria, span/	480		
Max. allowed total defl:	0.516667 ft in	Max LL defl:	0.3875 in
Total defl. * I:	1060.6	Required I:	2,053 in^4
LL defl. * I:	606.1	Required I:	1,564 in^4
Actual deflections: TOTAL:	0.515 inches		0.294 inches

**Force analysis:**

Max. moment:	44146 ft-lb	Max Shear:	11393 lbs
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**Selected Member: (1) GLB 5.5 x 16.5**

<b>Member properties:</b>	<b>Provided:</b>	<b>Required:</b>
Moment of inertia:	2,058.9 in^4	2,052.8 in^4
Section Modulus:	249.6 in^3	222.6 in^3
Section Area:	90.8 in^2	64.5 in^2
Bearing Area:		17.5 in^2
Minimum bearing dimensions:	5.5 x	3.2 inches



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Page number: R3

**BEAM DESIGN (Uniform Load+Concentrated Load)**

2015 International Building Code (IBC)

2015 NDS

Beam Description: WEST HEADERS

Fully Supported:	1	Snow Load:		Wind Load:	
Repetitive Member:		P.T. Lumber:		Wet Use:	

**Geometry and Loads:**

Span:	8 ft	Tributary Width:	14 ft	P@x > (L-x)=	8 ft
Add'l uniform DL:		DL unit load:	45 psf	Concentrated DL:	
Add'l uniform LL:		LL unit load:	60 psf	Concentrated LL:	
Add'l uniform SL:		SL unit load:		Concentrated SL:	
Add'l uniform WL:		WL unit load:		Concentrated WL:	

DL Reaction 1:	2520 lbs	DL Reaction 2:	2520 lbs	Note: Design automatically uses load combinations
LL Reaction 1:	3360 lbs	LL Reaction 2:	3360 lbs	
SL Reaction 1:	0 lbs	SL Reaction 2:	0 lbs	
WL Reaction 1:	0 lbs	WL Reaction 2:	0 lbs	
Total Reaction 1:	5880 lbs	Total Reaction 2:	5880 lbs	

**Material Properties:**

E	1.8 msi	E'	1.8 msi
Fb	2400 psi	Fb'	2400 psi
Fv	265 psi	Fv'	265 psi
Fc perp	650 psi	Fc perp'	650 psi
Emin	0.95 msi	Emin'	0.95 msi

**Deflection analysis:**

For total load: Allowed deflection criteria, span/	360		
For LL only: Allowed deflection criteria, span/	480		
Max. allowed total defl:	0.266667 ft in	Max LL defl:	0.2 in
Total defl. * I:	75.3	Required I:	282 in^4
LL defl. * I:	43.0	Required I:	215 in^4
Actual deflections:	TOTAL: 0.223 inches		0.127 inches

**Force analysis:**

Max. moment:	11760 ft-lb	Max Shear:	5880 lbs
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**Selected Member: (1) GLB 3.5 x 10.5**

Member properties:	Provided:	Required:
Moment of inertia:	337.6 in^4	282.2 in^4
Section Modulus:	64.3 in^3	58.8 in^3
Section Area:	36.8 in^2	33.3 in^2
Bearing Area:		9.0 in^2
Minimum bearing dimensions:	3.5 x	2.6 inches



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Job number: 2020.081

Project: Trumble

Date: 21-Oct-20

Architect: Suzanne Zahr

Page number: R4

**BEAM DESIGN (Uniform Load+Concentrated Load)**

2015 International Building Code (IBC)

2015 NDS

Beam Description: TYPICAL HEADERS

Fully Supported:	1	Snow Load:		Wind Load:	
Repetitive Member:		P.T. Lumber:		Wet Use:	

**Geometry and Loads:**

Span:	4.5 ft	Tributary Width:	14 ft	P@x > (L-x)=	4.5 ft
Add'l uniform DL:		DL unit load:	45 psf	Concentrated DL:	
Add'l uniform LL:		LL unit load:	60 psf	Concentrated LL:	
Add'l uniform SL:		SL unit load:		Concentrated SL:	
Add'l uniform WL:		WL unit load:		Concentrated WL:	

DL Reaction 1:	1418 lbs	DL Reaction 2:	1418 lbs	Note: Design automatically uses load combinations
LL Reaction 1:	1890 lbs	LL Reaction 2:	1890 lbs	
SL Reaction 1:	0 lbs	SL Reaction 2:	0 lbs	
WL Reaction 1:	0 lbs	WL Reaction 2:	0 lbs	
Total Reaction 1:	3308 lbs	Total Reaction 2:	3308 lbs	

**Material Properties:**

E	1.6 msi	E'	1.6 msi
Fb	900 psi	Fb'	1080 psi
Fv	180 psi	Fv'	180 psi
Fc perp	625 psi	Fc perp'	625 psi
Emin	0.58 msi	Emin'	0.58 msi

**Deflection analysis:**

For total load: Allowed deflection criteria, span/	360		
For LL only: Allowed deflection criteria, span/	480		
Max. allowed total defl:	0.15 ft in	Max LL defl:	0.1125 in
Total defl. * I:	8.5	Required I:	57 in^4
LL defl. * I:	4.8	Required I:	43 in^4
Actual deflections: TOTAL:	0.037 inches		0.021 inches

**Force analysis:**

Max. moment:	3721 ft-lb	Max Shear:	3308 lbs
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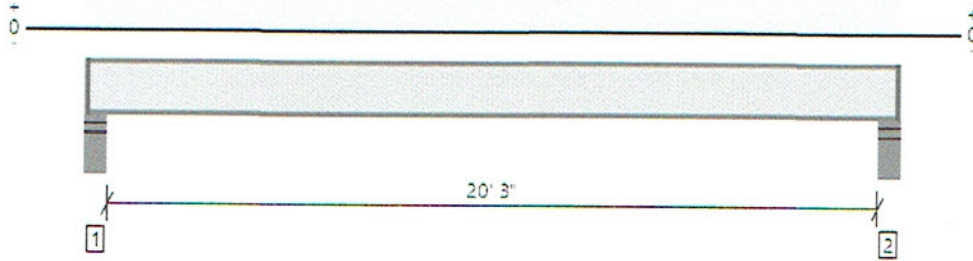
**Selected Member: (1) DF #2 3.5 x 9.25**

Member properties:	Provided:	Required:
Moment of inertia:	230.8 in^4	56.5 in^4
Section Modulus:	49.9 in^3	41.3 in^3
Section Area:	32.4 in^2	27.6 in^2
Bearing Area:		5.3 in^2
Minimum bearing dimensions:	3.5 x	1.5 inches

Upper Floor Framing, Floor Joists  
**1 piece(s) 14" TJI® 110 @ 16" OC**

U1

Overall Length: 21' 2"



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)	768 @ 4 1/2"	1375 (3.50")	Passed (56%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	743 @ 5 1/2"	1860	Passed (40%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	3821 @ 10' 7"	3740	Passed (102%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.470 @ 10' 7"	0.510	Passed (L/521)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.646 @ 10' 7"	1.021	Passed (L/379)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	34	Any	Passed	--	--

System : Floor  
 Member Type : Joist  
 Building Use : Residential  
 Building Code : IBC 2015  
 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 - SPF	5.50"	4.25"	1.75"	212	564	776	1 1/4" Rim Board
2 - Stud wall - SPF	5.50"	4.25"	1.75"	212	564	776	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)	21' o/c	

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

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 21' 2"	16"	15.0	40.0	Default Load

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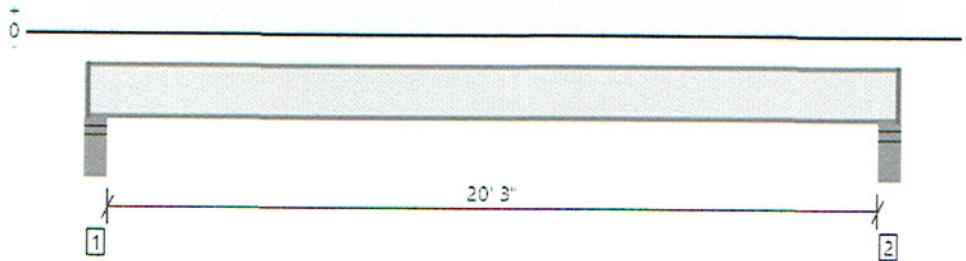




Upper Floor Framing, Deck Joists  
**1 piece(s) 14" TJI® 360 @ 16" OC**

U2

Overall Length: 21' 2"



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)	1048 @ 4 1/2"	1505 (3.50")	Passed (70%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1012 @ 5 1/2"	1955	Passed (52%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	5211 @ 10' 7"	7335	Passed (71%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.498 @ 10' 7"	0.510	Passed (L/492)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.623 @ 10' 7"	1.021	Passed (L/393)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	42	Any	Passed	--	--

System : Floor  
 Member Type : Joist  
 Building Use : Residential  
 Building Code : IBC 2015  
 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 - SPF	5.50"	4.25"	1.75"	212	847	1059	1 1/4" Rim Board
2 - Stud wall - SPF	5.50"	4.25"	1.75"	212	847	1059	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)	4' 5" o/c	
Bottom Edge (Lu)	21' o/c	

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

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 21' 2"	16"	15.0	60.0	Default Load

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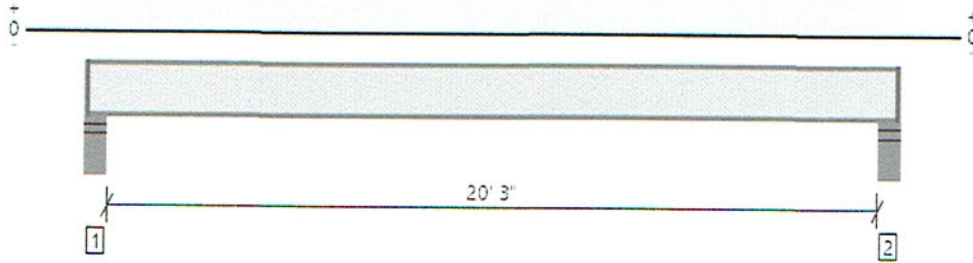
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Upper Floor Framing, Green Floor Joists  
**1 piece(s) 14" TJI® 360 @ 16" OC**

U3

Overall Length: 21' 2"



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)	1188 @ 4 1/2"	1505 (3.50")	Passed (79%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1148 @ 5 1/2"	1955	Passed (59%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	5905 @ 10' 7"	7335	Passed (81%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.332 @ 10' 7"	0.510	Passed (L/737)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.706 @ 10' 7"	1.021	Passed (L/347)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	42	Any	Passed	--	--

System : Floor  
 Member Type : Joist  
 Building Use : Residential  
 Building Code : IBC 2015  
 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 - SPF	5.50"	4.25"	2.19"	635	564	1199	1 1/4" Rim Board
2 - Stud wall - SPF	5.50"	4.25"	2.19"	635	564	1199	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)	4' 1" o/c	
Bottom Edge (Lu)	21' o/c	

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

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 21' 2"	16"	45.0	40.0	Default Load

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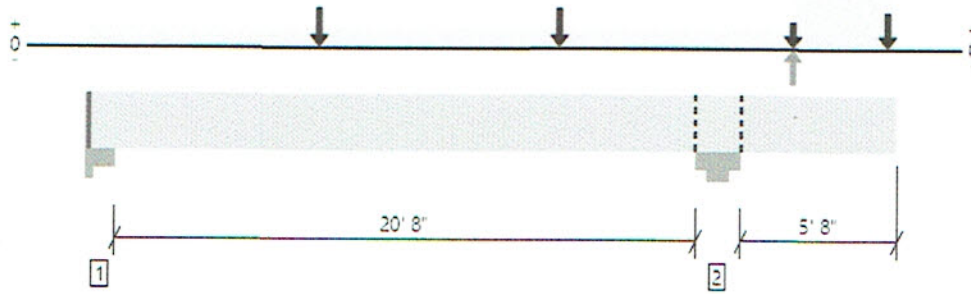
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File Name: Trumble



Upper Floor Framing, West Garage Beam  
**1 piece(s) 5 1/2" x 24" 24F-V4 DF Glulam**

Overall Length: 27' 10"



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)	31913 @ 21' 8 1/2"	39325 (11.00")	Passed (81%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	17975 @ 19' 3"	23320	Passed (77%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	92459 @ 8'	98242	Passed (94%)	1.00	1.0 D + 1.0 L (Alt Spans)
Neg Moment (Ft-lbs)	-42555 @ 21' 8 1/2"	80717	Passed (53%)	1.00	1.0 D + 1.0 L (Alt Spans)
Live Load Defl. (in)	0.384 @ 11' 1 3/8"	0.708	Passed (L/665)	--	1.0 D + 1.0 L (Alt Spans)
Total Load Defl. (in)	0.634 @ 10' 11 1/8"	1.063	Passed (L/402)	--	1.0 D + 1.0 L (Alt Spans)

System : Floor  
 Member Type : Flush Beam  
 Building Use : Residential  
 Building Code : IBC 2015  
 Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Overhang deflection criteria: LL (2L/360) and TL (2L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume factor of 0.93 that was calculated using length L = 20' 1 3/4".
- Critical negative moment adjusted by a volume factor of 0.99 that was calculated using length L = 10' 7 3/4".
- Upward deflection on right cantilever exceeds 0.4".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Wind	Total	
1 - Column Cap - steel	7.00"	5.75"	3.86"	6117	7724/-1072	-1537	13841/-2609	1 1/4" Rim Board
2 - Column Cap - steel	11.00"	11.00"	8.93"	14806	17107	1537	33450	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)	14' 5" o/c	
Bottom Edge (Lu)	27' 9" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Wind (1.60)	Comments
0 - Self Weight (PLF)	1 1/4" to 27' 10"	N/A	32.1	--	--	
1 - Uniform (PSF)	0 to 27' 10" (Front)	3' 9"	30.0	40.0	-	Default Load
2 - Point (lb)	8' (Front)	N/A	5040	6720	-	
3 - Point (lb)	16' 3" (Front)	N/A	5040	6720	-	
4 - Point (lb)	24' 3" (Front)	N/A	2520	3360	-10050	Omega = 2.5
5 - Uniform (PSF)	24' 3" to 27' 8" (Front)	13' 6"	45.0	60.0	-	
6 - Uniform (PLF)	0 to 27' 10" (Front)	N/A	80.0	-	-	Wall
7 - Point (lb)	27' 6" (Front)	N/A	-	-	10050	Omega = 2.5

ForteWEB Software Operator	Job Notes
Evan Apolis CSES, Inc (206) 369-3984 episoen@gmail.com	Trumble 2020.081



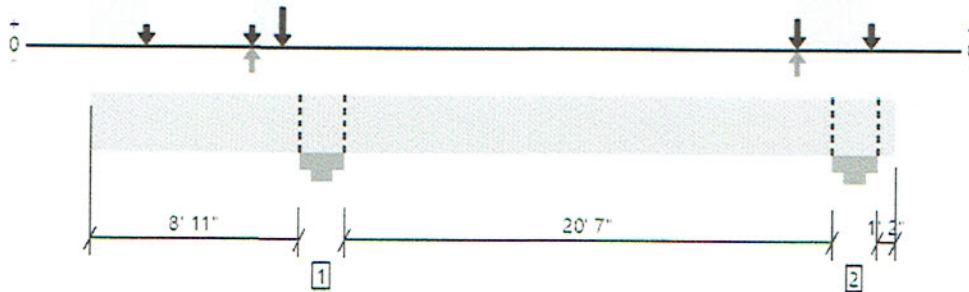


Upper Floor Framing, East Garage Beam  
1 piece(s) 6 3/4" x 24" 24F-V8 DF Glulam

Left cantilever exceeds the maximum braced cantilever length of 7'.  
An excessive uplift of -2269 lbs at support located at 30' 10 1/2" failed this product.

OKAY BY  
DETAILING

Overall Length: 32' 6"



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)	30645 @ 9' 4 1/2"	48263 (11.00")	Passed (63%)	--	1.0 D + 1.0 L (Adj Spans)
Shear (lbs)	17639 @ 6' 11"	28620	Passed (62%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	25794 @ 28' 6"	125016	Passed (21%)	1.00	1.0 D + 1.0 L (Alt Spans)
Neg Moment (Ft-lbs)	-86419 @ 9' 4 1/2"	85962	Passed (101%)	1.00	1.0 D + 1.0 L (Alt Spans)
Live Load Defl. (in)	0.497 @ 0	0.625	Passed (2L/452)	--	1.0 D + 1.0 L (Alt Spans)
Total Load Defl. (in)	0.816 @ 0	0.938	Passed (2L/276)	--	1.0 D + 1.0 L (Alt Spans)

System : Floor  
Member Type : Flush Beam  
Building Use : Residential  
Building Code : IBC 2015  
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Overhang deflection criteria: LL (2L/360) and TL (2L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Moment capacity over cantilever support 1 has been reduced by 25% to lessen the effects of buckling.
- Critical positive moment adjusted by a volume factor of 0.96 that was calculated using length L = 11' 5 1/8".
- Critical negative moment adjusted by a volume factor of 0.88 that was calculated using length L = 27' 2 7/8".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Seismic	Total	
1 - Column Cap - steel	11.00"	11.00"	6.98"	14638	16007	1490/-1490	32135/-1490	Blocking
2 - Column Cap - steel	11.00"	11.00"	3.43"	5778	8208/-1625	8194/-8194	22180/-9819	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)	32' 6" o/c	
Bottom Edge (Lu)	32' 6" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Seismic (1.60)	Comments
0 - Self Weight (PLF)	0 to 32' 6"	N/A	39.4	--	--	
1 - Uniform (PSF)	0 to 2' 3" (Front)	14'	45.0	60.0	-	Default Load
2 - Point (lb)	2' 3" (Front)	N/A	1339	1785	-	
3 - Point (lb)	6' 6" (Front)	N/A	1339	1785	-7537	omega = 2.5
4 - Uniform (PSF)	6' 6" to 7' 9" (Front)	14'	45.0	60.0	-	
5 - Point (lb)	28' 6" (Front)	N/A	4882	6510	-7537	omega = 2.5
6 - Uniform (PSF)	28' 6" to 31' 6" (Front)	14'	45.0	60.0	-	
7 - Point (lb)	7' 9" (Front)	N/A	4882	6510	7537	omega = 2.5
8 - Uniform (PLF)	0 to 32' 6" (Front)	N/A	80.0	-	-	
9 - Point (lb)	31' 6" (Front)	N/A	-	-	7537	omega = 2.5

FortewEB Software Operator	Job Notes
Evan Apolls CSES, Inc (206) 369-3984 episoen@gmail.com	Trumble 2020.081





John S. Apolis, P.E.

CSES, Inc.

Job number: 202.081

Project: Trumble

Date: 27-Oct-20

Architect:

Page number: 06

**Post Design (Combined Axial and Moment Loading)**

2015 International Building Code (IBC)

2015 NDS

Beam Description: SOUTH HEAVY BEAM POSTS

Enter '1' for wind load:

Enter '1' for repetitive member:

Enter '1' for wet use:

**Geometry and loads:**

Height	7 ft	w(d)	20.482 plf
P	33450 lbs	w(b)	0 plf
	<i>REF U4</i>		
Le(d)	7 ft	Le(b)	1 ft

**Material Properties:**

Fb1	2400 psi	Fb(d)'	2400 psi
Fb2	2400 psi	Fb(b)'	2400 psi
Fc	2500 psi	Fc'	1859 psi
E	1.8 x10 <sup>6</sup> psi	E'	1.8 x10 <sup>6</sup> psi
Emin	0.915 x10 <sup>6</sup> psi	Emin'	0.915 x10 <sup>6</sup> psi

**Selected Member:** PSL 5.25 x 5.25

b

d

**Member properties:**

Section Modulus (d):	24.1 in <sup>3</sup>
Section Modulus (b):	24.1 in <sup>3</sup>
Section Area:	27.6 in <sup>2</sup>

**Variables:**

Rb(d)	4.00
Rb(b)	1.51
c	0.8

**Member stresses: Provided**

FcE(d)	2938 psi	>
FcE(b)	143962 psi	>
FbE	68625 psi	>
FbE	68625 psi	>

**Required**

fc	1214 psi
fc	1214 psi
fb(d)	62 psi
fb(b)	0 psi

**Bending and Axial Compression Check:**

NDS 2010 EQ 3.9-3 0.47 < 1.0

John S. Apolis, P.E.

CSES, Inc.

Job number: 202.081

Project: Trumble

Date: 27-Oct-20

Architect:

Page number: 07

**Post Design (Combined Axial and Moment Loading)**

2015 International Building Code (IBC)

2015 NDS

Beam Description: NE HEAVY POST

Enter '1' for wind load:

Enter '1' for repetitive member:

Enter '1' for wet use:

Geometry and loads:

Height	10 ft	w(d)	20.482 plf
P	32135 lbs	w(b)	0 plf
	<i>REFUS</i>		
Le(d)	10 ft	Le(b)	1 ft

Material Properties:

Fb1	2400 psi	Fb(d)'	2400 psi
Fb2	2400 psi	Fb(b)'	2400 psi
Fc	2500 psi	Fc'	1212 psi
E	1.8 x10 <sup>6</sup> psi	E'	1.8 x10 <sup>6</sup> psi
Emin	0.915 x10 <sup>6</sup> psi	Emin'	0.915 x10 <sup>6</sup> psi

**Selected Member: PSL 7 x 5.25**

Member properties:

Section Modulus (d):	32.2 in <sup>3</sup>
Section Modulus (b):	42.9 in <sup>3</sup>
Section Area:	36.8 in <sup>2</sup>

Variables:

Rb(d)	5.52
Rb(b)	1.13
c	0.8

Member stresses: Provided

FcE(d)	1440 psi	>
FcE(b)	255933 psi	>
FbE	36028 psi	>
FbE	36028 psi	>

Required

fc	874 psi
fc	874 psi
fb(d)	96 psi
fb(b)	0 psi

Bending and Axial Compression Check:

NDS 2010 EQ 3.9-3 0.62 < 1.0



John S. Apolis, P.E.

CSES, Inc.

Job number: 2020.081

Project: Trumble

Date: 27-Oct-20

Architect:

Page number: 08

**BEAM DESIGN (Uniform Load+Concentrated Load)**

2015 International Building Code (IBC)

2015 NDS

Beam Description: SOUTH BEAM

Fully Supported:	1	Snow Load:		Wind Load:	
Repetitive Member:		P.T. Lumber:		Wet Use:	

**Geometry and Loads:**

Span:	27 ft	Tributary Width:	2 ft	P@x > (L-x)=	27 ft
Add'l uniform DL:	80 lbs/ft	DL unit load:	45 psf	Concentrated DL:	
Add'l uniform LL:	40 lbs/ft	LL unit load:	60 psf	Concentrated LL:	
Add'l uniform SL:		SL unit load:		Concentrated SL:	
Add'l uniform WL:		WL unit load:		Concentrated WL:	

DL Reaction 1:	2295 lbs	DL Reaction 2:	2295 lbs	Note: Design automatically uses load combinations
LL Reaction 1:	2160 lbs	LL Reaction 2:	2160 lbs	
SL Reaction 1:	0 lbs	SL Reaction 2:	0 lbs	
WL Reaction 1:	0 lbs	WL Reaction 2:	0 lbs	
Total Reaction 1:	4455 lbs	Total Reaction 2:	4455 lbs	

**Material Properties:**

E	2 msi	E'	2 msi
Fb	2900 psi	Fb'	2772 psi
Fv	290 psi	Fv'	290 psi
Fc perp	625 psi	Fc perp'	625 psi
Emin	0.914 msi	Emin'	0.914 msi

**Deflection analysis:**

For total load: Allowed deflection criteria, span/	240		
For LL only: Allowed deflection criteria, span/	360		
Max. allowed total defl:	1.35 ft in	Max LL defl:	0.9 in
Total defl. * I:	1973.0	Required I:	1,461 in^4
LL defl. * I:	956.6	Required I:	1,063 in^4
Actual deflections: TOTAL:	1.160 inches		0.562 inches

**Force analysis:**

Max. moment:	30071 ft-lb	Max Shear:	4455 lbs
--------------	-------------	------------	----------

**Selected Member: (1) PSL 3.5 x 18**

Member properties:	Provided:	Required:
Moment of inertia:	1,701.0 in^4	1,461.5 in^4
Section Modulus:	189.0 in^3	130.2 in^3
Section Area:	63.0 in^2	23.0 in^2
Bearing Area:		7.1 in^2
Minimum bearing dimensions:	3.5 x	2.0 inches

John S. Apolis, P.E.

CSES, Inc.

Job number: 2020.081

Project: Trumble

Date: 27-Oct-20

Architect:

Page number: 09

**BEAM DESIGN (Uniform Load+Concentrated Load)**

2015 International Building Code (IBC)

2015 NDS

Beam Description: NE BEAM

Fully Supported:	1	Snow Load:		Wind Load:	
Repetitive Member:		P.T. Lumber:		Wet Use:	

**Geometry and Loads:**

Span:	11.5 ft	Tributary Width:	4 ft	P@x > (L-x)=	8.5 ft
Add'l uniform DL:		DL unit load:	15 psf	Concentrated DL:	540 lbs
Add'l uniform LL:		LL unit load:	40 psf	Concentrated LL:	560 lbs
Add'l uniform SL:		SL unit load:		Concentrated SL:	
Add'l uniform WL:		WL unit load:		Concentrated WL:	

DL Reaction 1:	744 lbs	DL Reaction 2:	486 lbs	Note: Design automatically uses load combinations
LL Reaction 1:	1334 lbs	LL Reaction 2:	1066 lbs	
SL Reaction 1:	0 lbs	SL Reaction 2:	0 lbs	
WL Reaction 1:	0 lbs	WL Reaction 2:	0 lbs	
Total Reaction 1:	2078 lbs	Total Reaction 2:	1552 lbs	

**Material Properties:**

E	2 msi	E'	2 msi
Fb	2900 psi	Fb'	2851 psi
Fv	290 psi	Fv'	290 psi
Fc perp	625 psi	Fc perp'	625 psi
Emin	0.914 msi	Emin'	0.914 msi

**Deflection analysis:**

For total load: Allowed deflection criteria, span/		240	
For LL only: Allowed deflection criteria, span/		360	
Max. allowed total defl:	0.575 ft in	Max LL defl:	0.38333333 in
Total defl. * I:	65.1	Required I:	113 in^4
LL defl. * I:	42.6	Required I:	111 in^4
Actual deflections:	TOTAL: 0.081 inches		0.053 inches

**Force analysis:**

Max. moment:	5474 ft-lb	Max Shear:	2078 lbs
--------------	------------	------------	----------

**Selected Member: (1) PSL 3.5 x 14**

Member properties:	Provided:	Required:
Moment of inertia:	800.3 in^4	113.1 in^4
Section Modulus:	114.3 in^3	23.0 in^3
Section Area:	49.0 in^2	10.7 in^2
Bearing Area:		3.3 in^2
Minimum bearing dimensions:	3.5 x	0.9 inches



John S. Apolis, P.E.

CSES, Inc.

Job number: 2020.081

Project: Trumble

Date: 27-Oct-20

Architect:

Page number: 010

**BEAM DESIGN (Uniform Load+Concentrated Load)**

2015 International Building Code (IBC)

2015 NDS

Beam Description: GARAGE ENTRY HEADER

Fully Supported:	1	Snow Load:		Wind Load:	
Repetitive Member:		P.T. Lumber:		Wet Use:	

**Geometry and Loads:**

Span:	3.5 ft	Tributary Width:	15 ft	P@x > (L-x)=	3.5 ft
Add'l uniform DL:		DL unit load:	15 psf	Concentrated DL:	
Add'l uniform LL:		LL unit load:	40 psf	Concentrated LL:	
Add'l uniform SL:		SL unit load:		Concentrated SL:	
Add'l uniform WL:		WL unit load:		Concentrated WL:	

DL Reaction 1:	394 lbs	DL Reaction 2:	394 lbs	Note: Design automatically uses load combinations
LL Reaction 1:	1050 lbs	LL Reaction 2:	1050 lbs	
SL Reaction 1:	0 lbs	SL Reaction 2:	0 lbs	
WL Reaction 1:	0 lbs	WL Reaction 2:	0 lbs	
Total Reaction 1:	1444 lbs	Total Reaction 2:	1444 lbs	

**Material Properties:**

E	1.6 msi	E'	1.6 msi
Fb	900 psi	Fb'	1170 psi
Fv	180 psi	Fv'	180 psi
Fc perp	625 psi	Fc perp'	625 psi
Emin	0.58 msi	Emin'	0.58 msi

**Deflection analysis:**

For total load: Allowed deflection criteria, span/	240		
For LL only: Allowed deflection criteria, span/	360		
Max. allowed total defl:	0.175 ft in	Max LL defl:	0.116666667 in
Total defl. * I:	1.7	Required I:	10 in^4
LL defl. * I:	1.3	Required I:	11 in^4
Actual deflections: TOTAL:	0.016 inches		0.011 inches

**Force analysis:**

Max. moment:	1263 ft-lb	Max Shear:	1444 lbs
--------------	------------	------------	----------

**Selected Member: (1) DF #2 3.5 x 7.25**

Member properties:	Provided:	Required:
Moment of inertia:	111.1 in^4	10.9 in^4
Section Modulus:	30.7 in^3	13.0 in^3
Section Area:	25.4 in^2	12.0 in^2
Bearing Area:		2.3 in^2
Minimum bearing dimensions:	3.5 x	0.7 inches

Use menu item Settings > Printing & Title Block to set these five lines of information for your program.

Project Name/Number : trumble  
 Title Short Retaining Wall  
 Dsgnr:  
 Description....

Page : 1  
 Date: 5 NOV 2020

This Wall in File: c:\users\lepis\documents\retainpro 10 project files\trumble.rpx

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### Cantilevered Retaining Wall

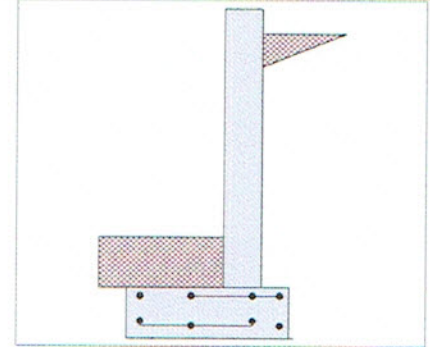
Code: IBC 2018,ACI 318-14,TMS 402-16

#### Criteria

Retained Height = 5.00 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 = 2,000.0 psf  
 Equivalent Fluid Pressure Method  
 Active Heel Pressure = 35.0 psf/ft  
 Passive Pressure = 300.0 psf/ft  
 Soil Density, Heel = 130.00 pcf  
 Soil Density, Toe = 130.00 pcf  
 Footing||Soil Friction = 0.350  
 Soil height to ignore for passive pressure = 0.00 in



#### Surcharge Loads

Surcharge Over Heel = 0.0 psf  
 NOT Used To Resist Sliding & Overturning  
 Surcharge Over Toe = 0.0  
 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 = 0.0 psf  
 (Service Level)

#### 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 = Line Load  
 Base Above/Below Soil = 0.0 ft  
 at Back of Wall  
 Poisson's Ratio = 0.300

#### Axial Load Applied to Stem

Axial Dead Load = 0.0 lbs  
 Axial Live Load = 400.0 lbs  
 Axial Load Eccentricity = 0.0 in

#### Earth Pressure Seismic Load

Method : Uniform  
 Multiplier Used = 8.000  
 (Multiplier used on soil density)

Uniform Seismic Force = 48.000  
 Total Seismic Force = 288.000

#### Design Summary

**Wall Stability Ratios**  
 Overturning = 2.04 OK  
 Sliding = 1.51 OK

Total Bearing Load = 2,269 lbs  
 ...resultant ecc. = 0.32 in

Soil Pressure @ Toe = 702 psf OK  
 Soil Pressure @ Heel = 628 psf OK  
 Allowable = 2,000 psf  
 Soil Pressure Less Than Allowable

ACI Factored @ Toe = 983 psf  
 ACI Factored @ Heel = 880 psf  
 Footing Shear @ Toe = 5.9 psi OK  
 Footing Shear @ Heel = 4.9 psi OK  
 Allowable = 75.0 psi

**Sliding Calcs**  
 Lateral Sliding Force = 831.6 lbs  
 less 100% Passive Force = - 600.0 lbs  
 less 100% Friction Force = - 654.1 lbs  
 Added Force Req'd = 0.0 lbs OK  
 ...for 1.5 Stability = 0.0 lbs OK

#### Stem Construction

**Bottom**  
 Design Height Above Ftg ft = Stem OK  
 0.00  
 Wall Material Above "Ht" = Concrete  
 Design Method = LRFD  
 Thickness = 8.00  
 Rebar Size = # 4  
 Rebar Spacing = 12.00  
 Rebar Placed at = Edge

**Design Data**  
 fb/FB + fa/Fa = 0.326

**Total Force @ Section**  
 Service Level lbs =  
 Strength Level lbs = 940.0

**Moment....Actual**  
 Service Level ft-# =  
 Strength Level ft-# = 1,766.7  
 Moment....Allowable = 5,412.6

**Shear.....Actual**  
 Service Level psi =  
 Strength Level psi = 12.5  
 Shear.....Allowable psi = 75.0

Anet (Masonry) in2 =  
 Rebar Depth 'd' in = 6.25

#### Masonry Data

f<sub>m</sub> psi =  
 F<sub>s</sub> psi =  
 Solid Grouting =  
 Modular Ratio 'n' =  
 Wall Weight psf = 100.0  
 Short Term Factor =  
 Equiv. Solid Thick. =  
 Masonry Block Type = Medium Weight  
 Masonry Design Method = ASD

#### Concrete Data

f<sub>c</sub> psi = 2,500.0  
 F<sub>y</sub> psi = 60,000.0

Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures.

#### Load Factors

Building Code IBC 2018,ACI  
 Dead Load 1.200  
 Live Load 1.600  
 Earth, H 1.600  
 Wind, W 1.000  
 Seismic, E 1.000



Use menu item Settings > Printing & Title Block  
to set these five lines of information  
for your program.

Project Name/Number : trumble  
Title Short Retaining Wall  
Dsgnr:  
Description....

Page : *FR*  
Date: 5 NOV 2020

This Wall in File: c:\users\lepis\documents\retainpro 10 project files\trumble.rpx

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### Cantilevered Retaining Wall

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

#### Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0662 in <sup>2</sup> /ft		
(4/3) * As :	0.0883 in <sup>2</sup> /ft	Min Stem T&S Reinf Area 1.056 in <sup>2</sup>	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in <sup>2</sup> /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in <sup>2</sup> /ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in <sup>2</sup> /ft	Horizontal Reinforcing Options :	
	=====	One layer of :	Two layers of :
Required Area :	0.1728 in <sup>2</sup> /ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2 in <sup>2</sup> /ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in <sup>2</sup> /ft	#6@ 27.50 in	#6@ 55.00 in

#### Footing Data

Toe Width	=	1.75 ft
Heel Width	=	1.17
Total Footing Width	=	2.92
Footing Thickness	=	12.00 in
Key Width	=	12.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	2.00 ft
f <sub>c</sub> =	2,500 psi	F <sub>y</sub> = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0012
Cover @ Top	2.00	@ Btm = 3.00 in

#### Footing Design Results

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	983	880 psf
Mu' : Upward	=	17,680	111 ft-#
Mu' : Downward	=	6,174	383 ft-#
Mu: Design	=	959	272 ft-#
Actual 1-Way Shear	=	5.89	4.93 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	# 4 @ 12.00 in	
Heel Reinforcing	=	# 4 @ 12.00 in	
Key Reinforcing	=	None Spec'd	
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@ 13.88 in, #5@ 21.52 in, #6@ 30.55 in, #7@ 41.66 in, #8@ 54.86 in, #9@ 6  
Heel: #4@ 13.88 in, #5@ 21.52 in, #6@ 30.55 in, #7@ 41.66 in, #8@ 54.86 in, #9@ 6  
Key: No key defined

Min footing T&S reinf Area	0.76	in <sup>2</sup>
Min footing T&S reinf Area per foot	0.26	in <sup>2</sup> /ft
If one layer of horizontal bars:		If two layers of horizontal bars:
#4@ 9.26 in		#4@ 18.52 in
#5@ 14.35 in		#5@ 28.70 in
#6@ 20.37 in		#6@ 40.74 in

Use menu item Settings > Printing & Title Block to set these five lines of information for your program.

Project Name/Number : trumble  
 Title Short Retaining Wall  
 Dsgnr:  
 Description....

Page : 3  
 Date: 5 NOV 2020

This Wall in File: c:\users\lepis\documents\retainpro 10 project files\trumble.rpx

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 License : KW-06061297  
 License To : CSES, Inc

### Cantilevered Retaining Wall

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

#### Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING.....			.....RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
HL Act Pres (ab water tbl)	630.0	2.00	1,260.0	Soil Over HL (ab. water tbl)	325.2	2.67	867.3
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		2.67	867.3
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 =	400.0	2.08	
Added Lateral Load =				* Axial Live Load on Stem =	400.0	2.08	833.3
Load @ Stem Above Soil =				Soil Over Toe =	227.5	0.88	199.1
Seismic Earth Load =	201.6	3.00	604.8	Surcharge Over Toe =			
=				Stem Weight(s) =	550.0	2.08	1,145.8
<b>Total</b> =	<b>831.6</b>	<b>O.T.M. =</b>	<b>1,864.8</b>	Earth @ Stem Transitions =			
				Footing Weight =	437.6	1.46	638.2
				Key Weight =		2.50	
				Vert. Component =	328.7	2.92	958.7
<b>Resisting/Overturning Ratio</b> =		<b>2.04</b>		<b>Total =</b>	<b>1,868.9 lbs</b>	<b>R.M. =</b>	<b>3,809.1</b>
Vertical Loads used for Soil Pressure =		2,268.9 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 considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS 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) 0.037 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.



# RETAINING WALL PILE DESIGN

~~TALL WALL -  $M = 19,831^{ft-lb}$  ARM = 4.92'  $P = 4,030^{plf}$  @ TOE~~

~~(SEE F1-F3) HEEL  $P = 6,836^{plf} - 4,030^{plf} = 2,806^{plf}$~~

~~TOE PILES:  $\frac{12,000}{4,030^{plf}} \approx 3'$  3" PILES @ 3' O.C.~~

~~HEEL PILES:  $\frac{12,000}{2,806^{plf}} = 4.28$  3" PILES @ 4' O.C. ← (LD)~~

~~MEDIUM WALL -  $M = 8,899^{ft-lb}$   $P = \frac{8,899}{3.5} = 2,543^{plf}$  @ TOE~~

~~(SEE F4-F6)~~

~~HEEL  $P = 3,884^{plf} - 2,543^{plf} = 1,341^{plf}$~~

~~TOE PILES:  $\frac{12,000}{2,543} = 4.72'$  3" PILES @ 4' O.C.~~

~~HEEL PILES:  $\frac{12,000}{1,341} = 8.94$  3" PILES @ 8' O.C.~~

~~SHORT WALL -  $M = 2,637^{ft-lb}$   $P = \frac{2,637}{1.92} = 1,374^{plf}$  @ TOE~~

~~(SEE F7-F9)~~

~~HEEL  $P = 2,032^{plf} - 1,374^{plf} = 658^{plf}$~~

~~TOE PILES:  $\frac{12,000}{1,374} = 8.73'$  3" PILES @ 8' O.C.~~

~~HEEL PILES:  $\frac{12,000}{658} = 18.23$  3" PILES @ 12' O.C.~~

## CONSULTING STRUCTURAL ENGINEERING SERVICES

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Project Name TRUMBLE

Comments \_\_\_\_\_

Revision \_\_\_\_\_ Page F27



## FOOTING PILE DESIGN

3"  $\times$  PILE CAP = 12"<sup>2</sup>

4"  $\times$  PILE CAP = 20"<sup>2</sup>

$$\text{TYPICAL FOOTING WEIGHT} = (0.67' \times 3' + 1' \times 2') \times 150 \text{ pcf} \approx 600 \text{ plf}$$

$$\text{N \& S GARAGE WALLS } W = 15' \times 55 \text{ psf} + 80 \text{ plf} + 600 \text{ plf} = 1,505 \text{ plf}$$

$$12,000^{\#} / 1,505 \text{ plf} = 7.97' \text{ SAY } 8' \text{ O.C.}$$

$$\text{NORTH WALL } W = 5' \times 55 \text{ psf} + 80 \text{ plf} + 658 \text{ plf} = 1,013 \text{ plf}$$

$$12,000^{\#} / 1,013 \text{ plf} = 11.8' \text{ SAY } 8' \text{ O.C.}$$

EAST & WEST GARAGE WALLS - 12' O.C. BY INSPECTION

HEAVY POSTS (2 CASES, SEE U4, U5)

$$33,450^{\#} < 40,000^{\#} \quad (2) \text{ 4" } \times \text{ PILES}$$

MEDIUM POSTS (1 CASE, SEE U4)

$$13,841^{\#} < 20,000^{\#} \quad \text{4" } \times \text{ PILE}$$

LIGHT POSTS (2 CASES, SEE U8, L5(SW7))

$$4,455^{\#} < 12,000^{\#} \quad \text{3" } \times \text{ PILE}$$

SOLDIER PILE

$$\text{CAP} = 15' \times 11' \times 1' + 18' \times 11' \times 2 \times 1' \times 11' = 160' >> 33.4' \text{ OK}$$

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Revision \_\_\_\_\_ Page F5



John S. Apolis, P.E.

CSES, Inc.

Job number: 2020.081

Project:

Trumble

Date: 10-Nov-20

Architect:

Suzanne Zahr

Page number: F6

**Soldier Pile Design**

2015 International Building Code (IBC)

AISC 14th

Piling Geometry:

Height:	10.0'	Spacing:	8'	Concrete Section:	
Embedment:	18.0'	Soil Ignored:	2'	D:	24.00"
Pile Size:	<b>W16x57</b>				
Pile Depth:	16.40"	Pile Width:	7.12"	Pile rx:	6.72"
Pile tw:	0.43"	Pile tf:	0.72"	Pile ry:	1.60"
Pile Ix:	758.0 in <sup>4</sup>	Pile Sx:	92.2 in <sup>3</sup>	Pile Cw:	2660
Pile Iy:	43.1 in <sup>4</sup>	Pile Zx:	105.0 in <sup>3</sup>	Pile J:	2.22
		Pile Zy:	18.9 in <sup>3</sup>		

Soil Pressures:

Active Pressure:	45 pcf	Surcharge:	80 psf
Passive Pressure:	300 pcf	D Multiplier:	2

Forces and Moments:

(distances are measured from bottom of pile)

Top Active Force:	18.0 k	At x =	21.3'	Overturning M:	8591 k-in
Bottom Active Force:	30.8 k	At x =	6.0'		
Surcharge Force:	6.4 k	At x =	23.0'	Resisting M:	13824 k-in
Passive Capacity:	192.0 k	At x =	6.0'	S.F.:	1.61
	<b>OK</b>				<b>OK</b>

Pile Stresses:

Max Shear:	24.4 k	r Inflection Point:	8.4'	Max Moment:	2905 k-in
------------	--------	---------------------	------	-------------	-----------

Pile Design:

E:	29000 ksi	Fy:	50 ksi		
$\Omega_b$ :	1.67	$\Omega_v$ :	1.5	$\Omega$ :	1.67
Lp:	285"	Lr:	220"	Lb:	235"
rts:	1.92"	c:	1	ho:	15.69"
b/t:	4.98	<	9.15	<b>OK</b>	
h/tw:	38.14	<	53.95	<b>OK</b>	
Mn (F2-1):	3144 k-in	>	2905 k-in	<b>OK</b>	
Vn/ $\Omega_v$ (G2-1):	141.0 k	>	24.4 k	<b>OK</b>	
Flange Rn/ $\Omega$ (J10-1):	267.6 k	>	1.8 k	<b>OK</b>	
Weak Axis Yielding (F6-1):	565.9 k	<	2905 k-in	<b>NG</b>	
Bi-Axial Bending (H1-1b):	6.057686959	>	1.00	<b>NG</b>	

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Project: Trumble

Date: 10-Nov-20

Architect:

Page number: F7

**BEAM DESIGN (Uniform Load+Concentrated Load)**

2015 International Building Code (IBC)

2015 NDS

Beam Description: LAGGING DESIGN

Fully Supported:	<input type="text"/>	Snow Load:	<input type="text"/>	Wind Load:	<input type="text"/>
Repetitive Member:	1	P.T. Lumber:	1	Wet Use:	<input type="text"/>

**Geometry and Loads:**

Span:	8 ft	Tributary Width:	1 ft	P@x > (L-x)=	8 ft
Add'l uniform DL:	<input type="text"/>	DL unit load:	250 psf	Concentrated DL:	<input type="text"/>
Add'l uniform LL:	<input type="text"/>	LL unit load:	<input type="text"/>	Concentrated LL:	<input type="text"/>
Add'l uniform SL:	<input type="text"/>	SL unit load:	<input type="text"/>	Concentrated SL:	<input type="text"/>
Add'l uniform WL:	<input type="text"/>	WL unit load:	<input type="text"/>	Concentrated WL:	<input type="text"/>

DL Reaction 1:	1000 lbs	DL Reaction 2:	1000 lbs	Note: Design automatically uses load combinations
LL Reaction 1:	0 lbs	LL Reaction 2:	0 lbs	
SL Reaction 1:	0 lbs	SL Reaction 2:	0 lbs	
WL Reaction 1:	0 lbs	WL Reaction 2:	0 lbs	
Total Reaction 1:	1000 lbs	Total Reaction 2:	1000 lbs	

**Material Properties:**

E	1.1 msi	E'	1.045 msi
Fb	675 psi	Fb'	869 psi
Fv	140 psi	Fv'	112 psi
Fc perp	405 psi	Fc perp'	405 psi
Emin	0.4 msi	Emin'	0.38 msi

**Deflection analysis:**

For total load: Allowed deflection criteria, span/	240		
For LL only: Allowed deflection criteria, span/	480		
Max. allowed total defl:	0.4 ft in	Max LL defl:	0.2 in
Total defl. * I:	22.0	Required I:	55 in^4
LL defl. * I:	0.0	Required I:	0 in^4
Actual deflections:	TOTAL: 0.141 inches		0.000 inches

**Force analysis:**

Max. moment:	2000 ft-lb	Max Shear:	1000 lbs
--------------	------------	------------	----------

**Selected Member: (1) HF #2 11.25 x 5.5**

Member properties:	Provided:	Required:
Moment of inertia:	156.0 in^4	55.1 in^4
Section Modulus:	56.7 in^3	27.6 in^3
Section Area:	61.9 in^2	13.4 in^2
Bearing Area:		2.5 in^2
Minimum bearing dimensions:	11.3 x	0.2 inches



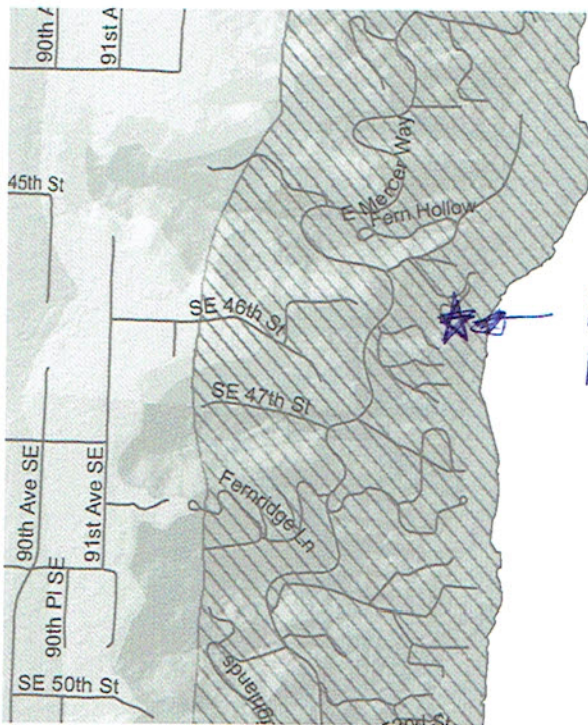
# 4602 E Mercer Way, Mercer Island, WA 98040, USA

Latitude, Longitude: 47.5634773, -122.2101121



<b>Date</b>	10/21/2020, 11:39:46 AM
<b>Design Code Reference Document</b>	ASCE7-16
<b>Risk Category</b>	II
<b>Site Class</b>	D - Default (See Section 11.4.3)

Type	Value	Description
$S_S$	1.423	$MCE_R$ ground motion. (for 0.2 second period)
$S_1$	0.494	$MCE_R$ ground motion. (for 1.0s period)
$S_{MS}$	1.708	Site-modified spectral acceleration value
$S_{M1}$	null -See Section 11.4.8	Site-modified spectral acceleration value
$S_{DS}$	1.139	Numeric seismic design value at 0.2 second SA
$S_{D1}$	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA



EXP C  
 $K_{zt} = 1.0$



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Job number: 2020.081

Project: Trumble

Date: 21-Oct-20

Designer:

Page number: L 1

**Lateral Loads Design per ASCE 7-10, Wind: Section 28 Seismic: Section 12**

**(Simplified Envelope Procedure Part 2)**

2015 International Building Code (IBC)

**WIND LOADS** 110 mph Basic Wind Speed 2015 NDS  
 $Ps = \lambda * Kzt * Ps(30) * 0.6$  Exposure C Roof Slope: 0.00 : 12 = 0.0  
 Least Horizontal Dimension, feet: 35 Mean Roof Ht, feet: 24 (degrees)  
 $\lambda = 1.34$  a = 3.5 ft, 2a = 7.0 ft  
 $Iw = 1.00$  KzT = 1.00

<u>Tabulated Ps(30):</u> (Refer to ASCE 7-10, Figure 28.6-1)	<u>Zone</u>	<u>Tabulated Wind Pressure</u>	<u>Calc'd Design Pressure</u>	<u>Min Design Pressure</u>	(Per section 28.6.4 minimum wind pressure is 16 PSF for zones A,C, and 8 PSF for zones B, D)
(horizontal)	A	19.2 psf	15.4	15.4	
"	B	-10.0 psf	-8.0	8.0	
"	C	12.7 psf	10.2	12.8	
"	D	-5.9 psf	-4.7	6.4	
(vertical)	E	-23.1 psf	-18.5		
"	F	-13.1 psf	-10.5		
"	G	-16.0 psf	-12.8		
"	H	-10.1 psf	-8.1		
(uplift on overhangs)	E(oh)	-32.3 psf	-25.9		
"	G(oh)	-25.3 psf	-20.3		

**(Equivalent Lateral Force Procedure, Section 12.8)**

**SEISMIC LOADS**  $Ie = 1.0$   $R = 6.5$  ASCE 7-10, Table 12.2.1  
 Seismic Parameters Group I Site Class: D  
 per ASCE 7-10) PGA (.2 sec) 1.423  $Fa = 1.00$  ASCE 7-10 Table 11.4-1  
 PGA (1 sec) 0.494  $Fv = 1.60$  ASCE 7-10 Table 11.4-2

**Seismic Design Categories per ASCE 7-10 Tables 11.6-1, 11.6-2**

Based on Sds: D Based on Sd1: D  
 PGA's based on peak ground accelerations per latest USGS Hazards Program (based on lat/lon).  
 $Ss = 1.4230$   $Sms = Fa * Ss = 1.42$  Equation 11.4-1  
 $S1 = 0.4940$   $Sml = Fv * S1 = 0.79$  Equation 11.4-2

Equations 11.4-3, 11.4-4  $Sds = 2/3 * Sms = 0.95$   $Sd1 = 2/3 * Sml = 0.53$   
 Equation 12.14-11  $Cs$  (or %V) =  $(Sds / (R/I)) = 0.146$  **Building period < 0.5 s per IBC eq 12.8-7**

**Base Shear = %V \* W \* 0.7 = 7.66 psf**, uniformly distributed over floor area  
 (0.7 reduction factor per ASCE 7-10, Section 2.4.1, Eq 5 (seismic vertical distribution per IBC eqs 12.8-11 & 12)

	<u>Roof or Floor Wall DL (psf)</u>	<u>Story Height Above Base (ft)</u>	<u>Lateral Load (psf)</u>
Base = top of foundation	<u>DL (psf)</u>	<u>dist. over floor area</u>	
Top Framing	45	6	6.38
Main Floor	12	9	1.29
Lower Floor			0.00
<b>Total Seismic DL:</b>	<b>75</b>	Sum	<b>7.66</b>



SHEAR WALL DESIGN - NORTH WALL - UPPER FLOOR - L = 8'

$$P_W = 10' \times 7' \times 15.4 \text{ psc} + 10' \times 10.5' \times 12.8 \text{ psc} = 2,422^\#$$

$$P_E = 17.9' \times 27' \times 6.38 \text{ psc} = \underline{3,015^\#}$$

$$V = 3,015^\# / 8' = 377 \text{ plf} < 550 \text{ plf } \underline{SW3}$$

$$\text{UPLIFT} = 377 \text{ plf} \times 10' = 3,768^\# < 4,585^\# \underline{CMSTC16}$$

SOUTH WALL - L = 27'

$$P_W = 2,422^\# \quad P_E = 3,015^\# \quad V = \frac{3,015^\#}{27'} = 112 \text{ plf} < 230 \text{ plf } \underline{SW1}$$

$$\text{UPLIFT} = 112 \text{ plf} \times 10' = 1,117^\# < 1,705^\# \underline{CS16}$$

EAST WALL - L = 6.5' + 3.5' = 10'

$$P_W = 10' \times 7' \times 15.4 \text{ psc} + 10' \times 6.5' \times 12.8 \text{ psc} = 1,910^\#$$

$$P_E = 3,015^\# \quad V = \frac{3,015^\#}{10'} = 302 \text{ plf} < 350 \text{ plf } \underline{SW2}$$

$$\text{UPLIFT} = 302 \text{ plf} \times 10' = 3,015^\# < 3,410^\# \underline{(2)CS16}$$

$$\text{ASPECT RATIO: } 302 \text{ plf} \left( 1.25 + 0.125 \times \frac{10}{3.5} \right) = 338 \text{ plf} < 350 \text{ plf } \underline{OK}$$

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Project No. 2020-081 Date 10/23/20  
Project Name TRUMBLE  
Comments \_\_\_\_\_  
Revision \_\_\_\_\_ Page L2



WEST WALL - UPPER FLOOR - L = 3.5' + 4' = 7.5'

$$P_W = 1,910^\# \quad P_E = 9,015^\# \quad V = \frac{3,015^\#}{7.5'} = 402 \text{ plf}$$

$$402 \text{ plf} / (1.25 - 0.125 \times \frac{10}{3.5}) = 450 \text{ plf} < 550 \text{ plf} \quad \underline{\text{SW3}}$$

$$\text{UPLIFT} = 402 \text{ plf} \times 10' = 4,020^\# < 4,490^\# \quad \underline{\text{MSTC66B3}}$$

NORTH WALL - MAIN FLOOR - L = 23'

$$P_W = 10' \times 5.5' \times 15.4 \text{ psf} + 2,422^\# = \underline{3,269^\#}$$

$$P_E = 5.5' \times 27' \times 1.29 \text{ psf} + 3,015^\# = 3,206^\#$$

$$V = \frac{3,269^\#}{23'} = 142 \text{ plf} < 230 \text{ plf} \quad \underline{\text{SW1}}$$

$$\text{UPLIFT} = 142 \text{ plf} \times 10' = 1,421^\# < 2,215^\# \quad \underline{\text{HDU2}}$$

$$1,421^\# + 4,020^\# = 5,441^\# < 5,820^\# \quad \underline{\text{HDUE}}$$

CENTRAL E-W WALL - L = 18' + 18' = 36'

$$P_W = 15' \times 10' \times 12.8 \text{ psf} = \underline{1,920^\#}$$

$$P_E = (15' \times 40' \times 1.29 \text{ psf} + 10' \times 4' \times 30 \text{ psf} \times 0.146 \times 0.7) \times 1.3 = 1,166^\#$$

$$V = \frac{1,920^\#}{36'} = 53 \text{ plf} < 100 \text{ plf} \quad \underline{\text{UNBLOCKED WALL ON}}$$

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Project Name TRUMBLE

Comments \_\_\_\_\_

Revision \_\_\_\_\_ Page L3



SOUTH WALL - MAIN FLOOR - L = 41'

$$P_w = 10' \times 7.5' \times 15.4 \text{ psf} + 10' \times 8.5' \times 12.8 \text{ psf} + 2,422^{\#} = 4,665^{\#}$$

$$P_E = (16' \times 40' \times 1.29 \text{ psf} + 10' \times 6' \times 30 \text{ psf} \times 0.146 \times 0.7 + 3,015^{\#}) \times 1.3 = 5,232^{\#}$$

$$V = \frac{5,232^{\#}}{41'} = 128 \text{ plf} < 230 \text{ plf } \underline{SW1}$$

$$\text{UPLIFT} = 128 \text{ plf} \times 10' = 1,276^{\#} < 2,215^{\#} \underline{HDU2}$$

EAST WALL - L = 1.67' \times 2 + 1.83 = 5.17'

$$P_w = (5' \times 7.5' \times 15.4 \text{ psf} + 5' \times 6.5' \times 12.8 \text{ psf}) \times (7 + 34.5) / 41 + 5' \times 14.5' \times 12.8 \text{ psf} + 5' \times 7.5' \times 15.4 \text{ psf} = 4,444^{\#}$$

$$P_E = 3,015^{\#} \times (7 + 34.5) / 41 + 34' \times 20' \times 1.29 \text{ psf} = 3,929^{\#}$$

$$V = \frac{4,444^{\#}}{5.17'} = 860 \text{ plf} < 910 \text{ plf } \underline{SW5} \quad 860 \times (1.25 - 0.125 \times \frac{4}{1.67}) = 905^{\#}$$

$$\text{UPLIFT1} = 860 \text{ plf} \times 3' = 2,580^{\#} < 4,065^{\#} \underline{HDU5}$$

$$\text{UPLIFT2} = \frac{4,444^{\#}}{21'} \times 3' + 2,580^{\#} = 3,215^{\#} < 4,065^{\#} \underline{HDU5}$$



WEST WALL - L=4' (MAIN FLOOR, GATE WALL)

$$P_w = (5' \times 7.5' \times 15.4 \text{ psf} + 5' \times 6.5' \times 12.8 \text{ psf} + 1,910 \#) \times \left( \frac{7+34}{34} \right) \\ + 5' \times 5' \times 15.4 \text{ psf} + 5' \times 15' \times 12.8 \text{ psf} = 4,847 \#$$

$$P_E = \left( 3,015 \# \times \frac{(7+34)}{34} + 34' \times 20' \times 1.29 \text{ psf} + 10' \times 5' \times 30 \text{ psf} \times 0.146 \times 0.7 \right) \\ = 4,666 \#$$

$$V = \frac{4,666 \#}{4'} = 1,167 \text{ plf} < 1,420 \text{ plf SW 7}$$

$$\text{UPLIFT} = 1,167 \text{ plf} \times 9.5' + 4,020 \# = 15,107 \# < 15,510 \# \text{ HD12} \\ < 15,996 \# \text{ PABO, dc=11", F=16.5"}$$

GARAGE WEST WALL - L=1.67 \times 2 + 1.83 = 5.17'

$$P_w = 3.5' \times 8' \times 15.4 \text{ psf} = 432 \#$$

$$P_E = \left( 2' \times 21' \times 1.29 \text{ psf} + 10' \times 5' \times 30 \text{ psf} \times 0.146 \times 0.7 \right) \times 1.3 = 269 \#$$

$$V = \frac{432}{5.17} = 84 \text{ plf} < 100 \text{ plf UNBLOCKED DIAPHRAGM OK}$$

$$84 \text{ plf} \times 6' = 501 \# < 2,215 \# \text{ HDV2}$$

DIAPHRAGM CHECKS - EAST:

$$4,444 \# / 21 = 211 < 230 \text{ plf SW1}$$

$$\text{SOUTH} - \frac{5,232 \#}{27} = 194 \text{ plf} < 230 \text{ plf SW1}$$

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Comments \_\_\_\_\_

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Page LS