SUPPLEMENTAL ANALYSIS FOR: MEI YOUNG SITE:

8251 WEST MERCER WAY MERCER ISLAND, WA 98040





 DATE:
 PLAN NUMBER:
 PHILLIPS STRUCTURAL ENGINEERING, PLLC

 OCT. 30, 2018
 WEN HU RESIDENCE
 P.O. BOX 108, MILTON, WA 98354 Phone (253) 344-1686

STRUCTURAL ENGINEERING CALCULATIONS

PHILLIPS STRUCTURAL ENGINEERING

The enclosed documents are to be used in conjunction with the plans referenced on the cover page. It is imperative that the contractor study and understand the engineering requirements and required changes to the architectural plan prior to start of work. Modifications may include additional foundations or footings, beam size changes, sheathing changes etc.

Scope of Engineering: Engineering analysis and design to resist lateral and gravity loads in accordance with the 2015 IBC have been performed and incorporated into stamped "S" sheets. All analyses and calculations are included in this engineering report (see 8½x11 pages). Engineering assumptions are listed below. If the conditions listed below are not present at the site, all calculations and stamped drawings are void and *Phillips Structural Engineering* must be contacted immediately.

LOADING CRITERIA

Building Code 2015 International Building Code (IBC)

Seismic Design Catagory (SDC) D
Ss (Short Period) 1.47
S1 (1 Second Period) 0.56
Response Mod. Coeff. (R) 6.5
Seismic Site Class D

Basic Wind Speed (3 Sec) 110 MPH Exposure C

LIVE LOADS (psf) U.N.O.

-Uninhabitable attics without storage	10
-Uninhabitable attics with storage	20
-Habitable attics and sleeping areas	30
-Deck Framing	60
-All other areas	40

DEAD LOADS (psf) U.N.O.

-Roof with composition roofing	20
-Floor	15

SNOW LOADS (psf) U.N.O.

-Flat Roof Snow (Reduced from Ground) 30

SOILS CRITERIA

Soils Consultant PanGEO Soils Report # 17-405

Allowable Pressure Req'd 3000 psf (Verify w/ Site Conditions)

Frost Bearing Depth 18"

PHILLIPS STRUCTURAL ENGINEERING, PLLC P.O. BOX 108 MILTON, WA 98354 Phone (253) 344-1666

Phillips Structural Engineering, PLLC WER HU Edgewood, Washington Project Job No.: (8.097 By: TA Date: (5/17/9 Client: CHIMMEY (29.5-1) FL= QZ (GCf) AF Af= 4 × 7.5 G= 0.85 1/2=25/2=10: Cf=1.2 (2=30') g = 0.00256KzKztKar F.=27.3(.85)(1.2) 130\$ (SOZ# A)0) (\$02" A)0)

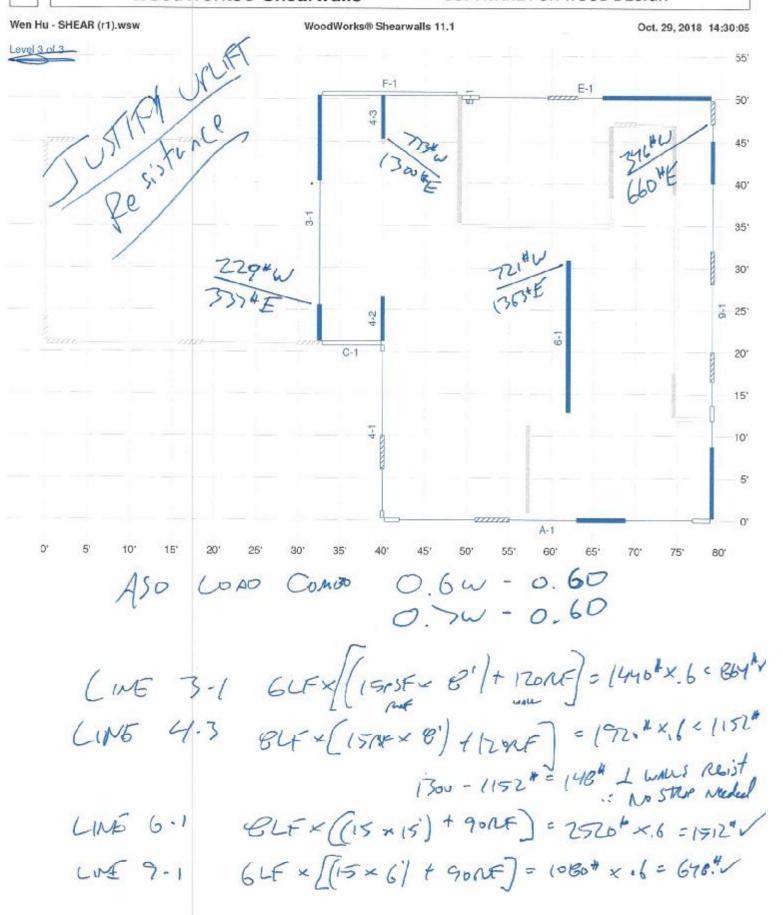
M.TM = 7.5/x 902# = 1881 ft#.

Q= 27.3/pst

Tunger = 1881 ft

Z:5 = 752# Z;(Z) T522 d(

T = 502# - 2.5' = 100 MF (MINIMAL SHKAR Registing) V= 110







Oct. 17, 2019 08:10

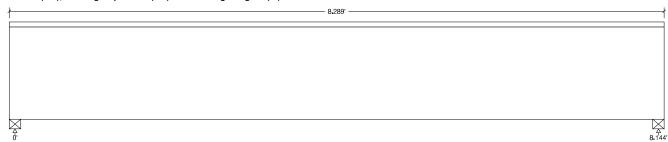
Design Check Calculation Sheet

WoodWorks Sizer 11.

Loads:

	Load	Type	Distribution	Pat- tern	Location Start	[ft] End	Magnitude Start End	Unit
	Load1	Dead	Full Area				20.00(18.00')	psf
	Load2	Snow	Full Area				30.00(18.00')	psf
ı	Solf-weight	Dead	Eull HDL				15 3	nlf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):



1554 2238		1554 2238
3792		3792
		3792
4199		4199
1.00		1.00
0.90		0.90
		#2 1.73
		1.73
1.00		1.00
1.00		1.00
		1.11 625
	3792 4199 1.00 0.90 #2 1.73 1.73 1.00	2238 3792 4199 1.00 0.90 42 1.73 1.73 1.73 1.73 1.71 1.00 1.00 1.00

PSL, 2.0E, 2900Fb, 3-1/2"x14" Supports: All - Timber-soft Beam, D.Fir-L No.2 Total length: 8.29"; Clear span: 8"; volume = 2.8 cu.ft. Lateral support: top= full, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 79	Fv' = 334	psi	fv/Fv' = 0.24
Bending(+)	fb = 797	Fb' = 3335	psi	fb/Fb' = 0.24
Live Defl'n	$0.03 = \langle L/999$	0.27 = L/360	in	0.12
Total Defl'n	$0.07 = \langle L/999$	0.41 = L/240	in	0.17

Additional Data:

Addition	iai Data	1.										
FACTORS:	F/E(p	si)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	290	1.15	-	1.00	-	-	-	-	1.00	-	1.00	2
Fb'+	2900	1.15	-	1.00	1.000	1.00	-	1.00	1.00	-	-	2
Fcp'	625	-	-	1.00	-	-	-	-	1.00	-	-	-
E'	2.0 m	illion	-	1.00	-	-	-	-	1.00	-	-	2
Eminy'	1.04 m	illion	-	1.00	-	-	-	-	1.00	-	-	2
CRITICAL I	LOAD COM	MB NATIO	NS:									
Shear	: LC	#2 = D+	s, v	max =	3727,	V desi	gn =	2593	lbs			
Bending	(+): LC	#2 = D+	S, M	= 75	89 lbs-	ft						
Deflect:	ion: LC	#2 = D+	-S (live)								
	LC	#2 = D+	-S (total)								
	L=live S						e Lc=	concent	rated 1	E=eart	thquake	
All LC's	s are li	sted in	the .	Analysi	s outpu	t						
	mbinatio	ns: ASCE	7-1	0 / IBC	2015							
CALCULAT	ONS:											
Deflect:	ion: EI	= 160	1e06	lb-in2								
"Live"	deflecti	on = Def	lect	ion fro	m all n	on-dead	lloads	s (live	, wind	, snow	v)	
Total De	eflectio	n = 1.50	(Dea	d Load	Deflect	ion) +	Live 1	Load De	flecti	on.		

- Design Notes:

 1. WoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. SCI-BEAMS (Structural Composite Lumber): the attached SCL selection is for preliminary design only. For final member design contact your local SCL manufacturer.

 4. Size factors vary from one manufacturer to another for SCL materials. They can be changed in the database editor.

 5. FIRE RATING: LVL, PSL and LSL are not rated for fire endurance.





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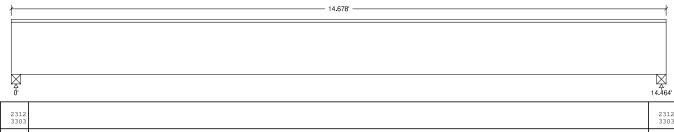
Design Check Calculation Sheet

WoodWorks Sizer 11.

Loads:

l	Load	Type	Distribution	Pat-	Location	[ft]	Magnitud	ie	Unit
ı				tern	Start	End	Start	End	
ı	Load1 Load2	Dead	Full Area				20.00(15.	.00')	psf
ı	Load2	Snow	Full Area				30.00(15.	.00')	psf
ı	Self-weight	Dead	Full UDL				15.3		plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):



	Dead Snow ctored:	2312 3303	2312 3303
	Total aring:	5615	5615
	aring: apacity		
	Beam	5615	5615
	Support	6217	6217
	es ratio		1 1
	Beam	1.00	1.00
	Support	0.90	0.90
	Load comb		#2
	ength	2.57	2.57
M	lin req'd	2.57	2.57
	b	1.00	1.00
	b min	1.00	1.00
C	b support	1.11	1.11
	cp sup	625	625

PSL, 2.0E, 2900Fb, 3-1/2"x14" Supports: All - Timber-soft Beam, D.Fir-L No.2 Total length: 14.68; 'Clear span: 14.25; 'volume = 5.0 cu.ft. Lateral support: top= full, bottom= at supports:

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 140	Fv' = 334	psi	fv/Fv' = 0.42
Bending(+)	fb = 2101	Fb' = 3335	psi	fb/Fb' = 0.63
Live Defl'n	0.28 = L/626	0.48 = L/360	in	0.57
Total Dofile	0 57 - T/305	0 72 - T /240	4 m	0.70

Additional Data:

FACTORS:	F/E(p	si)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	290	1.15	-	1.00	-	-	-	-	1.00	-	1.00	2
Fb'+	2900	1.15	-	1.00	1.000	1.00	-	1.00	1.00	-	-	2
Fcp'	625	-	-	1.00	-	-	-	-	1.00	-	-	-
E'	2.0 m	illion	-	1.00	-	-	-	-	1.00	-	-	2
Eminy'	1.04 m	illion	-	1.00	-	-	-	-	1.00	-	-	2

Eminy' 1.04 million - 1.00 - - - - 1.00 - - - CRITICAL LOAD COMBINATIONS:

Shear : LC #2 = D+\$, V max = 5535, V design = 4560 lbs

Bending(+): LC #2 = D+\$, M = 20014 lbs-ft

Deflection: LC #2 = D+\$ (live)

LC #2 = D+\$ (total)

D-dead L-live S-snow W-wind I-impact Lr-roof live Lc-concentrated E-earthquake

All LC's are listed in the Analysis output

Load combinations: ASCE 7-10 / IBC 2015

CALCULATIONS:

Load combinations. AGCS / 10 / 10 CALCULATIONS:

Deflection: EI = 1601e06 lb-in2

"Live" deflection = Deflection from all non-dead loads (live, wind, snow...)

Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.

- Design Notes:

 1. WoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. SCI-BEAMS (Structural Composite Lumber): the attached SCL selection is for preliminary design only. For final member design contact your local SCL manufacturer.

 4. Size factors vary from one manufacturer to another for SCL materials. They can be changed in the database editor.

 5. FIRE RATING: LVL, PSL and LSL are not rated for fire endurance.





Oct. 18, 2019 10:01

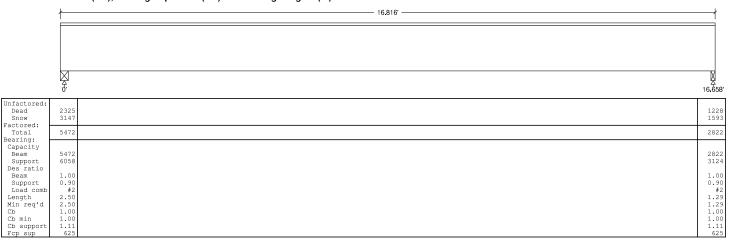
Design Check Calculation Sheet

WoodWorks Sizer 11.

Loads:

Load	Type	Distribution	Pat-	Location	[ft]	Magnitude	Unit
			tern	Start	End	Start End	
Loadl	Dead	Full Area				20.00(2.00')	psf
Load2	Snow	Full Area				30.00(2.00')	psf
Load3	Dead	Point		2.54		314	lbs
Load4	Snow	Point		2.54		428	lbs
Load5	Dead	Point		5.29		2312	lbs
Load6	Snow	Point		5.29		3303	lbs
Self-weight	Dead	Full UDL				15.3	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):



PSL, 2.0E, 2900Fb, 3-1/2"x14" Supports: All - Timber-soft Beam, D.Fir-L No.2 Total length: 16.82"; Clear span: 16.5"; volume = 5.7 cu.ft. Lateral support: top=full, bottom= at supports

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 163	Fv' = 334	psi	fv/Fv' = 0.49
Bending(+)	fb = 2595	Fb' = 3335	psi	fb/Fb' = 0.78
Live Defl'n	0.37 = L/546	0.56 = L/360	in	0.66
Total Defl'n	0.77 = L/258	0.83 = L/240	in	0.93

Additional Data:

FACTORS:	F/E(p	si)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	290	1.15	-	1.00	-	-	-	-	1.00	-	1.00	2
Fb'+	2900	1.15	-	1.00	1.000	1.00	-	1.00	1.00	-	-	2
Fcp'	625	-	-	1.00	-	-	-	-	1.00	-	-	-
E'	2.0 m	illion	-	1.00	-	-	-	-	1.00	-	-	2
Deciment.	1 04 m	41114an		1 00					1 00			2

Eminy' 1.04 million - 1.00 - - - - 1.00 - - CRITICAL LOAD COMBINATIONS:
Shear : LC #2 = D+S, V max = 5461, V design = 5315 lbs
Bending(+): LC #2 = D+S, M = 24724 lbs-ft
Deflection: LC #2 = D+S (live)
LC #2 = D+S (total)
D-dead L-live S-snow W-wind I-impact Lr-roof live Lc-concentrated E-earthquake
All LC's are listed in the Analysis output
Load combinations: ASCE 7-10 / IBC 2015
CALCULATIONS:

CALCULATIONS:
Deflection: EI = 1601e06 lb-in2
"Live" deflection = Deflection from all non-dead loads (live, wind, snow...)
Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.

- 1. WoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement. 2. Please verify that the default deflection limits are appropriate for your application.
 3. SCL-BEAMS (Structural Composite Lumber): the attached SCL selection is for preliminary design only. For final member design contact your local SCL manufacturer.
 4. Size factors vary from one manufacturer to another for SCL materials. They can be changed in the database editor.
 5. FIRE RATING: LVL, PSL and LSL are not rated for fire endurance.





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Design Check Calculation Sheet

Loads:

ı	Load	Type	Distribution	Pat-	Location	[ft]	Magnitude		Unit
ı				tern	Start	End	Start	End	
ı		Dead	Full Area	No			20.00(14.5	('0	psf
ı		Snow	Full Area	Yes			30.00(14.5	0')	psf
ı	Self-weight	Dead	Full UDL	No			15.3		plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) : - 13 87° -13.794 Unfactored:
Dead
Snow
Factored:
Total
Bearing:
Capacity
Beam
Support
Des ratio
Beam
Support
Load comb
Length
Min req'd
Cb
min
Cb support 6296 4037 6507 6296

| Ecp sup | 625|
**Minimum bearing length governed by the required width of the supporting member.

Maximum reaction on at least one support is from a different load combination than the critical one for bearing design, shown here, due to Kd factor. See Analysis results for reaction from critical load combination.

PSL, 2.0E, 2900Fb, 3-1/2"x14"
Supports: All - Timber-soft Beam, D.Fir-L No.2
Total length: 13.87; Clear span: 2.5; 11; volume = 4.7 cu.ft.
Lateral support: top= full. bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 105	Fv' = 334	psi	fv/Fv' = 0.31
Bending(+)	fb = 1124	Fb' = 3335	psi	fb/Fb' = 0.34
Bending(-)	fb = 264	Fb' = 3043	psi	fb/Fb' = 0.09
Deflection:				
Interior Live	$0.09 = \langle L/999$	0.37 = L/360	in	0.24
Total	0.18 = L/758	0.56 = L/240	in	0.32
Cantil. Live	-0.06 = L/502	0.17 = L/180	in	0.36
Total	-0.12 = T/264	0.26 - T/120	in	0.45

Additional Data:

FACTORS:	F/E(p	si)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Ci	Cn	LC#	
Fv'	290	1.15	-	1.00	-	-	-	-	1.00	-	1.00	2	
Fb '+	2900	1.15	-	1.00	1.000	1.00	-	1.00	1.00	-	-	4	
Fb'-	2900	1.15	-	1.00	0.912	1.00	-	1.00	1.00	-	-	2	
Fcp'	625	-	-	1.00	-	-	-	-	1.00	-	-	-	
E'	2.0 m	illion	-	1.00	-	-	-	-	1.00	-	-	4	
Eminy'	1.04 m	illion	-	1.00	-	-	-	-	1.00	-	-	4	

Eminy 1.00 million 1.00 - - - 1.00 - 1.00

Design Notes:

Design Notes.

1. WoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

2. Please verify that the default deflection limits are appropriate for your application.

3. SCLEEAMS (Siructural Composite Lumber): the attached SCL selection is for preliminary design only. For final member design contact your local SCL manufacturer.

4. Size lactors vary from one manufacture to another for SCL materials. They can be changed in the database editor.

5. FIRER TATING LVL, PSL and LSL are not rated for fire endurance.

6. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design





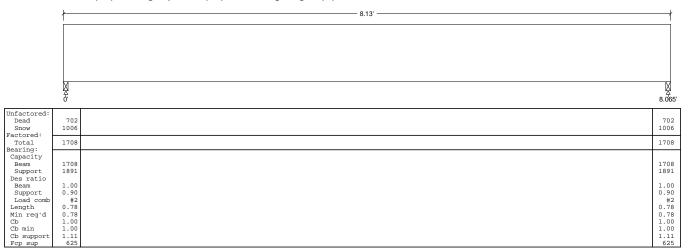
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Design Check Calculation Sheet

Loads:

l	Load	Type	Distribution	Pat-	Location	[ft]	Magnitude	Unit
l				tern	Start	End	Start End	
ı	Loadl	Dead	Full Area				20.00(8.25')	psf
ı	Load2	Snow	Full Area				30.00(8.25')	psf
ı	Self-weight	Dead	Full UDL				7.7	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):



R5

Lumber-soft, D.Fir-L, No.2, 4x10 (3-1/2"x9-1/4") Supports: All - Timber-soft Beam, D.Fir-L No.2 Total length: 8.13'; Clear span: 8.0'; volume = 1.8 cu.ft. Lateral support: top= at supports, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 63	Fv' = 207	psi	fv/Fv' = 0.30
Bending(+)	fb = 821	Fb' = 1222	psi	fb/Fb' = 0.67
Live Defl'n	$0.06 = \langle L/999 \rangle$	0.27 = L/360	in	0.24
Total Defl'n	0.13 = L/741	0.40 = L/240	in	0.32

Additional Data:

FACTORS:	F/E(ps	si)CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	180	1.15	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	900	1.15	1.00	1.00	0.984	1.200	1.00	1.00	1.00	1.00	-	2
Fcp'	625	-	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.6 mi	illion	1.00	1.00	-	-	-	-	1.00	1.00	-	2
Emin'	0.58 mi	illion	1.00	1.00	-	-	-	-	1.00	1.00	-	2

Emin' 0.58 million 1.00 1.00 - - - - 1.00 1.00 - CRITICAL LOAD COMBINATIONS:

Shear : LC #2 = D+S, V max = 1694, V design = 1357 lbs

Bending(+): LC #2 = D+S, M = 3417 lbs-ft

Deflection: LC #2 = D+S (total)

LC #2 = D+S (total)

Dedead Lelive = Sensow #ewind Teimpact Lr=roof live Lc=concentrated E=earthquake All LC's are listed in the Analysis output

Load combinations: ASCE 7-10 / IBC 2015

Load combinations. ASLE / TI / IDE ZULE
CALCULATIONS:
Deflection: EI = 369e06 lb-in2
"Live" deflection = Deflection from all non-dead loads (live, wind, snow...)
Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.
Lateral stability(+): Lu = 8.06' Le = 15.44' RB = 11.8

- L. WoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.





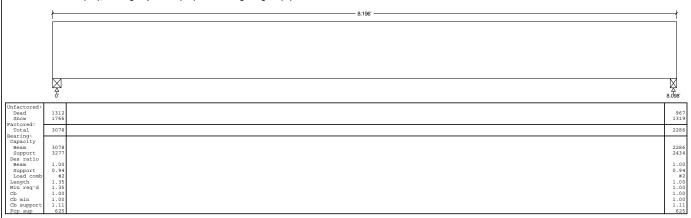
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Design Check Calculation Sheet

Loads:

ı	Load	Type	Distribution	Pat-		n [ft]		Unit
ı				tern	Start	End	Start End	1
ı	Load1		Partial Area		0.11	3.11	20.00(7.00')	psf
ı	Load2	Snow	Partial Area		0.18	3.18	30.00(7.00')	psf
	Load3		Partial Area		3.11	8.11	20.00(5.75')	psf
ı	Load4	Snow	Partial Area		3.11	8.11	30.00(5.75')	psf
	Load5	Dead	Point		3.11		1225	lbs
ı	Load6	Snow	Point		3.11		1593	lbs
ı	Self-weight	Dead	Full UDL				7.3	nlf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :



R6
Glulam-Unbal., West Species, 24F-V4 DF, 3-1/2"x9"
6 iaminations, 3-1/2" maximum width.
Supports: All - Timbers off Bearn, D-Fir-L No. 2
Todal length 2-1; Clear spant 25, volume = 1,8 c.u.ft.
Laterial support: tigs- at supports; bottom- at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 135	Fv' = 305	psi	fv/Fv' = 0.44
Bending(+)	fb = 1991	Fb' = 2685	psi	fb/Fb' = 0.74
Live Defl'n		0.27 = L/360	in	0.45
Total Defl'n	0.25 = L/382	0.40 = L/240	in	0.63

Additional Data:

PACIORS.	F/E	DRI)CD	CPI	CL	CL	CV	CIU	CE	CLIL	Mores	CH-CAL	T/C#
Fv'	265	1.15	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+		1.15	1.00	1.00	0.973	1.000	1.00	1.00	1.00	1.00	-	2
Fcp'	650	-	1.00	1.00	-	-	-	-	1.00	-	-	-
		million					-	-	1.00		-	2
Eminy'	0.85	million	1.00	1.00	-	-	-	-	1.00	-	-	2
CRITICAL L	OAD CO	OMBINATION	ONS:									
Shear	: L0	2 #2 = E	0+S, V	max =	3078,	V desi	gn =	2827	lbs			
Bending(41 lbs-	ft						
Deflecti	ion: Lo	2 #2 = E	D+S (1	live)								
	LO	2 #2 = E	0+S (t	otal)								
D=dead I							re Lc=c	oncent	rated	E=ear	thquake	
All LC's						ıt.						
Load com	mbinati	ions: ASC	E 7-10	/ IBC	2015							

Load combinations: ASCE 7-10 / IBC 2015
CALCULATIONS:

Deflection: EI = 383e66 lb-in2

*Live' deflection = Deflection from all non-dead loads (live, wind, snow.)

Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.

Lateral stability(+): Lu = 6.13' Le = 15.44' RB = 11.7

- Design Notes: Lessign Notes:

 I. WoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. Glularn design values are for materials conforming to ANSI 117-2015 and manufactured in accordance with ANSI A190.1-2012

 4. GLULAM: but = actual breadth x actual depth.

 5. Glularn Beans shall be laterally supported according to the provisions of NDS Clause 3.3.3.

 6. GLULAM: bearing length based on smaller of Fcp(tension), Fcp(comp*n).





R7 Oct. 18, 2019 12:59

3525 3903 1.00

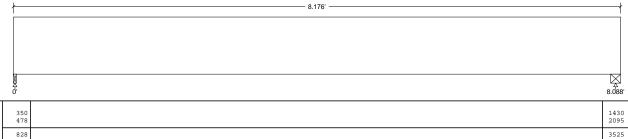
1.61 1.61 1.00 1.00 1.11 625

Design Check Calculation Sheet

Loads:

1	Load	Type	Distribution	Pat-	Location	[ft]	Magnitude	2	Unit
-				tern	Start	End	Start	End	
	Loadl		Full Area				20.00(1.00)')	psf
	Load2	Snow	Full Area				30.00(1.00)')	psf
	Load3	Dead	Point		6.87		1554		lbs
	Load4	Snow	Point		6.87		2328		lbs
1	Self-weight	Dead	Full UDL				7.7		plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):



Unfactored
Dead
Snow
Factored:
Total Bearing: Capacity Capacity
Beam 1094
Support 1211
Des ratio
Beam 0.76
Support 0.68
Load comb #2
Length 0.50*
Min req'd 0.50*
Cb 1.00
Cb min 1.00
Cb support 1.11
Fcp sup 625

Minimum bearing length setting used: 1/2 for end supports

Lumber-soft, D.Fir-L, No.2, 4x10 (3-1/2"x9-1/4")

Supports: All - Timber-soft Beam, D.Fir-L No.2
Total length: 8.18'; Clear span: 8.0'; volume = 1.8 cu.ft.
Lateral support: top= at supports, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 161	Fv' = 207	psi	fv/Fv' = 0.78
Bending(+)	fb = 1037	Fb' = 1222	psi	fb/Fb' = 0.85
Live Defl'n	$0.06 = \langle L/999$	0.27 = L/360	in	0.23
Total Defl'n	0.13 = L/762	0.40 = L/240	in	0.31

Additional Data:

FACTORS:	F/E(psi)CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	180 1.15	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	900 1.15	1.00	1.00	0.984	1.200	1.00	1.00	1.00	1.00	-	2
Fcp'	625 -	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.6 million	1.00	1.00	-	-	-	-	1.00	1.00	-	2
Emin'	0.58 million	1.00	1.00	-	-	-	-	1.00	1.00	-	2

Emin' 0.58 million 1.00 1.00 - - - - 1.00 1.00 - CRITICAL LOAD COMBINATIONS:
Shear : LC #2 = D+S, V max = 3522, V design = 3473 lbs
Bending(+): LC #2 = D+S, M = 4312 lbs-ft
Deflection: LC #2 = D+S (live)
LC #2 = D+S (total)
D-dead L=live S=snow W=wind I=impact Lr=roof live Lc=concentrated E=earthquake
All LC's are listed in the Analysis output
Load combinations: ASCE 7-10 / IBC 2015
CALCIHATIONS:

Load combinations: ASCE 7-10 / IBC 2015
CALCULATIONS:
Deflection: EI = 369e06 lb-in2
"Live' deflection = Deflection from all non-dead loads (live, wind, snow...)
Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.
Lateral stability(+): Lu = 8.06' Le = 15.50' RB = 11.8

- 1. Wood/Works analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.
 2. Please verify that the default deflection limits are appropriate for your application.
 3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.





R8 Oct. 18, 2019 12:59

Design Check Calculation Sheet

Loads:

ı	Load	Type	Distribution	Pat-	Location	[ft]	Magnitud	de	Unit
ı				tern	Start	End	Start	End	
ı	Load1	Dead	Full Area				20.00(11	.00')	psf
ı	Load2	Snow	Full Area				30.00(11	.00')	psf
ı	Self-weight	Dead	Full UDL				15.0		olf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in): 10.139' 10.069 Unfactored Dead Snow Factored: Total Bearing: Capacity Beam Support 2864 2864 3059 2864 3059 Support Des ratio Beam 1.00 0.94 #2 0.83 0.83 1.00 1.00 1.00 0.94 #2 0.83 0.83 1.00 1.00 Support Load comb Length Min req'd Cb min Cb support Fcp sup

R8

Timber-soft, D.Fir-L, No.2, 6x12 (5-1/2"x11-1/2")
Supports: All - Timber-soft Beam, D.Fir-L No.2
Total length: 10.14'; Clear span: 10.0'; volume = 4.5 cut.ft; Beam and stringer Lateral support: top= full, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 54	Fv' = 195	psi	fv/Fv' = 0.28
Bending(+)	fb = 709	Fb' = 1006	psi	fb/Fb' = 0.70
Live Defl'n	$0.08 = \langle L/999$	0.34 = L/360	in	0.25
Total Doflin	0 17 - 1/602	0 50 - 7/240	in	0.25

Additional Data:

FACTORS:	F/E(psi)CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	170 1.15	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	875 1.15	1.00	1.00	1.000	1.000	1.00	1.00	1.00	1.00	-	2
Fcp'	625 -	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.3 million	1.00	1.00	-	-	-	-	1.00	1.00	-	2
Emin'	0.47 million	1.00	1.00	-	-	-	-	1.00	1.00	-	2

Emin' 0.47 million 1.00 1.00 - - - - 1.00 1.00 - CRITICAL LOAD COMBINATIONS:
Shear : LC #2 = D+S, V max = 2845, V design = 2284 lbs
Bending(+): LC #2 = D+S, M = 7161 lbs-ft
Deflection: LC #2 = D+S (live)
LC #2 = D+S (total)
D=dead L=live S=snow W=wind T=impact Lr=roof live Lc=concentrated E=earthquake
All LC's are listed in the Analysis output
Load combinations: ASCE 7-10 / IBC 2015

Load computations:

CALCULATIONS:

Deflection: EI = 906e06 lb-in2

"Live" deflection = Deflection from all non-dead loads (live, wind, snow...)

Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.

Design Notes:

1. WoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.





SF1 Oct. 18, 2019 13:00

0.60 0.56 #3 0.50* 0.50* 1.00 1.11 625

Design Check Calculation Sheet

Loads:

Load	Type	Distribution	Pat-	Location		Magnitud		Unit
			tern	Start	End	Start	End	
Load1	Dead	Full Area				20.00(0.7	75')	psf
Load2	Live	Full Area				60.00(0.7	75')	psf
Load3	Snow	Full Area				30.00(0.7	75')	psf
Self-weight	Dead	Full UDL				9.7		olf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):



0.56 #3 0.50* 0.50* 1.00 1.11 Cb min Cb support Fcp sup num bearing length setting used: 1/2" for end supports

SF1

Glulam-Unbal., West Species, 24F-V4 DF, 3-1/2"x12" 8 laminations, 3-1/2" maximum width, Supports: All - Timber-soft Beam, D.Fir-L.No.2 Total length: 18.08'; Clear span: 18'; volume = 5.3 cu.ft. Lateral support: top= at supports, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 20	Fv' = 265	psi	fv/Fv' = 0.08
Bending(+)	fb = 438	Fb' = 2191	psi	fb/Fb' = 0.20
Live Defl'n	$0.13 = \langle L/999$	0.60 = L/360	in	0.22
Total Defl'n	0.23 = L/940	0.90 = L/240	in	0.26

Additional Data:

Support Load comb

Length Min req'd

FACTORS:	F/E(ps	si)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cn*Cvr	LC#
Fv'	265	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	2400	1.15	1.00	1.00	0.794	1.000	1.00	1.00	1.00	1.00	-	3
Fcp'	650	-	1.00	1.00	-	-	-	-	1.00	-	-	-
E'	1.8 m	illion	1.00	1.00	-	-	-	-	1.00	-	-	3
Eminy'	0.85 m	illion	1.00	1.00	-	-	-	-	1.00	-	-	3

CRITICAL LOAD COMBINATIONS:

CRTICAL LOAD COMBINATIONS:

Shear : LC #2 = D+L, V max = 628, V design = 557 lbs

Bending(+): LC #3 = D+.75(L+S), M = 3064 lbs-ft

Deflection: LC #3 = D+.75(L+S) (live)

LC #3 = D+.75(L+S) (total)

D=dead L=live S=snow M=wind T=impact Lr=roof live Lc=concentrated E=earthquake
All LC's are listed in the Analysis output

Load combinations: ASCE 7-10 / IBC 2015

CALCULATIONS:

Deflection: EI = 907e06 lb-in2

"Live' deflection = Deflection from all non-dead loads (live, wind, snow...)

Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.

Lateral stability(+): Lu = 18.06' Le = 33.19' RB = 19.8

- NoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.
 Please verify that the default deflection limits are appropriate for your application.
 Glulam design values are for materials conforming to ANSI 117-2015 and manufactured in accordance with ANSI A190.1-2012
 GLULANE by a exclual breadth x actual depth.
 Glulam Beams shall be laterally supported according to the provisions of NDS Clause 3.3.3.

- 6. GLULAM: bearing length based on smaller of Fcp(tension), Fcp(comp'n)





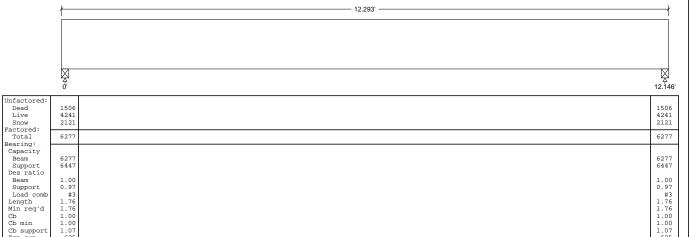
SF2 Oct. 18, 2019 13:00

Design Check Calculation Sheet

Loads:

l	Load	Type	Distribution	Pat- tern	Location Start	[ft] End	Magnitude Start F	nd	Unit
ı	Loadl	Dead	Full Area	cern	Start	EIIG	20.00(11.50		psf
	Load2		Full Area				60.00(11.50		psi
	Load3		Full Area				30.00(11.50		psf
ı	Self-weight	Dead	Full UDL				15.2		olf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):



SF2

Glulam-Unbal., West Species, 24F-V4 DF, 5-1/2"x12" 8 laminations, 5-1/2" maximum width, Supports: All - Timber-soft Beam, D.Fir-L No.2 Total length: 12.29; Cilear span: 12; volume = 5.6 cu.ft. Lateral support: top= at supports, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 106	Fv' = 265	psi	fv/Fv' = 0.40
Shear Bending(+) Live Defl'n Total Defl'n	fb = 1568	Fb' = 2360	psi	fb/Fb' = 0.66
Live Defl'n	0.27 = L/546	0.40 = L/360	in	0.66
Total Defl'n	0.39 = L/370	0.61 = L/240	in	0.65

Additional Data:

Cb support

FACTORS:	F/E(ps:	i)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cn*Cvr	LC#
Fv'	265	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	2400	1.00	1.00	1.00	0.984	1.000	1.00	1.00	1.00	1.00	-	2
Fcp'						-						-
E'	1.8 mi	llion	1.00	1.00	-	-	-	-	1.00	-	-	3
Eminy'	0.85 mi	llion	1.00	1.00	-	-	-	-	1.00	-	-	3

Eminy' 0.85 million 1.00 1.00 - - - - 1.00 - - CRITICAL LOAD COMBINATIONS:

Shear : LC #2 = D+L, V max = 5680, V design = 4676 lbs

Bending(+): LC #2 = D+L, M = 17247 lbs-ft

Deflection: LC #3 = D+.75(L+S) (live)

LC #3 = D+.75(L+S) (total)

D=dead L=live S=snow W=wind I=impact Lx=roof live Lc=concentrated E=earthquake
All LC's are listed in the Analysis output

Load combinations: ASCE 7-10 / IBC 2015

CALCULATIONS:

Load combinations: ASUE /-10 / IBC 2015
CALCULATIONS:
Deflection: EI = 1426e06 lb-in2
"Live" deflection = Deflection from all non-dead loads (live, wind, snow...)
Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.
Lateral stability(+): Lu = 12.13' Le = 22.81' RB = 10.4

- 1. Wood/Works analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. Glulam design values are for materials conforming to ANSI 117-2015 and manufactured in accordance with ANSI A190.1-2012

 4. GLULAM: bxd = actual breadth x actual depth.

 5. Glulam Beams shall be laterally supported according to the provisions of NDS Clause 3.3.3.

 6. GLULAM: bearing length based on smaller of Fcp(tension), Fcp(comp'n).





SF3 Oct. 18, 2019 13:00

Design Check Calculation Sheet

Loads:

Load	Type	Distribution	Pat-	Location	[ft]	Magnitude	Unit
			tern	Start	End	Start End	I
Load1	Dead	Full Area	No				psf
Load2	Live	Full Area	Yes			60.00(5.75')	psf
Load3	Snow	Full Area	Yes			30.00(5.75')	psf
Self-weight	Dead	Full IIDI.	NO			15 2	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) : -117 3045 1.00

Glulam-Bal., West Species, 24F-V8 DF, 5-1/2"x12"
8 laminations, 5-1/2 maximum width,
Supports: All - Timber-soft Beam, D-Fir-L No.2
Total length: 20-75; Clear span: 77, 135; yolume = 9.5 cu.ft.
Lateral support: top= full, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 77	Fv' = 265	psi	fv/Fv' = 0.29
Bending(+)	fb = 829	Fb' = 2400	psi	fb/Fb' = 0.35
Bending(-)	fb = 1019	Fb' = 2361	psi	fb/Fb' = 0.43
Deflection:				
Interior Live	0.19 = L/868	0.45 = L/360	in	0.41
Total	0.22 = L/751	0.68 = L/240	in	0.32
Cantil. Live	0.47 = L/180	0.47 = L/180	in	1.00
Total	0.54 = L/157	0.71 = L/120	in	0.76

Additional Data:

FACTORS:	F/E	(psi)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cn*Cvr	LC#
Fv'	265	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	2400	1.00	1.00	1.00	1.000	1.000	1.00	1.00	1.00	1.00	-	6
Fb'-		1.00		1.00	0.984	1.000	1.00	1.00	1.00	1.00	-	2
Fcp'	650	-	1.00	1.00	-	-	-	-	1.00	-	-	-
E'	1.8	million	1.00	1.00	-	-	-	-	1.00	-	-	12
Eminy'	0.85	million	1.00	1.00	-	-	-	-	1.00	-	-	12
CRITICAL L	OAD C	OMBINAT	IONS:									
Shear	: L4	2 #2 =	D+L, V	max =	3864,	V desi	gn =	3380	lbs			
Bending(+): L	2 #6 =	D+L (pa	attern:	_L), M	= 91	21 lbs	-ft				
Bending(-): L	2 #2 =	D+L, M	= 112	13 lbs-	ft						
Deflecti	on: L	2 #12 =	(live	≥)								
	L	2 #12 =	(tota	al)								
D=dead I	=live	S=snow	W=wind	I=impa	ct Lr=r	oof liv	e Lc=c	oncent	rated	E=eart	thquake	

All LC's are listed in the Analysis output
Load Patterns: s=5/2, X=L+S or L+Lr, _=no pattern load in this span
Load combinations: ASCF 7-10 / IBC 2015

Load combinations: ASCE 7-10 / IRC 2US
CACULATIONS

DETIRETION:

Defilection: Detiretion: 1 145660 lb-in2

Defilection: Defilection: 1 50(Dead Load Defilection) - Live Load Defilection.

Total Defilection = 1.50(Dead Load Defilection) - Live Load Defilection.

Lateral stability(-): Lu = 13.53' Le = 22.53' RB = 10.4; Lu based on full span

- | Design Notes:
 | I. Wood/Works analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.
 | 2. Please verify that the default deflection limits are appropriate for your application.
 | 3. Glulam design values are for materials conforming to ANSI 117-2015 and manufactured in accordance with ANSI A190.1-2012
 | 4. Grades with equal bending capacity in the top and bottom edges of the beam cross-section are recommended for continuous beams.
 | 5. GLULAM Evalue a catual breadth a vactual depth.
 | 6. Glulam Beams shall be laterally supported according to the provisions of NDS Clause 3.3.3.
 | 7. GLULAM Evaning length based on smaller of Epitension), Fopicomphi).
 | 8. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.





SF4 Oct. 18, 2019 13:00

Design Check Calculation Sheet

Loads:

Load	Type	Distribution		Location			Unit
	I		tern	Start	End	Start End	
Load1	Dead	Full Area	No			15.00(1.33')	psf
Load2	Live	Full Area	Yes			60.00(1.33')	psf
Load3	Dead	Point	No	0.00		1595	lbs
Load4	Live	Point	Yes	0.00		5426	lbs
Load5	Snow	Point	Yes	0.00		2716	lbs
Load6	Snow	Full Area	Yes			30.00(1.33')	psf
Self-weight	Dead	Full UDL	No	l		15.2	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

11.277 2.117 11.256 2209 7238 3622

Total Bearing:		10353	150
Capacity Beam	,	11421	1787
Support Des rati	:	10353	1836
Beam		0.91 1.00	0.08
Support Load co		#3	#6
Length Min req'	d	2.82 2.82**	0.50*
Cb Cb min		1.13 1.13	1.00
Cb suppo Fcp sup	ort	1.07 625	1.07 625
*Minimum be	earing length	setting used: 1/2" for end supports	

**Minimum bearing length governed by the required width of the supporting member.

Maximum reaction on at least one support is from a different load combination than the critical one for bearing design, shown here, due to Kd factor. See Analysis results for reaction from critical load combination.

SF4

ST4
Glulam-Bal., West Species, 24F-V8 DF, 5-1/2"x12"
8 laminations, 5-1/2" maximum width,
Supports: All - Timber-soft Beam, D.Fir-L No.2
Total length '1.28' Clear span: 2, 9' volume = 5.2 cu.ft.
Lateral support: top= at supports, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear Bending(+) Bending(-) Deflection:	fv = 163 fb = 8 fb = 1375	Fv' = 265 Fb' = 2374 Fb' = 2374	psi psi psi	fv/Fv' = 0.61 fb/Fb' = 0.00 fb/Fb' = 0.58
Interior Live	-0.08 = <l 999<br="">-0.11 = L/981 0.13 = L/203 0.17 = L/148</l>	0.30 = L/360 0.46 = L/240 0.14 = L/180 0.21 = L/120	in in in in	0.27 0.24 0.89 0.81

Additional Data:

FACTORS:	F/E(psi)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cn*Cvr	LC#
Fv'	265	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	2400	1.00	1.00	1.00	0.989	1.000	1.00	1.00	1.00	1.00	-	6
Fb'-	2400	1.00	1.00	1.00	0.989	1.000	1.00	1.00	1.00	1.00	-	2
Fcp'	650	-	1.00	1.00	-	-	-	-	1.00	-	-	-
E'	1.8	million	1.00	1.00	-	-	-	-	1.00	-	-	11
Eminy'	0.85	million	1.00	1.00	-	-	-	-	1.00	-	-	11

E' 1.8 million 1.00 1.00 1 - 0 - 1.00 - 1 CHINCALLOAD COMBINATIONS.

REMINDAL LOAD COMBINATIONS.

1 CRUICAL LOAD COMBINATION COMBINA

- UeStign Notes:

 1. Wood/Works analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. Glulam design values are for materials conforming to ANIS I117-2015 and manufactured in accordance with ANSI A190.1-2012

 4. Grades with equal bending capacity in the top and bottom edges of the beam cross-section are recommended for continuous beams.

 5. GLULAM: but a catual breadth a vacual depth.

 6. Glulam Beams shall be laterally supported according to the provisions of NDS Clause 3.3.3.

 7. GLULAM: bearing length based on smaller of Englemsion), Englempin.

 8. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.





SF5 Oct. 18, 2019 13:00

Design Check Calculation Sheet WoodWorks Sizer 11.1

Loads:

Load	Type	Distribution				Unit
			tern	Start End	Start End	
Load1	Dead	Full Area			20.00(11.50')	psf
Load2	Live	Full Area			60.00(11.50')	psf
Load3	Dead	Partial Area		9.40 11.15	15.00(0.67')	psf
Load4	Live	Partial Area		9.40 11.15	60.00(0.67')	psf
Load5	Dead	Point		9.40	507	lbs
Load6	Live	Point		9.40	2360	lbs
Load7	Snow	Full Area			30.00(11.50')	psf
Load8	Snow	Partial Area		9.40 11.15	30.00(0.67')	psf
Load9	Snow	Point	l	9.40	1022	lbs
Self-weight	Dead	Full IIDI.	ı		15 2	nlf

Maximum I	Reacti	ons (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :	
	 	11.343' —	-
	Ŗ		11.172
	O'		11.172'
Unfactored: Dead Live Snow	1472 4301 2125		1831 5956 2846
Factored: Total Bearing:	6291		8433
Capacity Beam Support Des ratio	6291 6462		8433 8661
Beam Support Load comb	1.00 0.97 #3		1.00 0.97 #3
Length Min req'd Cb Cb min	1.76 1.76 1.00 1.00		2.36 2.36 1.00 1.00
Cb support Fcp sup	1.07		1.07

SF5
Glulam-Unbal., West Species, 24F-V4 DF, 5-1/2"x12"
8 laminations, 5-1/2" maximum width,
Supports: All - Timber-soft Beam, D.Fir-L No.2
Total length: 11.34", (Des span: 11') volume = 5.2 cu.ft.
Lateral support: top- at supports, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 151	Fv' = 265	psi	fv/Fv' = 0.57
Bending(+)	fb = 1582	Fb' = 2364	psi	fb/Fb' = 0.67
Live Defl'n	0.23 = L/572	0.37 = L/360	in	0.63
Total Defl'n	0.34 = L/396	0.56 = L/240	in	0.60

Additional Data:

PACIORS.	F/E(D	ST)CD	CM	CL	CL	CV	CIU	CE	CIFL	Mores	CH-CAL	T/C#
	265					-					1.00	2
Fb'+									1.00	1.00	-	2
Fcp'											-	
E'										-	-	3
Eminy'	0.85 m	illion	1.00	1.00	-	-	-	-	1.00	-	-	3
CRITICAL L	OAD COM	MBINATIO	DNS:									
Shear							gn =	6624	lbs			
Bending(+): LC	#2 = E	+L, M	= 174	06 lbs-	ft						
Deflecti	on: LC	#3 = E	+.75(L	+S) (live)							
		#3 = E										
D=dead I	=live S	=snow W	=wind	I=impa	ct Lr=r	oof liv	e Lc=c	oncent	rated	E=ear	thquake	
All LC's	are li	sted in	the A	nalysi	s outpu	t						
Load con	binatio	ns: ASC	E 7-10	/ IBC	2015							
CALCULAT	IONS:											
Deflecti	on: EI	= 14	26e06	lb-in2								
"Live" d	leflecti	on = De	flecti	on fro	m all n	on-dead	loads	(live	e, wind	i, sno	v)	
Total De	Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.											
Lateral	stabili	ty(+):	Lu =	11.19'	Le =	21.19	RB =	10.0				

- Design Notes:

 I Wood/Works analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. Glulard nesign values are for materials conforming to ANSI 117-2015 and manufactured in accordance with ANSI A190.1-2012

 4. GLULAM: but a actual breadth x actual depth.

 5. Glularn Beans shall be laterally supported according to the provisions of NDS Clause 3.3.3.

 6. GLULAM: but paring length based on smaller of Fcp(tension), Fcp(comp'n).





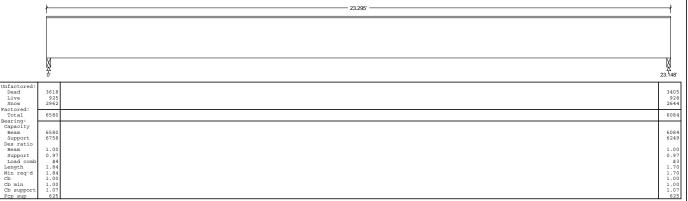
SF6 Oct. 18, 2019 13:00

Design Check Calculation Sheet

Loads:

Load	Type	Distribution	Pat- tern	Location [ft Start End	Magnitude Start End	Unit
Load1	Dead	Full Area	CCLI	Deare mid	20.00(0.67')	psf
Load2	Live	Full Area	l		60.00(0.67')	psf
Load3	Dead	Partial Area	l	8.40 14.99	15.00(3.50')	psf
Load4	Live	Partial Area	l	8.40 14.99	40.00(3.50')	psf
Load5	Dead	Partial Area	l	0.15 4.28	20.00(8.00')	psf
Load6	Snow	Partial Area	l	0.15 4.28	30.00(8.00')	psf
Load7	Dead	Partial Area	l	8.28 9.11	20.00(8.00')	psf
Load8	Snow	Partial Area	l	8.28 9.11	30.00(8.00')	psf
Load9	Dead	Partial Area	l	14.28 15.11	20.00(8.00')	psf
Load10	Snow	Partial Area	l	14.28 15.11	30.00(8.00')	psf
Load11	Dead	Partial Area	l	19.11 23.15	20.00(4.75')	psf
Load12	Snow	Partial Area	l	19.11 23.15	30.00(4.75')	psf
Load13	Dead	Point	l	4.28	339	lbs
Load14	Snow	Point	l	4.28	486	lbs
Load15	Dead	Point	l	8.28	339	lbs
Load16	Snow	Point	l	8.28	486	lbs
Load17	Dead	Point	l	9.11	422	lbs
Load18	Snow	Point	l	9.11	610	lbs
Load19	Dead	Point	l	14.28	422	lbs
Load20	Snow	Point	l	14.28	610	lbs
Load21	Dead	Point	l	15.11	339	lbs
Load22	Snow	Point	l	15.11	490	lbs
Load23	Dead	Point	l	19.11	339	lbs
Load24	Snow	Point	ı	19.11	490	lbs
Load25	Dead	Full UDL	l		100.0	plf
Load26	Snow	Full Area	ı		30.00(0.67')	psf
Self-weight	Dead	Pull HDr	1		22.0	vs.1 f

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):



Glulam-Unbal., West Species, 24F-V4 DF, 5-1/2"x18"
12 larinations, 5-1/2" maximum width,
Supports: All - Timber-soft Beam, D.FirL No.2
Total length: 23.3"; Clear Span: 23"; volume = 16.0 cu.ft.
Lateral support: top- full, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Shear	fv = 87	Fv' = 305	psi	fv/Fv' = 0.29
Bending(+)	fb = 1562	Fb' = 2606	psi	fb/Fb' = 0.60
Live Defl'n	0.35 = L/791	0.77 = L/360	in	0.45
Total Defl'n	0.99 = L/281	1.16 = L/240	in	0.85

Additio	nai Da	ta:										
FACTORS:	F/E(p	si)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cn*Cvr	LC#
Fv'	265	1.15	1.00	1.00	-	-	-	-	1.00	1.00	1.00	3
Fb'+	2400	1.15	1.00	1.00	1.000	0.944	1.00	1.00	1.00	1.00	-	3
Fcp'	650	-	1.00	1.00	-	-	-	-	1.00	-	-	-
E'	1.8 m	illion	1.00	1.00	-	-	-	-	1.00	-	-	3
Eminy'	0.85 m	illion	1.00	1.00	_	_	-	-	1.00	-	-	3

Eminy 0.85 million 1.00 1.00 -

- Design Notes:

 1. WoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. Glulam design values are for materials conforming to ANSI 117-2013 and manufactured in accordance with ANSI A190.1-2012

 4. GLULAM: but = actual breadth x actual depth.

 5. Glulam Beams shall be laterally supported according to the provisions of NDS Clause 3.3.3.

 6. GLULAM: bearing length based on smaller of Fcp(tension), Fcp(comp¹n).





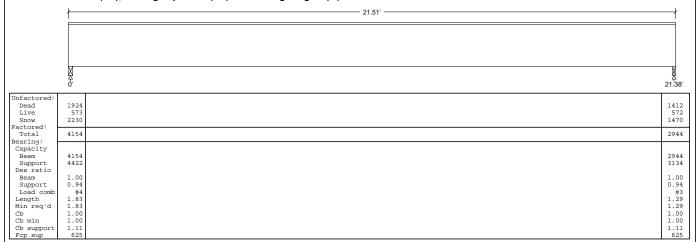
SF7 Oct. 18, 2019 13:00

Design Check Calculation Sheet

Loads:

Load	Type	Distribution	Pat-	Location	[ft]	Magnitude		Unit
			tern	Start	End	Start 1	End	
Load1		Full Area				15.00(1.33	')	psf
Load2	Live	Full Area				40.00(1.33	')	psf
Load3	Dead	Point		8.66		2597		lbs
Load4	Snow	Point		8.57		3700		lbs
Self-weight	Dead	Full UDL				14.5		plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):



SF7

Glulam-Unbal., West Species, 24F-V4 DF, 3-1/2"x18"
12 laminations, 3-1/2" maximum width,
Supports: All - Timber-soft Beam, D.Fir-L No.2
Total length: 21.51; Clear span: 21.25; volume = 9.4 cu.ft.
Lateral support: top= full, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 98	Fv' = 305	psi	fv/Fv' = 0.32
Bending(+)	fb = 2162	Fb' = 2748	psi	fb/Fb' = 0.79
Live Defl'n	0.40 = L/638	0.71 = L/360	in	0.56
Total Defl'n	0.91 = L/283	1.07 = L/240	in	0.85

Additional Data:

FACTORS:	F/E(ps	si)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cn*Cvr	LC#
Fv'	265	1.15	1.00	1.00	-	-	-	-	1.00	1.00	1.00	4
Fb'+	2400	1.15	1.00	1.00	1.000	0.996	1.00	1.00	1.00	1.00	-	4
Fcp'	650	-	1.00	1.00	-	-	-	-	1.00	-	-	-
E'	1.8 mi	llion	1.00	1.00	-	-	-	-	1.00	-	-	4
Eminy'	0.85 mi	llion	1.00	1.00	-	-	-	-	1.00	-	-	4

Eminy' 0.85 million 1.00 1.00 - - - 1.00 - CRITICAL LOAD COMBINATIONS:
Shear : LC #4 = D+S, V max = 4152, V design = 4098 lbs
Bending(+): LC #4 = D+S, M = 34047 lbs-ft
Deflection: LC #4 = D+S (live)
LC #4 = D+S (total)
Dedead L=live S=snow W=wind T=impact Lr=roof live Lc=concentrated E=earthquake
All LC's are listed in the Analysis output
Load combinations: ASCE 7-10 / IBC 2015
CALCULATIONS:

CALCULATIONS: E1 = 3062e06 lb-in2

"Live" deflection = Deflection from all non-dead loads (live, wind, snow...)

Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.

- S. Gulann design values are to materials continuing to ANOT 177-2013 and manufactured in a 4. GLULAM: bxd = actual breadth x actual depth.
 Glulam Beams shall be laterally supported according to the provisions of NDS Clause 3.3.3.
 G. GLULAM: bearing length based on smaller of Fcp(tension), Fcp(comp'n).





SF8 Oct. 18, 2019 13:00

Design Check Calculation Sheet

Loads:

Load	Type	Distribution	Pat- tern	Location [ft] Start End	Magnitude Start End	Unit
Load1 Load2	Dead Live	Partial Area Partial Area		0.21 8.46 0.21 8.46	15.00(10.75') 40.00(10.75')	psf psf
Load3 Load4	Dead Live	Partial Area Partial Area		8.46 13.21 8.46 13.21	15.00(14.50')	psf
Load5 Load6	Dead Dead	Partial Area Partial Area		13.21 15.55 13.21 15.55	15.00(7.75')	psf
Load7 Load8	Dead Live	Point Point		2.38	1924 573	lbs lbs
Load9 Self-weight	Snow	Point Full HDL		2.38	2230	lbs nlf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):

	23.302'	1
	M	
	₩ ₩	23.151'
Unfactored: Dead Live Snow	4021 4894 2011	1788 1982 219
Factored: Total Bearing:	9200	3770
Capacity Beam Support Des ratio	9200 9449	3770 3872
Beam Support Load comb Length	1.00 0.97 2.57	1.00 0.97 1.05
Min req'd Cb Cb min Cb support	2.57 1.00 1.00	#2 1.05 1.05 1.00 1.00 1.00 625
Fcp sup	625	625

Glulam-Unbal., West Species, 24F-V4 DF, 5-1/2"x18"
12 Iaminations, 5-1/2" maximum width,
Supports: All - Timber-ost Beam, DFirl- No.2
Total length: 23.3" (Clear span: 25", volume = 16.0 cuft.
Lateral support to: p-full, bottom = a tupports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

ı	Criterion	Analysis Value	Design Value	Unit	Analysis/Design
ı	Shear Bending(+) Live Defl'n Total Defl'n	fv = 122	Fv' = 265 Fb' = 2266	psi	fv/Fv' = 0.46
ı	Bending(+) Live Defl'n	fb = 1596 0.43 = L/644	Fb' = 2266 0.77 = L/360	psi in	fb/Fb' = 0.70 0.56
ı	Total Defl'n	0.43 = L/644 0.91 = L/303	1.16 = L/240	in	0.56
ı	TOTAL DELL II	0.91 - 2/303	1.10 - 2/210		0.75

Additional Data

Auditio	nai De	ala.										
FACTORS:	F/E()	osi)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cn*Cvr	LC#
Fv'	265	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+												2
Fcp'										-		-
		million									-	2
Eminy'				1.00	-	-	-	-	1.00	-	-	2
CRITICAL L												
Shear							gn =	8024	lbs			
Bending					10 lbs-	ft						
Deflecti												
		#2 = D										
D=dead I							re Lc=c	oncent	rated	E=ear	thquake	
All LC's						t						
Load con		ons: ASC	E 7-10	/ IBC	2015							
CALCULAT												
Deflecti												
"Live" o											w)	
Total De	eflecti	on = 1.5	0 (Dead	Load	Deflect	ion) +	Live L	oad De	eflect	ion.		
												_
Design	Notes											

- LPESIGIT NOTES:

 I. Wood/Vorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. Gluidam design values are for materials conforming to ANSI 117-2015 and manufactured in accordance with ANSI A190.1-2012

 4. GLUIAM: but = actual breadth x actual depth.

 5. Gluidam Beans shall be laterally supported according to the provisions of NDS Clause 3.3.3.

 6. GLUIAM: but placed to the provision of State o





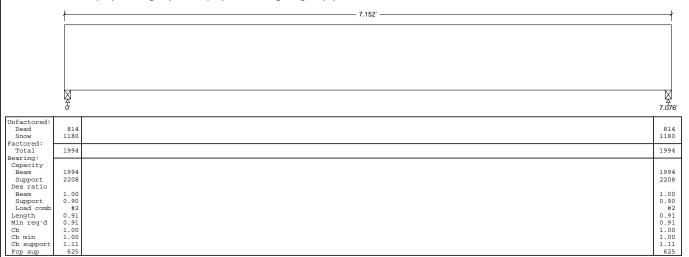
SF9 Oct. 18, 2019 13:01

Design Check Calculation Sheet

Loads:

п									
I	Load	Type	Distribution	Pat-	Location	[ft]	Magnitud	le	Unit
I				tern	Start	End	Start	End	
ı	Loadl	Dead	Full Area				20.00(11.		psf
ı	Load2	Snow	Full Area				30.00(11.	.00')	psf
ı	Self-weight	Dead	Full UDL				7.7		plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):



Lumber-soft, D.Fir-L, No.2, 4x10 (3-1/2"x9-1/4")

Supports: All - Timber-soft Beam, D.Fir-L No.2
Total length: 7.15'; Clear span: 7.0'; volume = 1.6 cu.ft.
Lateral support: top= at supports, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 71	Fv' = 207	psi	fv/Fv' = 0.34
Bending(+)	fb = 839	Fb' = 1225	psi	fb/Fb' = 0.69
Live Defl'n	0.05 = < L/999	0.24 = L/360	in	0.21
Total Defl'n	0.10 = L/827	0.35 = L/240	in	0.29

Additional Data:

Addition	iai Data.										
FACTORS:	F/E(psi)CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	180 1.15	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	900 1.15	1.00	1.00	0.986	1.200	1.00	1.00	1.00	1.00	-	2
Fcp'	625 -	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.6 million	1.00	1.00	-	-	-	-	1.00	1.00	-	2

E' 1.6 million 1.00 1.00 - - - 1.00 1.00
Emin' 0.58 million 1.00 1.00 - - - - 1.00 1.00
CRITICAL LOAD COMBINATIONS:

Shear : LC #2 = D+S, V max = 1973, V design = 1522 lbs

Bending(+): LC #2 = D+S, M = 3491 lbs-ft

Deflection: LC #2 = D+S (live)

D=dead L=live S=snow W=wind I=impact Lr=roof live Lc=concentrated E=earthquake
All LC's are listed in the Analysis output

Load combinations: ASCE 7-10 / IBC 2015

CALCULATIONS:

Load combinations: ASCE 7-10 / IBC 2015
CALCULATIONS:
Deflection: EI = 369e06 lb-in2
"Live" deflection = Deflection from all non-dead loads (live, wind, snow...)
Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.
Lateral stability(+): Lu = 7.06' Le = 13.88' RB = 11.2

- 1. Wood/Works analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.
 2. Please verify that the default deflection limits are appropriate for your application.
 3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.





SF10 Oct. 18, 2019 13:01

Design Check Calculation Sheet WoodWorks Sizer 11.1

Loads:

Load	Type	Distribution	Pat-		[ft]	Magnitud		Unit
			tern	Start	End	Start	End	l
Load1		Full Area	No			20.00(16.		psf
Load2	Snow	Full Area	Yes			30.00(16.	.0")	psf
Self-weight	Dead	Full UDL	No			2.2		plf

Maximum Reactions (lbs	s), Bearing Capacities (lbs) and Bearing Lengths (in) :	
<u> </u>	10.95'	
0'	₩ 5.621'	10.929'
Unfactored: Dead Snow	325 450	_ 4
Factored: Uplift Total Bearing:	775	-7 3
Capacity Joist	775 1856	30

ring length setting used: 1/2" for end supports
tion on at least one support is from a different load combination than the critical one for bearing design, shown here, due to Kd factor. See Analysis results for reaction from critical load combination.

SF10

Lumber-soft, Hem-Fir, No.2, 2x8 (1-1/2"x7-1/4")

Supports: All - Timber-soft Beam, D.Fir-L No.2

Roof joist spaced at 16.0" cc. Total length: 10.95: Clear space. 55.83*, 5.25: volume = 0.8 cu.ft.

Lateral support: top= full, bottom= at supports; Repetitive factor: applied where permitted (refer to online help);

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear Bending(+) Bending(-)	fv = 48 fb = 9 fb = 994	Fv' = 172 Fb' = 1349 Fb' = 1147	psi psi psi	fv/Fv' = 0.28 fb/Fb' = 0.01 fb/Fb' = 0.87
Deflection: Interior Live Total Cantil. Live	-0.03 = <l 999<br="">-0.05 = <l 999<br="">0.30 = L/228</l></l>	0.27 = L/240 0.35 = L/180 0.56 = L/120	in in in	0.10 0.14 0.53

Additional Data:

FACTORS:						CF				Cl		LC:
		1.15									1.00	2
Fb'+	850	1.15	1.00	1.00	1.000	1.200	1.00	1.15	1.00	1.00	-	4
Fb'-												2
Fcp'												-
E'	1.3 m	illion	1.00	1.00	-	-	-	-	1.00	1.00	-	
Emin'	0.47 m	illion	1.00	1.00	-	-	-	-	1.00	1.00	-	3
CRITICAL L	OAD COL	MBINATIO	ONS:									
Shear	: LC	#2 = D	+S, V	max =	387,	V desi	gn =	346	lbs			
Bending(+): LC	#4 = E	+S (pa	ttern:	sS), N	= 1	10 lbs	-ft				
Bending(-): LC	#2 = E	+S, M	= 10	89 lbs-	ft						
Deflecti	on: LC	#3 =	(live)								
	LC	#3 =	(tota	1)								
D=dead L	=live S	=snow W	=wind	I=impa	ct Lr=r	oof liv	e Lc=c	oncent	rated	E=eart	hquake	
All LC's	are li	sted in	the A	nalysi	s outpu	it						
Load Pat	terns:	s=S/2,	X=L+S	or L+	Lr, _=	no patt	ern lo	ad in	this s	pan		
Load com	binatio	ns: ASC	E 7-10	/ IBC	2015							
CALCULATI	ONS:											
Deflecti	on: EI	= 61	.9e06	lb-in2								
"Live" d	eflecti	on = De	flecti	on fro	m all n	on-dead	loads	(live	. wind	l. snow)	
Total De	flectio	n = 1.5	0 (Dead	Load	Deflect	ion) +	Live L	oad De	flecti	on.		
Lateral											ll spa	n

- | Design Notes:
 | Neod/Works analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.
 | Posses verify that the default deflection limits are appropriate for your application.
 | Confinence of Certailleverde Bears. NDS Clause 4.2.5: requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cartilevers and other spans.
 | A. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
 | The critical deflection value has been determined using maximum back-span deflection. Certailever deflection shall be laterally supported as the provisions of NDS Clause 4.4.1.





SF11 Oct. 18, 2019 13:01

Design Check Calculation Sheet

Loads:

l	Load	Type	Distribution	Pat- tern	Location Start	[ft] End		nd	Unit
ı	Load1	Dead	Full UDL				90.0		plf
ı	Load2	Dead	Full Area				15.00(5.75')	psf
ı	Load3	Live	Full Area				60.00(5.75)	psf
ı	Load4	Dead	Full Area				15.00(10.75	')	psf
ı	Load5	Live	Full Area				40.00(10.75	')	psf
ı	Load6	Snow	Full Area				30.00(5.75)	psf
ı	Self-weight	Dead	Full HDL				7.3		plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

	 	7.56' —		
	₩ Ŷ		7.405	_
Unfactored: Dead Live Snow Factored:	1303 2930 652		1303 2930 652	0
Total Bearing:	4232		4232	2
Capacity Beam Support Des ratio	4232 4505		4232 4505	2
Beam Support Load comb Length Min req'd Cb Cb min Cb support	1.00 0.94 #2 1.86 1.86 1.00 1.00		1.00 0.94 0.24 1.86 1.08 1.00 1.100	4 2 6 6 0
Fcp sup	625		625	

SF11
Glulam-Unbal., West Species, 24F-V4 DF, 3-1/2"x9"
6 laminators, 3-1/2" maximum width,
Supports: All-1 Timber-soft Beam, D.Fir-L No.2
Total length: 7-56; Clear span: 7-25; volume = 1,7 ou.ft.
Lateral support: top= at supports, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 153	Fv' = 265	psi	fv/Fv' = 0.58
Bending(+)	fb = 1949	Fb' = 2352	psi	fb/Fb' = 0.83
Live Defl'n	0.14 = L/648	0.25 = L/360	in	0.56
Total Defl'n	0.23 = L/389	0.37 = L/240	in	0.62

Additional Data:

Addition	nai De	ata.										
FACTORS:	F/E()	psi)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cn*Cvr	LC#
		1.00									1.00	
Fb'+					0.980	1.000	1.00	1.00	1.00	1.00	-	2
Fcp'					-	-					-	-
		million						-			-	2
Eminy'	0.85 1	million	1.00	1.00	-	-	-	-	1.00	-	-	2
CRITICAL L												
Shear							gn =	3219	lbs			
Bending(75 lbs-	ft						
Deflecti												
		#2 = E										
D=dead L							e Lc=c	oncent	rated	E=ear	thquake	
All LC's						t						
Load com		ons: ASC	E 7-10	/ IBC	2015							
CALCULATI												
Deflecti												
"Live" d											w)	
Total De									flect:	ion.		
Lateral	Lateral stability(+): Lu = 7.38' Le = 14.31' RB = 11.2											
<u> </u>												_

Design Notes:

1. Wood/Works analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

2. Please verify that the default deflection limits are appropriate for your application.

3. Glulam design values are for materials conforming to ANSI 117-2015 and manufactured in accordance with ANSI A190.1-2012

4. GLULAM: but a actual breadth x actual depth.

5. Glulam Beans shall be laterally supported according to the provisions of NDS Clause 3.3.3.

6. GLULAM: bearing length based on smaller of Fcp(tension), Fcp(compin).





SF12 Oct. 18, 2019 13:01

Design Check Calculation Sheet

Loads:

Load	Type	Distribution	Pat- tern	Location Start	[ft] End	Magnitude Start End	Unit
Load1	Dead	Full UDL				90.0	plf
Load2	Dead	Full Area	l			15.00(5.75')	psf
Load3	Live	Full Area	l			60.00(5.75')	psf
Load4	Dead	Full Area				15.00(10.75')	psf
Load5	Live	Full Area	l			40.00(10.75')	psf
Load6	Snow	Full Area	l			30.00(5.75')	psf
Self-weight	Dead	Full UDL	l			7.7	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) : — 5.223' — ¥ 5.111 901 2024 450 2925 2925 2925 3238

SF12

Lumber-soft, D.Fir-I., No.2, 4x10 (3-1/2"x9-1/4")
Supports: All Timber-soft Beam, D.Fir-I. No.2
Total length: 5.22°; Clear span: 5.0°; volume = 1.2 cu.ft.
Lateral support: top= at supports, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 90	Fv' = 180	psi	fv/Fv' = 0.50
Bending(+)	fb = 880	Fb' = 1071	psi	fb/Fb' = 0.82
Live Defl'n	$0.03 = \langle L/999 \rangle$	0.17 = L/360	in	0.19
Total Defl'n	$0.05 = \langle L/999 \rangle$	0.26 = L/240	in	0.21

Additional Data:

FACTORS:	F/E(p	si)CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	180	1.00	1.00	1.00		-		-			1.00	2
Fb'+	900	1.00	1.00	1.00	0.991	1.200	1.00	1.00	1.00	1.00	-	2
Fcp'	625	-	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.6 m	illion	1.00	1.00	-		-	-	1.00	1.00	-	2
Emin'		illion		1.00	-	-	-	-	1.00	1.00	-	2

Design Notes:

1. WoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

2. Please with that the default deflection limits are appropriate for your application.

3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.





SF13 Oct. 18, 2019 13:01

Design Check Calculation Sheet

Loads:

ı	Load	Type	Distribution	Pat-		[ft]	Magnitude		Unit
ı				tern	Start	End	Start	End	
ı	Load1	Dead	Full UDL				90.0		plf
ı	Load2	Dead	Full Area				15.00(0.67	7')	psf
ı	Load3	Live	Full Area				40.00(0.67	7')	psf
ı	Load4	Dead	Full Area				20.00(1.00)')	psf
ı	Load5	Snow	Full Area				30.00(1.00)')	psf
ı	Load6	Earthquake	Point		9.30		7485		lbs
1	0-16	D 3	n11 mm	ı	ı		2 2		-16

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) : 10,253 10.127 659 138 155 6854 5457 1197 1.00 0.90 #5 0.55 0.55 1.00 1.00 1.00 0.90 #8 2.49 2.49 1.00

SF13

Lumber-soft, D.Fir-I., No.2, 4x10 (3-1/2"x9-1/4")
Supports: All - Timber-soft Beam, D.Fir-I. No.2
Total length: 10.25'; Clear span: 10.0'; volume = 2.3 cut.t.
Lateral support: top- at supports, bottom- at supports,

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv* = 241	Fv' = 288 j	si	fv*/Fv' = 0.84
Bending(+)	fb = 1114	Fb' = 1670	psi	fb/Fb' = 0.67
Live Defl'n	0.14 = L/891	0.34 = L/360	in	0.40
Total Defl'n	0.26 = L/472	0.51 = L/240	in	0.51

The effect of point loads within a distance d of the support has been included as per NDS 3.4.3.1

Additional Data: F/E(psi)CD CM Ct CL CF Cfu Cr Cfrt Ci Cn LC#

Fv'	180	1.60	1.00	1.00	-	-	-	-	1.00		1.00	8
Fb'+	900	1.60	1.00	1.00	0.967	1.200	1.00	1.00	1.00	1.00	-	8
Fcp'	625	-	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'					-					1.00	-	8
Emin'	0.58 m	illion	1.00	1.00	-	-	-	-	1.00	1.00	-	8
CRITICAL L	OAD COM	MBINATIC	NS:									
Shear	: LC	#8 = D	+.7E,	V max	= 544	4, V de	sign*	= 52	04 lbs			
Bending(s-ft						
Deflecti	on: LC	#8 = D	+.7E	(live)								
		#8 = D										
D=dead L	=live S	=snow W	=wind	I=impa	ct Lr=r	oof liv	e Lc=c	oncent	rated	E=eart	hquake	
All LC's	are li	sted in	the A	nalysi	s outpu	t						
Load com	mbinatio	ns: ASC	E 7-10	/ IBC	2015							

Load combinations: ASCE 7-10 / IBC 2015
CACUUATIONS:

Deflection: EI = 369e06 lb-in2
**Live* deflection = Deflection from all non-dead loads (live, wind, snow.)
Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.

Lateral stability(+): Lu = 10.13' Le = 18.81' RB = 13.1

Design Notes:

. WoodVorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

Please verify that the default deflection limits are appropriate for your application.

Samu furnisher benefing members shall be literally supported according to the provisions of NDS Clause 4.4.1.





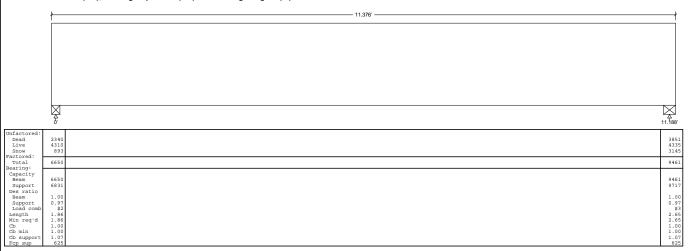
SF14 Oct. 18, 2019 13:01

Design Check Calculation Sheet WoodWorks Sizer 11.1

Loads:

Load	Type	Distribution	Pat-	Location [fi		Unit
			tern	Start End	l Start End	
Load1	Dead	Full Area			15.00(19.00')	psf
Load2	Live	Full Area			40.00(19.00')	psf
Load3	Dead	Partial Area		8.16 11.1	20.00(19.00')	psf
Load4	Snow	Partial Area		8.16 11.10	30.00(19.00')	psf
Load5	Dead	Point		8.16	1554	lbs
Load6	Snow	Point		8.16	2328	lbs
Self-weight	Dead	Full UDL			22.8	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :



SF14

Glulam-Unbal., West Species, 24F-V4 DF, 5-1/2"x18" 12 laminations, 5-1/2" maximum width, Supports: All - Timber-soft Beam, D-Fir-L No.2 Total length: 11.36; Clear span: 11; volume = 7.8 cu.ft. Lateral support: top= at supports, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 104	Fv' = 305	psi	fv/Fv' = 0.34
Bending(+)		Fb' = 2331	psi	fb/Fb' = 0.35
Live Defl'n	$0.06 = \langle L/999 \rangle$	0.37 = L/360	in	0.16
Total Defl'n	$0.12 = \langle L/999 \rangle$	0.56 = L/240	in	0.22

Additional Data:

FACTORS:	F/E(p	si)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cn*Cvr	LC:
Fv'												3
Fb'+	2400	1.00	1.00	1.00	0.971	1.000	1.00	1.00	1.00	1.00	-	2
Fcp'	650	-	1.00	1.00	-	-	-	-	1.00	-	-	-
E'												3
Eminy'				1.00	-	-	-	-	1.00	-	-	3
CRITICAL L	OAD CO	MBINATIO	DNS:									
Shear	: LC	#3 = E	+.75(L	+S), V	max =	9367,	V des	ign =	683	9 lbs		
Bending(ft						
Deflecti	on: LC	#3 = E	+.75(L	+S) (live)							
		#3 = E										
D=dead L							re Lc=c	oncent	rated	E=ear	thquake	
All LC's	are li	sted in	the A	nalysi	s outpu	t						
Load com	binatio	ns: ASC	E 7-10	/ IBC	2015							
CALCULAT	IONS:											
Deflecti	on: El	= 48	11e06	lb-in2								
"Live" d	leflecti	on = De	flecti	on fro	m all n	on-dead	lloads	(live	, wind	d, sno	w)	
Total De	Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.											
Lateral	stabili	ty(+):	Lu =	11.19'	Le =	22.75'	RB =	12.7				

- Design Notes:

 I wood/lords analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. Gluidam design values are for materials conforming to ANSI 117-2015 and manufactured in accordance with ANSI A190.1-2012

 4. GLUIAM: but = actual breadth x actual depth.

 5. Gluidam Beans shall be laterally supported according to the provisions of NDS Clause 3.3.3.

 6. GLUIAM: but plantly based on smaller of Fcp(tension), Fcp(comp'n).





SF15 Oct. 18, 2019 13:01

Design Check Calculation Sheet

Loads:

Load	Type	Distribution	Pat-	Location	[ft]	Magnitude	Unit
			tern	Start	End	Start End	
Load1	Dead	Full UDL				90.0	plf
Load2	Dead	Full Area				15.00(0.67')	psf
Load3	Live	Full Area				40.00(0.67')	psf
Load4	Dead	Full Area				20.00(1.00')	psf
Load5	Snow	Full Area				30.00(1.00')	psf
Load6	Dead	Point		2.24		2340	lbs
Load7	Live	Point		2.24		4310	lbs
Load8	Snow	Point		2.24		893	lbs
Load9	Dead	Point		3.41		1430	lbs
Load10	Snow	Point		3.41		2095	lbs
Load11	Earthquake	Point		3.41		8253	lbs
Load12	Earthquake	Point	1	8.91		-8253	lbs
Self-weight	Dead	Full UDL	1			13.3	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) : 10 312 ₩. 10.156 Unfactored:
Dead
Live
Snow
Earthquak
Factored:
Uplift
Total
Bearing:
Capacity
Beam
Support
Des ratio
Beam
Support
Load comk
Length
Min req'd
Cb
Cb min
Cb support
Fcp sup -2149 3174 10228 3174 3260

SF15

Glulam-Unbal., West Species, 24F-V4 DF, 5-1/2"x10-1/2"
7 Iaminations, 5-1/2" maximum width,
Supports: All - Timber-soft Beam, D. FirL No.2
Total length: 10.31"; Clear span: 10"; volume = 4.1 cu.ft.
Lateral support: top- at supports, Softom- at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value		Unit	Analysis/Design
Shear	fv = 179	Fv' = 265	psi	fv/Fv' = 0.67
Bending(+)	fb = 3006	Fb' = 3761	psi	fb/Fb' = 0.80
Live Defl'n	0.24 = L/516	0.34 = L/360	in	0.70
Total Defl'n	0.44 = L/277	0.51 = L/240	in	0.86

Additional Data:

Additio	nal D	ata:										
FACTORS:	F/E	(psi)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cn*Cvr	LC#
Fv'	265	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	2400	1.60	1.00	1.00	0.980	1.000	1.00	1.00	1.00	1.00	-	5
		-		1.00	-		-	-	1.00	-	-	-
E'	1.8	million	1.00	1.00	-	-	-	-	1.00	-	-	5
Eminy'	0.85	million	1.00	1.00	-	-	-	-	1.00	-	-	5
CRITICAL I	LOAD CO	OMBINATI	ONS:									
Shear	: L0	2 #2 =	D+L, V	max =	7043,	V desi	gn =	6884	lbs			
Bending	(+): LO	2 #5 =	D+.75(I	+S+.7E), M =	25313	lbs-ft					
Shear	: L0	2 #2 =	D+L, V						lbs			

Shear : LC % = D-1.75 (Max - 72 / Nu), v design = 0884 IDS
Bending(+): Nu : 2533 lbs-ft
Deflection: L6 % D+.75 (Max - 72 / Nu : 2533 lbs-ft
Deflection: L6 % D+.75 (Max - 72 / Nu : 2533 lbs-ft
Deflection: L6 % D+.75 (Max - 72 / Nu : 2532 lbs-ft
L6 % D+.75 (Max - 72 / Nu : 2532 lbs-ft
L6 % D-.75 (Max - 72 / Nu : 2532 lbs-ft
L6 % D-.75 (Max - 72 / Nu : 2532 lbs-ft
L6 % D-.75 (Max - 72 / Nu : 2532 lbs-ft
L6 % D-.75 (Max - 72 / Nu : 2532 lbs-ft
L8 % D-.75 (Max - 72 / Nu : 2532 lbs-ft
L8 % D-.75 (Max - 72 / Nu : 2532 lbs-ft
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L8 % D-.75 (Max - 72 / Nu : 2532 lbs-ft
L8 % D-.75 (Max - 72 / Nu : 2532 lbs-ft
L8 % D-.75 (Max - 72 / Nu : 2532 lbs-ft
L

- Design Notes:

 I wood/Works analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. Glulam design values are for materials conforming to ANSI 117-2015 and manufactured in accordance with ANSI A190.1-2012

 4. GLULAM: but a actual breadth x actual depth.

 5. Glulam Beans shall be laterally supported according to the provisions of NDS Clause 3.3.3.

 6. GLULAM: bearing length based on smaller of Fcp(tension), Fcp(comp/n).





SF16 Oct. 18, 2019 13:01

Design Check Calculation Sheet WoodWorks Sizer 11.1

Loads:

Load	Type	Distribution				Magnitude	Unit
			tern	Start	End	Start End	
Load1	Dead	Full Area				15.00(16.75')	psf
Load2	Live	Full Area	l			40.00(16.75')	psf
Load3	Dead	Partial Area	l	0.32	9.57	20.00(19.00')	psf
Load4	Snow	Partial Area	l	0.32	9.57	30.00(19.00')	psf
Load5	Dead	Partial Area	l	9.57	16.61	20.00(14.75')	psf
Load6	Snow	Partial Area	l	9.57	16.61	30.00(14.75')	psf
Load7	Dead	Point	l	12.07		1412	lbs
Load8	Live	Point	l	12.07		572	lbs
Load9	Snow	Point	l	12.07		1470	lbs
Self-weight	Dead	Full HDL	I	ı		22.8	nlf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) : 16.618 5959 6088 4995 13705 14272 1.00 0.97 #3 3.99 3.99 1.00

SF-16
Glulam-Unbal., West Species, 24F-V4 DF, 5-1/2"x18"
12 laminations, 5-1/2" maximum width,
Supports: All - Timber-soft Beam, D.Fir-L No.2
Total length: 16.94"; Clear spar: 16.292"; Outume = 11.6 cu.ft.
Lateral support: top= at supports, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 180	Fv' = 305	psi	fv/Fv' = 0.59
Bending(+)	fb = 2398	Fb' = 2587	psi	fb/Fb' = 0.93
Live Defl'n	0.36 = L/556	0.55 = L/360	in	0.65
Total Defl'n	0.75 = L/267	0.83 = L/240	in	0.90

Additional Data:

Fv'	265	1.15	1.00	1.00	-	-	-	-	1.00	1.00	1.00	3
Fb'+												3
Fcp'												-
E'												3
Eminy'									1.00	-	-	3
Only the	lesser	of CL a	nd CV	is app	lied, a	s per N	DS 5.3	. 6				
CRITICALI	OAD COL	MBINATIO	DNS:									
Shear								ign =	11899	lbs		
Bending	(+): LC	#3 = E	+.75(I	L+S), M	= 593	47 lbs-	ft					
Deflect:												
		#3 = E										
D=dead 1							e Lc=c	oncent	rated	E=eart	hquake	
All LC's						t						
Load cor	mbinatio	ns: ASC	E 7-10) / IBC	2015							
CALCULAT	IONS:											
Deflect:	ion: EI	= 48	11e06	lb-in2								
"Live" o	deflecti	on = De	flecti	on fro	m all n	on-dead	loads	(live	, wind	, snow)	
Total De	eflectio	n = 1.5	0 (Dead	Load	Deflect	ion) +	Live L	oad De	flecti	on.		
Lateral	stabili	ty(+):	Lu =	16.63'	Le =	31.56'	RB =	15.0				

- Design Notes:

 I wood/lords analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. Gluidam design velues are for materials conforming to AMSI 117-2015 and manufactured in accordance with ANSI A190.1-2012

 4. GLUIAM: but a catual breadth x actual depth.

 5. Gluidam Beams shall be laterally supported according to the provisions of NDS Clause 3.3.3.

 6. GLUIAM: but beating length based on smaller of Poptlersion), Fogicompin).





SF17 Oct. 18, 2019 13:01

Design Check Calculation Sheet WoodWorks Sizer 11.1

Loads:

Load	Type	Distribution	Dot	Location	[f + 1	Magnitude	Unit
Load	Type	DISCIIDUCION	tern	Start	End	Start End	
Load1	Dead	Full UDL				90.0	plf
Load2	Dead	Full Area				15.00(0.67')	psf
Load3	Live	Full Area				40.00(0.67')	psf
Load4	Dead	Full Area				20.00(1.00')	psf
Load5	Snow	Full Area				30.00(1.00')	psf
Load6	Earthquake	Point		10.83		4298	lbs
Load7	Earthquake	Point	l	13.95		-4298	lbs
Load8	Earthquake	Point		17.20		5233	lbs
Self-weight	Dead	Eull HDI.	l			14 5	nlf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) : 18.232 18.116 Unfactored Dead Live Show Earthqual Factored: Total Bearing: Capacity Beam Support Des ratio Beam Support Load comb 1224 244 273 1016 1228 245 274 4217 2145 4180 4180 4450

SF17

Glulam-Unbal., West Species, 24F-V4 DF, 3-1/2"x18"
12 Iaminations, 3-1/2" maximum width,
Supports: All - Timber-soft Beam, D-Fir4. No.2
Total length: 18.23' (Clear span: 18'; volume = 8.0 cu.ft.
Lateral support to: p-ful, bottom = at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv* = 70	Fv' = 424 j	si	fv*/Fv' = 0.17
Bending(+)	fb = 825	Fb' = 3840	psi	fb/Fb' = 0.21
Live Defl'n	$0.11 = \langle L/999 \rangle$	0.60 = L/360	in	0.18
Total Defl'n	0.27 = L/801	0.91 = L/240	in	0.30
*The effect of	point loads within	a distance d of	the suppor	rt

*The effect of point loads within a distance d of the has been included as per NDS 3.4.3.1

Additional Data:

Additio	nu. D	utu.										
FACTORS:	F/E	psi)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cn*Cvr	LC#
Fv'	265	1.60	1.00	1.00	-	-	-	-	1.00	1.00	1.00	8
Fb'+		1.60		1.00	1.000	1.000	1.00	1.00	1.00	1.00	-	8
		-		1.00	-	-	-	-	1.00		-	-
E'					-		-	-	1.00	-	-	5
Eminy'	0.85	million	1.00	1.00	-	-	-	-	1.00	-	-	5
CRITICAL L												
Shear							sign*	= 29	57 lbs	3		
Bending												
Deflecti	ion: Lo	2 #5 =	D+.75(I	L+S+.7E) (liv	re)						
		2 #5 =										
D=dead I	L=live	S=snow	W=wind	I=impa	ct Lr=1	coof liv	e Lc=c	concent	rated	E=eart	hquake	

D-dead L-live S-smow Wewind I-Impact Lr-roof live Lc-concentrated E-earthqu All LC's are listed in the Analysis output Load combinations: ASCE 7-10 / IBC 2015 CACCULATIONS: Deflection: EI = 3062e06 lb-in2 *Live' deflection = Deflection from all non-dead loads (live, wind, snow_) Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.

- | Design Notes:
 | I. Wood/Works analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.
 | Please verify that the default deflection limits are appropriate for your application.
 | Sollulam design values are for materials conforming to ANSI 117-2015 and manufactured in accordance with ANSI A190.1-2012
 | 4. GLULAM: bot = actual breadth x actual depth.
 | Sollulam Besines shall be laterally supported according to the provisions of NDS Clause 3.3.3.
 | B. GLULAM: bota actual breadth sacro of the provisions of NDS Clause 3.3.3.
 | C. GLULAM: bearing length based on smaller of Ecptension), Ecptcomp'n).





SF18 Oct. 18, 2019 13:02

Design Check Calculation Sheet

Loads:

Load	m	Distribution	D-4	Location [ftl	Magnitude	Unit
Load	Type	DISCFIDUCION	tern		nd	Start End	Onic
Load1	Dead	Full Area	No			15.00(12.50')	psf
Load2	Live	Full Area	Yes			40.00(12.50')	psf
Load3	Dead	Point	No	0.00		1228	lbs
Load4	Live	Point	Yes	0.00		245	lbs
Load5	Snow	Point	Yes	0.00		274	lbs
Load6	Earthquake	Point	No	0.00		4217	lbs
Load7	Dead	Point	No	0.00		2310	lbs
Load8	Snow	Point	Yes	0.00		3303	lbs
Colf woight	Dond	Poll HDI	NO			22 0	n1 f

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

9.195'
0 2.283 9.1

Unfactored: Dead Live Snow Barthquake Factored:	7012 3953 5571 6567	46 1483 -1992 -2350
Uplift Total Bearing:	17603	-4270 46
Capacity Beam Support Des ratio	18479 17603	1787 1836
Beam Support Load comb Length	0.95 1.00 #5 4.79	0.03 0.03 #1 0.50°
Min reg'd Cb Cb min Cb support FCp sup	4.79** 1.08 1.08 1.07 625	0.50* 1.000 1.00 1.07 625

Let'p aup 1 e29

Winimum bearing length setting used: 1/2" for end supports

"Minimum bearing length governed by the required width of the supporting member.

Maximum bearing length governed by the required width of the supporting member.

Maximum reaction on at least one support is from a different load combination than the critical one for bearing design, shown here, due to Kd factor. See Analysis results for reaction from critical load combination.

Glulam-Bal., West Species, 24F-V8 DF, 5-1/2"x18"

12 laminations, 5-1/2" maximum width,
Supports: All - Timber-soft Beam, D Firl-L No.2

Total length; 91; Clear span: 0,303; 567; Volume = 6.3 cu.ft.
Lateral support: tope full, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 115	Fv' = 305	psi	fv/Fv' = 0.38
Bending(-)	fb = 990	Fb' = 2724	psi	fb/Fb' = 0.36
Deflection:				-
Interior Live	-0.01 = < L/999	0.20 = L/360	in	0.07
Total	-0.03 = < L/999	0.29 = L/240	in	0.09
Cantil. Live	0.06 = L/625	0.22 = L/180	in	0.29
Total	0.13 = L/307	0.33 = L/120	in	0.39

Additional Data:

Auditio	nai Data											
FACTORS:	F/E(psi) CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cn*Cvr	LC#
Fv'	265				-							
Fb'-	2400	1.15	1.00	1.00	0.987	1.000	1.00	1.00	1.00	1.00	-	4
Fcp'	650	-	1.00	1.00	-	-	-	-	1.00	-	-	-
E'	1.8 mil	lion	1.00	1.00	-	-	-	-	1.00	-	-	5
Eminy'	0.85 mil	lion	1.00	1.00	-	-	-	-	1.00	-	-	5

Eminy' 0.85 million 1.00 1.00 1.00 1.00 1.00 CRITICAL LOAD COMBINATIONS:

CRITICAL LOAD COMBINATIONS:

Shear : LC 83 D+.75(L+9), V max = 8326, V design = 7579 lbs Bending(-): LC 84 D = 85, M = 24493 lbs-ft

Deflection: LC 85 D+.75(L+8-7E) (live)

LC 85 D+.75(L+8-7E) (total)

D=dead L=live S=snow W=wind I=Impact Lr=roof live Lc=concentrated E=earthquake
All LC's are listed in the Analysis output

Load Patterns: s=5/2, X=L+S or L+1r, _=no pattern load in this span

Load combinations: ASCE 7-10 / Isc 2015

CALCULATIONS:

Deflection: EI = 4811e06 lb-inz

*Live' deflection = Deflection from all non-dead loads (live, wind, snow.)

Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.

Lateral stability(-): Lu = 5.88 Le = 11.00 RB = 8.9

- Live od/Vorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. Glulam design values are for materials conforming to ANIS I117-2015 and manufactured in accordance with ANSI A190.1-2012

 4. Grades with equal bending capacity in the top and bottom edges of the beam cross-section are recommended for continuous beams.

 5. GLULAM: but a catual breadth a vactual depth.

 6. Glulam Beams shall be laterally supported according to the provisions of NDS Clause 3.3.3.

 7. GLULAM: bearing length based on smaller of Epitension), Fopicomphi).

 8. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.





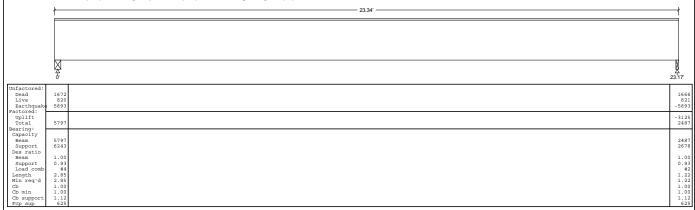
FF1 Oct. 18, 2019 13:02

Design Check Calculation Sheet

Loads:

Load	Type	Distribution		Location		Magnitude	Unit
			tern	Start	End	Start End	
Load1	Dead	Full UDL				100.0	plf
Load2	Dead	Full Area				15.00(0.67')	psf
Load3	Live	Full Area				40.00(0.67')	psf
Load4	Dead	Partial Area		0.24 2	.74	20.00(0.67')	psf
Load5	Live	Partial Area		0.24 2	.74	60.00(0.67')	psf
Load6	Dead	Partial Area		20.74 23	.24	20.00(0.67')	psf
Load7	Live	Partial Area		20.74 23	.24	60.00(0.67')	psf
Load8	Dead	Point		2.74		201	lbs
Load9	Live	Point		2.74		407	lbs
Load10	Earthquake	Point		2.74		7585	lbs
Load11	Dead	Point		20.74		201	lbs
Load12	Live	Point	l	20.74		407	lbs
Load13	Earthquake	Point	l	20.74		-7585	lbs

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):



Glulam-Unibal., West Species, 24F-V4 DF, 3-1/8"x18"
12 laminations, 3-1/8" maximum width,
Supports: All - Timber-ost Beam, D'Fir-I, No.2
Total length: 23.34; Cilear span: 23; volume = 9.1 cu.ft.
Lateral support to: p-full, bottom= a tupports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear Bending(+)	fv = 149 fb = 839	Fv' = 424 Fb' = 2398	psi	fv/Fv' = 0.35 fb/Fb' = 0.35
Live Defl'n	0.12 = <l 999<="" td=""><td>0.77 = L/360</td><td>in</td><td>0.16</td></l>	0.77 = L/360	in	0.16
Total Doflin	0 EQ - T /474	1 16 - T/240	in	0 51

Additional Data:

FACTORS:	F/E(ps	si)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cn*Cvr	LC#
Fv'	265	1.60	1.00	1.00	-	-	-	-	1.00	1.00	1.00	4
Fb'+	2400	1.00	1.00	1.00	1.000	0.999	1.00	1.00	1.00	1.00	-	2
Fcp'	650	-	1.00	1.00	-	-	-	-	1.00	-	-	-
E'	1.8 mi	illion	1.00			-	-	-	1.00	-	-	2
Eminy'	0.85 mi	illion	1.00	1.00	-	-	-	-	1.00	-	-	2

Enjny. 0.85 million 1.00 1.00 - - - 1.00 - Enjny. 0.85 million 1.00 1.00 - - - 1.00 - CRUICALLOAD COMBINATIONS.

Shear : Lt #4 = D+.7E y max = 5784, V design = 5571 lbs

Bending(+): Lt #4 = D+.7E y max = 5784, V design = 5571 lbs

Bending(+): Lt #4 = D+.7E y max = 1803 lbe-ft

Deflection: 0.83 = D+.75(L+.7E) (live)

Lt #2 = D+1 (total)

Deflead Lelive Seanow Wewind I=Impact Le-roof live Lo-concentrated E-earthquake
All Lt's are listed in the Analysis output

Load combinations: ASCE 7-10 / IBC 2015

CALCULATIONS:

Deflection: EI = 2734e06 lb-in2

*Live' deflection = Deflection from all non-dead loads (live, wind, snow.)

Total Deflection = 1.50 (Dead Load Deflection) + Live Load Deflection.

- | Live Sign Notes:
 | NeodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.
 | Please verify that the default deflection limits are appropriate for your application.
 | Soliulam design values are for materials conforming to ANSI 117-2015 and manufactured in accordance with ANSI A190.1-2012
 | 4. CLULAM: but = actual breadth x actual depth.
 | Soliulam Beasines shall be laterally supported according to the provisions of NDS Clause 3.3.3.
 | B. GLULAM: but paring length based on smaller of Fcp(tension), Fcp(comp*n).





Design Check Calculation Sheet

Load	Тура	Distribution	Sat-		on [ft] End	Magnitude Start End	Onit
Leneti Londi	Double Double Live Double Live Double Live Double Live Double Live Double Live Earthquake Earthquake Earthquake Shringashu Shringashu Double Live Double Double Live Double Live Double Double Live Double Double Live Double Double Double Live Double Double Live Double Double Double Live Double Double Double Live Double Double Double Double Live Double Double Double Live Double Double Double Live Double Doubl	Fall No. Fal	No Ho Yes Ho yes ho	0.88 B.88 15.85 6.80 8.00 8.00 8.00 8.15 18.15 3.15 3.15 3.15 3.15 3.15 3.15	3.75 3.76 18.65 18.65	109.6 15.66 (1.50°) 10.86 (1.50°) 10.86 (11.50°) 10.80 (11	put put put put

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):

	25,617	
v		\ 20 \$
nfactoreed; Dead Item Harthquake Storeed:	12 26 W/71 1691	2.2
Uplift Total eting: upsclty	36919	-11 116
Brown Stapport sp ratio Stam Stapport Just Own Stapport Just Own Own I we'd I we'd I we'd I want	25910 37920 1, 30 9, 37 82 18, 33 18, 34 18,	11: 1.13 2. 2. 2. 2. 2. 2. 2. 2. 2. 3.

FF2
Glutarn-Bal., West Spucies, 24E-A9 DF, 5-1/2*x28-4G*
T terminates - 1-17 means or wirth,
Supports As - Texts-and Bess, Differ hes2
Total engit 25-05. Chair spain 7, 1851, volume 2, 550 cust
Labertal supports pp. 18, 000ms - 1250 cust

Analysis vs. Allowable Stress and Deflection was 1005 2016 :

Criterion	Apolymir Value	Design Value	thir.	Analysiszpetian
Shegg Bending(+) Brading(-) Deflection	2V = 191 2b = 1901 2b = 1905	LP. = 5389 LP. = 5589	port port port	fu/r,' = 0.5 fu/re' = 0.5 fb/re' = 0.5
Interior Live Social Centil. Lise	0.15 = <l 393<br="">0.15 = ×L/393 0.31 = L/203</l>	8.57 = 1/380 8.65 - 1/240 8.56 = 1/280	in in in	8.30 8.20 0.96

LANGER P.												
ENCHORS:	F/t-ip	02 (DE	CM:	Ct	CL	DV .	Cox	CE	oter	Antonia.	Craffee	100
100	200	2.00	1.00	1.:30	100	-	-		5-100	5.00	4 100	- 19
8974	2401	1.00	1.00	1.00	1.00	T. 100.0	1 110	7 22	2 50	2 100	4104	- 20
For-	2.401	1 00	3 - 200	2 30	1 360	W 200	2.00	2.00	4190	2.00	-	18
	5401	4-14	4-66	5 - 100	27.000	B-MILE	人心理	3.18	1.98	1.00	100	- 15
GEVID C	CO. 8		1.50	2.00		77.66		100	1.00		-	523
- 13	1.1	ATT SOME	7 ED	2(01)					4			-
fininy"	0.85 #	illion	1.40	1.00			- 3		1 700			
CHRONIC 44 4	CAP COM	ALABAMA NA	Aries .				_		1.02			(T)

Tainy' S.65 million 1.50 1.00 1.00 1.08 CONTCAL LADO (AMERICANDE)

Contral (AMERICAND

PESIGN NOTES:

Wood/Molific Supplies and casign are in economics with the VCC University of European Duking Code (85.0) (15.1), inclinational Curring repetitions (1/85.2015); and MQS Design Supplies and Coder (86.0) (1/85.2015); and MQS Design Supplies and Coder (

- SEE NEXT POR STEEL BEAM CALLULATIONS

FF2 (USE STEEL)

WoodWorks® Sizer 11.1

Page 2

STEEL (4000) + .19" O INT. 800 EI + .79" O CAT. 1800 (7600;") = 13680 000 King I/egil = Limo EI = 472" W14x48 I=4841: V 65=8" Mrx/22 = 196 WA > Mmx = 91.7 WEN 4135 5×5×1/4 (HT=9') PAXIM ALLOW = 96"V 60° PAO Op = 1428, FV





FF3 (LSF STFFL) Oct 18, 3018 14:25

Design Check Calculation Sheet

Loads

Load	1396	Distribution	But- tern	Eccati Start	on [111]	Mognitoria Stort Ped	unix
Load1	Encad	FOLL UDG	50			100.0	ric
Load 7	Dood	Full Area	50			15,00 (11,59%)	BSI
Lood)	51.70	Full fried	300			40.00111.501	100
Load4	Dead	Percial Area	35	0.00	3.15	20.00(11.53")	pat
Loadi	L198	Portical Area	See	0.00	2.35	68,00001.580	pat
Loads	Dead	Pertial Area	50-	16,00	16.00	28,00(11,587)	mat
Load?	Line	Suttied Area	Deb	00.00	19.88	65,00(31,50)	par
Lough	provi	Foint.	So.	0.00	41.744	1687	Ibe
10009	Live	Boint	500	0.00		690	ibs
LoadII	Maint Ingraine	Bount.	80	2.00		3857	Lisa
lord]]	Sarthquake	Foliat	30	03.00		-10157	Unit.
Nond12	Karrhquake	Police:	No.	22,15		10153	Ibe
ided13	wastnquake	Fount.	No.	16.00		-8270	lbst
508014	Earthquake	90.00	Box	19,60		9270	1bo
Load 15	Dead	Sount:	Bo	2.16		1317	lbe
boadle:	Acre.	Polat:	Yes	37,75		4232	liter
Load 17	Doed	Point	No	16.60		1503	Ibe:
L09218	Live	Bolat	res	10.11		4232	lto.
Load19	Dona	PO SEC.	Ho.	19.11		1165	lbu.
Load20	Laur	Point	160	19.00		9791	ltw-
Load21	Donad	Purtial Aces	80	9.43	25.21	35.00 (6.75)	pal
Load22	1.100	Durtist Area	Yes		85.91	60:00 (6.75°)	per
felf-welght	Deal	Full: Ulli.	No.	1			plf:

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):

	75 137	
	847P	E
Secure: Sead Live Earthquake	13946 26983 5166	33
Unite Total	40038	200
acoucley Askam Support on randic Bayers Bayers Loed runb acqui b b b b b b copyri b b copyri b copyri b copyri copyr	49529 49038 2.100 0.75; 45 1362 13.	1ec tes 3. 0. 0. 4. 4. 2. 2. 2. 1. 4. 4. 2. 1. 2. 1. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4.

FF3
Glutam-Bal., West Species, 24F-V8 DF, 5-1/2"x25-1/2"
17 Introductors, 5-1(7" materials width,
Supports, An - Tender-out Basin, DFIn - No.2
Total length: 76.53° Color 1991 F, 11.5°, victions = 25.2 out.
Lateral support top- Nat, instrume AA,

Analysis vs. Allowable Stress and Deflection Have NOS 2015:

SEISGEION	Amulyola Value	Jeolga Value	Unit	analysis/Pesign
Secding(+) Secding(-) Declection:	fo = 1613 fb = 1613 fb = 1985	Pb' = 2284 Pb' = 2384	peri peri	fb/Fb' = 0.52 fb/Fb' = 0.52
Interior 1, we Total Cartil, 1, we	8.29 - 1/727	0.57 = L/368 0.86 - L/368 0.57 = L/190 0.85 = L/120	in in in	0.45 0.33 0.31

Additional Data:

E' 1-8 million 1.00 1.00 - Dirry' 8.0 million 1.00 1.00 - GUITCAL LOAD COMMUNETIONS: Thear 1.0 42 0-6, V may = 2235, V during Reching +1 to 47 0-6 (pattern: L) M = 48149 Reching +1 to 47 0-6 (pattern: L) M = 58613 Reching +1 to 47 0-6 (pattern: L) M = 58613 Reching +1 to 47 0-6 (pattern: L) M = 58613 Reching +1 to 48 0-6 (patt	- 1.80 1.80 1.00 500 1.70 1.80 1.00 500 1.00 1.00 1.00 - - 1.00 - - 1.00 - - 1.00 - - 20150 lbs
PV 255 1.46 1.90 1.00 1.00 1.00 0.50 1.50 0.50 1.50 1.00 1.0	- 1.80 1.80 1.00 500 1.70 1.80 1.00 500 1.00 1.00 1.00 - - 1.00 - - 1.00 - - 1.00 - - 20150 lbs
#85" 2000 1.30 1.00 1.00 1.00 1.00 8.00 1.50 1.50 1.00 1.00 1.00 1.00 1.00 1	.00 1.00 1.00 1.0000 1.00 1.00 1.00 1.00 1.00 1.00 20150 lbs
Port 200 1.80 1.00 1.00 1.00 1.00 1.00 1.00 1.	- 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
Prof 650 - 1.8 in in E. P. 1.9 in E. P. 1.9 illion 1.00 1.00 - 1.00 in Entry B./0 million 1.00 1.00 - 1.00 in Entry B./0 million 1.00 1.00 in Entry B./0 million 1.00 1.00 in Entry B./0 million 1.00 in Entry B./0 in Entry B./	- 1.00 - 1.00 - 1.00
Entry 8.40 million 1.00 1.00 GUNTACLONGOLOMOMOTORS Sheat : DC 62 = D46, V max = 22755, V design Sheat : DC 62 = D46, V max = 22755, V design Sheat : DC 62 = D46, V max = 22755, V design Sheatlage 1.1 DC 62 = D46, Ipathern 1.0, M = 5815 Sheatlage 1.1 DC 62 = D46, Ipathern 1.0, M = 5815 Sheatlage 1.1 DC 62 = D46, Ipathern 1.0, M = 5815 Sheatlage 1.1 DC 63 = D46, Ipathern 1.0, M = 5815 Sheatlage 1.1 DC 63 = D46, Ipathern 1.0, M = 5815 Sheatlage 1.1 DC 63 = D46, Ipathern 1.0, M = 5815 Sheatlage 1.1 DC 63 = D46, Ipathern 1.0, M = 5815 Sheatlage 1.1 DC 63 = D46, Ipathern 1.0 Sheatlage 1.1 DC 64, Ipathern	- 1,00 - 20159 lbs
GRITCAL LOAD COMPRESSION . See . 22355, V design floor: IC 62 - 064, V may = 22355, V design flooring the loading this for 67 - 054 [pattern: L. M. = 88149 flooring this floor of 15 - 11 [may] . M. = 8865 leaf leathers: IC 67 - 1 [Total] . M. = 8865 leaf leathers: IC 67 - 1 [Total] . M. = 8865 leaf leather flooring the manufacture of 15 - 1 [Total] . M. = 1 [T	20159 (bs
<pre>theat : UC 42 * DeG, V 889 = 22255, V 681 igs bending 4-1 to 47 * DeG [rettern: L). 8- 88143 bending 4-1 LC 86 * DeG [rettern: L), 8- 88143 bending 4-1 LC 86 * DeG [rettern: L), 8- 88613 bending 4-1 LC 87 * Lived Declaration: UC 87</pre>	Many 10c
CM.CH.ATCKS: Deflection: ET = lTeTseUE lb-Lm2 "Live" Setfection - Deflection five dli mon-deat lo Total Offiction = 1.38(Dead Load Deflection) + Liv	Coccentrated E-marthquai a load in talk apan

See celevations not po for Steel Beam

- Design Notes:

 1 Monthly/Wis public and decign after in accordance with the CID international Finding Code (IBC 2015), the transcriptional Design Superinted 2 Finding words the default deflected terms are appropriate for plant application.

 2 Finding words give a medical deflected terms are appropriate for plant application.

 3 Colorating Replay Tested are for instance, conforming an ANSI 117.2015 for instance for accordance with ANSI ANSI 2.5015 for instance for accordance with ANSI ANSI 2.5012

 4 Colorating Wish and bending acquiring the tax and bodies applied in a proper plant and applications of the second plant and applications are applications of the second plant and applications are applications are applications and applications are applications are applications and applications are applications are applications.

FF3 (USE STEEL)

WoodWorks® Sizer 11.1

Page 2

1 + 77" @ CANT

W14×48 of Pu # 2

Mx/2=196= Mmx=98.600

MAX RXN= 41" WID 5x5+1/4 25 2 66" PAD g= 1355pst/





FF4 Oct. 18, 2019 13:02

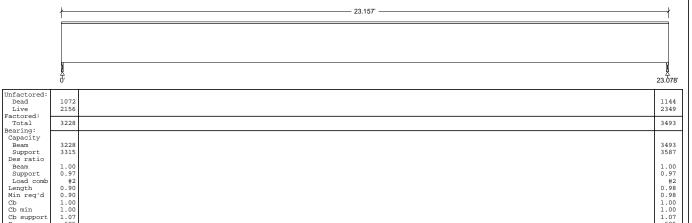
1.00

Design Check Calculation Sheet

Loads:

Load	Type	Distribution	Pat-	Location	on [ft]	Magnitude	Unit
			tern	Start	End	Start End	
Load1	Dead	Partial Area		0.08	13.58	15.00(4.25')	psf
Load2	Live	Partial Area		0.08	13.58	40.00(4.25')	psf
Load3	Dead	Partial Area		13.58	17.08	15.00(8.50')	psf
Load4	Live	Partial Area		13.58	17.08	40.00(8.50')	psf
Load5	Dead	Partial Area		17.08	23.08	15.00(4.25')	psf
Load6	Live	Partial Area		17.08	23.08	40.00(4.25')	psf
Self-weight	Dead	Full IIDI.				22 8	blf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):



FF4

Glulam-Unbal., West Species, 24F-V4 DF, 5-1/2"x18"

12 Iaminations, 5-1/2" maximum width,
Supports: All - Timber-soft Beam, D.Fir-L No.2

Total length: 23.16; Clear span: 23; volume = 15.9 cu.ft.
Lateral support: top= full, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 47	Fv' = 265	psi	fv/Fv' = 0.18
Bending(+)	fb = 825	Fb' = 2267	psi	fb/Fb' = 0.36
Live Defl'n	$0.27 = \langle L/999 \rangle$	0.77 = L/360	in	0.35
Total Defl'n	0.47 = L/588	1.15 = L/240	in	0.41

Additional Data:

Cb Cb min

Addition	iai Dala.										
FACTORS:	F/E(psi)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cn*Cvr	LC#
Fv'	265 1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	2400 1.00	1.00	1.00	1.000	0.945	1.00	1.00	1.00	1.00	-	2
Fcp'	650 -	1.00	1.00	-	-	-	-	1.00	-	-	-
E'	1.8 million	1.00	1.00	-	-	-	-	1.00	-	-	2

CALCULATIONS:
Deflection: EI = 4811e06 lb-in2

"Live" deflection = Deflection from all non-dead loads (live, wind, snow...)

Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.

- Design Notes:

 1. WoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. Glulam design values are for materials conforming to ANSI 117-2015 and manufactured in accordance with ANSI A190.1-2012

 4. GLULAM: bxd = actual breadth x actual depth.

 5. Glulam Beams shall be laterally supported according to the provisions of NDS Clause 3.3.3.

 6. GLULAM: bearing length based on smaller of Fcp(tension), Fcp(comp'n).





FF5 Oct. 18, 2019 13:02

Design Check Calculation Sheet

Loads:

ı								
ı	Load	Type	Distribution	Pat-		[ft]		Unit
ı				tern	Start	End	Start End	l
ı	Load1	Dead	Full Area	No			15.00(6.75')	psf
ı	Load2	Live	Full Area	Yes			60.00(6.75')	psf
ı	Load3	Snow	Full Area	Yes			30.00(6.75')	psf
ı		Dead	Full UDL	NO			15 2	nlf

Maximum I	React	tions (lbs), Bearing Capacities (lbs) and Bearing Le	engths (in):	
	<u></u>		21.122" —	ł
				1
		Ä	<u>)</u>	(
	0'	6.432'	21.0	576'
Unfactored: Dead Live Snow		1766 6142 3071		693 2984 1349
Factored: Total		8676		3943
Bearing: Capacity Beam Support Des ratio		9788 8676		3943 4050
Beam Support Load comb Length Min req'd Cb		0.89 1.000 8 2.36 2.36** 1.16		1.00 0.97 #12 1.10 1.10 1.00 1.00
Cb Cb min Cb support		1.16 1.07		1.00

FF5

FF5
Glulam-Bal., West Species, 24F-V8 DF, 5-1/2"x12"
8 laminations, 5-1/2" maximum width,
Supports: All - Timber-soft Beam, D. Fir-L. No.2
Total length: 2-1/2; Clear span (-6.33/; 14.5; volume = 9.7 cu.ft.
Lateral support: top= full, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear Bending(+) Bending(-)	fv = 91 fb = 1164 fb = 981	Fv' = 265 Fb' = 2400 Fb' = 2357	psi psi psi	fv/Fv' = 0.34 fb/Fb' = 0.48 fb/Fb' = 0.42
Deflection: Interior Live Total Cantil. Live	0.31 = L/575 0.37 = L/470 0.42 = L/182	0.49 = L/360 0.73 = L/240 0.43 = L/180	in in in	0.63 0.51 0.99
Total	0 43 - T./180	0 64 - T./120	in	0.67

Additional Data:

Additio	nai De	ııa.										
FACTORS:	F/E(p	osi)CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cn*Cvr	LC#
Fv'	265	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+			1.00		1.000	1.000	1.00	1.00	1.00	1.00	-	6
Fb'-	2400	1.00	1.00	1.00	0.982	1.000	1.00	1.00	1.00	1.00	-	2
Fcp'					-			-	1.00	-	-	-
E'	1.8 n	nillion	1.00	1.00	-	-	-	-	1.00	-	-	12
Eminy'	0.85 m	nillion	1.00	1.00	-	-	-	-	1.00	-	-	12
CRITICAL L	OAD CO	MBINATIO	ONS:									
Shear	: LC	#2 = E)+L, V	max =	4555,	V desi	gn =	3984	lbs			
Bending(+): LC	#6 = I)+L (pa	ttern:	_L), M	= 127	99 lbs	-ft				
Bending(-): LC	#2 = E)+L, M	= 107	86 lbs-	ft						
Deflecti	ion: LC	#12 =	(live)								
		#12 =										
D=dead I	=live S	S=snow W	/=wind	I=impa	ct Lr=r	oof liv	e Lc=c	oncent	rated	E=eart	hquake	

D-dead L-live S-snow W-wind I-impact Lr=roof live Lc=concentrated E-earthquake
All LC's are listed in the Analysis output
Load Patterns: s=S/2, X=L+S or L-LT, _=no pattern load in this span
Load combinations: ASCE 7-10 / IBC 2015
CALCULATIONS:
Deflection: EI = 1426e06 lb-in2
Live deflection = Deflection from all non-dead loads (live, wind, snow_)
Total Deflection = 1.50/Lead Load Deflection) + Live Load Deflection.
Lateral stability(-): Lu = 14.63' Le = 24.06' RB = 10.7; Lu based on full span

- Design Notes:

 1. WoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. Gluland nesign values are for materials conforming to ANSI 117-2015 and manufactured in accordance with ANSI A190.1-2012

 4. Grades with equal bending capacity in the top and bottom edges of the beam cross-section are recommended for continuous beams.

 5. GLULANT but = actual breasth a vactual depth.

 6. Glulan Beams shall be laterally supported according to the provisions of NDS Clause 3.3.3.

 7. GLULANT beams shall be laterally supported according to the provisions of NDS Clause 3.3.3.

 8. The critical deflection value has been determined using maximum back-span deflection. Cartillever deflections do not govern design.





FF6 Oct. 18, 2019 13:02

Design Check Calculation Sheet

n	-	A	0	

Load	Type	Distribution	Pat-		[ft]			Unit
			tern	Start	End	Start	End	l .
Load1	Dead	Full Area	No			15.00(16	.50')	psf
Load2	Live	Full Area	Yes			40.00(16	.50')	psf
Self-weight	Dead	Full UDL	No			7.7		plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :

 	16.873'		+
M	M	M	N N
ك	ل	<u>₩</u>	Ž.

	1.333'	6.5'	11.667'	16.833'
Unfactored: Dead Live Factored:	923 2558	1380 4092	1468 4137	534 1561
Total Bearing:	3482	5472	5605	2095
Capacity Beam Support Des ratio Beam Support	3965 3482 0.88 1.00	5763 5472 0.95 1.00	5883 5605 0.95 1.00	2095 2320 1.00 0.90
Load comb Length Min req'd Cb	#13 1.44 1.44** 1.26	#8 2.26** 1.17	#15 2.31 2.31** 1.16	#12 0.96 0.96 1.00
Cb min Cb support	1.26 1.11 625	1.17	1.16 1.11 625	1.00 1.11 625

| 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200

FF6

Lumber-soft, D.Fir-L, No.2, 4x10 (3-1/2"x9-1/4")
Supports: All - Timber-soft Beam, D.Fir-L No.2
Total length: 16.87"; Clear span: 1.273", 5.013", 4.976", 5.03"; volume = 3.8 cu.ft.
Lateral support: top= at all supports, bottom= at all supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 98	Fv' = 180	psi	fv/Fv' = 0.55
Bending(+)	fb = 557	Fb' = 1072	psi	fb/Fb' = 0.52
Bending(-)	fb = 671	Fb' = 1072	psi	fb/Fb' = 0.63
Deflection:				
Interior Live	0.02 = <l 999<="" td=""><td>0.17 = L/360</td><td>in</td><td>0.13</td></l>	0.17 = L/360	in	0.13
	0.02 = <l 999<br="">0.03 = <l 999<="" td=""><td>0.17 = L/360 0.26 = L/240</td><td>in in</td><td>0.12</td></l></l>	0.17 = L/360 0.26 = L/240	in in	0.12
Interior Live Total				

Additional Data:

ı	FACTORS:	F/E(p	si)CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
ı	Fv'	180	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	15
ı	Fb'+	900	1.00	1.00	1.00	0.992	1.200	1.00	1.00	1.00	1.00	-	12
ı	Fb'-	900	1.00	1.00	1.00	0.992	1.200	1.00	1.00	1.00	1.00	-	15
ı	Fcp'												-
ı		1.6 m									1.00		12
ı	Emin'				1.00	-	-	-	-	1.00	1.00	-	12
ı	CRITICAL L												
ı	Shear										= 2	119 lb	S
ı	Bending(
ı	Bending(L_LL),	M =	2791 1	bs-ft				
ı	Deflection: LC #12 = (live)												
ı			#12 =										
ı	D=dead I							re Lc=c	oncent	trated	E=eart	hquake	2
ı	All LC's												
ı	Load Pat						no pati	tern lo	ad in	this s	pan		
ı	Load com		ns: ASC	E 7-10	/ IBC	2015							
ı	CALCULAT												
ı	Deflecti												
ı	"Live" d											·)	
ı	Total De												
ı	Lateral												
ı	Lateral	stabili	τλ(-):	Lu =	5.19'	ье = 9	.69' 1	KB = 9.	4; Lu	pased	on ful	ı span	
Ì	Doolan	Notos											

- Design Notes:

 I. Wood/Vorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. Continuous or Cantilevered Beams: NDS Clause 4.2.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.

 4. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.

 5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.





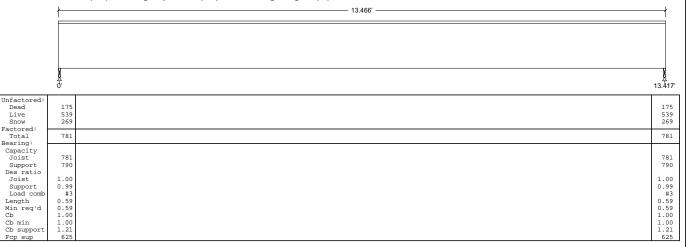
FF7 (deck joist) Oct. 18, 2019 13:02

Design Check Calculation Sheet

Loads:

Load	Type	Distribution	Pat-	Location	[ft]	Magnitud	le	Unit
			tern	Start	End	Start	End	
Loadl	Dead	Full Area				15.00(16.	.0")	psf
Load2	Live	Full Area				60.00(16.	.0")	psf
Load3	Snow	Full Area				30.00(16	.0")	psf
Self-weight	Dead	Full UDL				6.0		olf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):



LVL n-ply, 1.8E, 2600Fb, 1-3/4"x11-7/8", 1-ply
Supports: All - Timber-soft Beam, D.Fir-L No.2
Floor joist spaced at 16" o/c; Total length: 13.47; Clear span: 13.367; volume = 1.9 cu.ft.
Lateral support: top= full, bottom= at supports; Repetitive factor: applied where permitted (refer to online help);

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 44	Fv' = 285	psi	fv/Fv' = 0.15
Bending(+)	fb = 696	Fb' = 2707	psi	fb/Fb' = 0.26
Live Defl'n	$0.15 = \langle L/999 \rangle$	0.45 = L/360	in	0.33
Total Defl'n	0.21 = L/752	0.67 = L/240	in	0.32

Additional Data:

FACTORS:	F/E(psi)	CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	285 1	L.00	-	1.00	-	-	-	-	1.00	-	1.00	2
Fb'+	2600 1	L.00	-	1.00	1.000	1.00	-	1.04	1.00	-	-	2
Fcp'	750	-	-	1.00	-	-	-	-	1.00	-	-	-
E'	1.8 mill	lion	-	1.00	-	-	-	-	1.00	-	-	3
Eminy!	0 93 mill	lion	_	1 00	_	_	_	_	1.00	_	_	3

Eminy' 0.93 million 1.00 - 1.00 - 1.00 - - CRITICAL LOAD COMBINATIONS:
Shear : LC #2 = D+L, V max = 711, V design = 603 lbs
Bending(+): LC #2 = D+L, M = 2385 lbs-ft
Deflection: LC #3 = D+.75(L+S) (live)
LC #3 = D+.75(L+S) (total)
Dedead L=live S=snow W=wind I=impact Lr=roof live Lc=concentrated E=earthquake
All LC's are listed in the Analysis output
Load combinations: ASCE 7-10 / IBC 2015
CALCULATIONS:

CALCULATIONS:
Deflection: EI = 440e06 lb-in2

"Live" deflection = Deflection from all non-dead loads (live, wind, snow...)

Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.

Design Notes:

- 1. WoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. System factor KH may not apply to field-assembled multi-ply beams.

 4. FIRE RATING: Joists, wall studs, and multi-ply members are not rated for fire endurance.





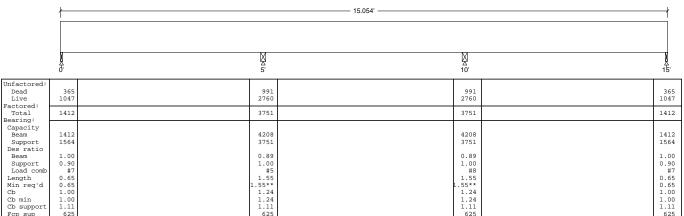
B1 Oct. 18, 2019 13:03

Design Check Calculation Sheet

Loads:

Load	Type	Distribution	Pat-	Location [f	t]	Magnitude	Unit
			tern	Start En	ıd	Start End	
Loadl	Dead	Full Area	No			15.00(11.50')	psf
Load2	Live	Full Area	Yes			40.00(11.50')	psf
Self-weight	Dead	Full UDL	No			7.7	plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in):



Fcp_sup | 625 | *Minimum bearing length governed by the required width of the supporting member.

Lumber-soft, D.Fir-L, No.2, 4x10 (3-1/2"x9-1/4")

Supports: All - Timber-soft Beam, D.Fir-L No.2

Total length: 15.05'; Clear span: 4.909', 4.871', 4.909'; volume = 3.4 cu.ft.

Lateral support: top= at all supports, bottom= at all supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 66	Fv' = 180	psi	fv/Fv' = 0.37
Bending(+)	fb = 366	Fb' = 1071	psi	fb/Fb' = 0.34
Bending(-)	fb = 431	Fb' = 1071	psi	fb/Fb' = 0.40
Live Defl'n	$0.01 = \langle L/999$	0.17 = L/360	in	0.08
Total Defl'n	$0.02 = \langle L/999$	0.25 = L/240	in	0.08

Additional Data:

FACTORS:	F/E(ps	si)CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	180	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	5
Fb'+	900	1.00	1.00	1.00	0.992	1.200	1.00	1.00	1.00	1.00	-	7
Fb'-	900	1.00	1.00	1.00	0.992	1.200	1.00	1.00	1.00	1.00	-	5
Fcp'	625	-	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.6 mi	illion	1.00	1.00	-	-	-	-	1.00	1.00	-	7
Emin'	0.58 mi	illion	1.00	1.00	-	-	-	-	1.00	1.00	-	7

Emin' 0.58 million 1.00 1.00 - - - - 1.00 1.00 - CRITICAL LOAD COMBINATIONS:

Shear : LC #5 = D+L (pattern: LL_), V max = 1959, V design = 1428 lbs

Bending(+): LC #7 = D+L (pattern: LL_), M = 1521 lbs-ft

Bending(-): LC #5 = D+L (pattern: LL_), M = 1792 lbs-ft

Deflection: LC #7 = (live)

LC #7 = (total)

D=dead L=live S=snow W=wind I=impact Lr=roof live Lc=concentrated E=earthquake
All LC's are listed in the Analysis output

Load combinations: ASCE 7-10 / IBC 2015

CALCULATIONS:

Deflection: EI = 369e06 lb-in2

"Live" deflection = Deflection from all non-dead loads (live, wind, snow...)

Total Deflection = 5.00 lead Load Deflection + Live Load Deflection.

Lateral stability(-): Lu = 5.00' Le = 10.31' RB = 9.7; Lu based on full span

Lateral stability(-): Lu = 5.00' Le = 10.31' RB = 9.7; Lu based on full span

Design Notes:

- 1. WoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.

 2. Please verify that the default deflection limits are appropriate for your application.

 3. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans. 4. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.

Title Soil High and Soil Low Job #: Dsgnr: TMP Description....

Page: 1 Date: 18 OCT 2019

This Wall in File: Q:\0-PROJECTS\2015\PB Architectural\Wen Hu Residence\Retaining Wall Calcs\cantile

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

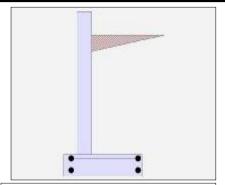
Criteria

Retained Height 5.00 ft Wall height above soil 1.00 ft Slope Behind Wall 0.00 Height of Soil over Toe 0.00 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 250.0 psf/ft Soil Density, Heel 110.00 pcf Soil Density, Toe 0.00 pcf 0.450 Footing||Soil Friction

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 NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load 360.0 lbs Axial Live Load 720.0 lbs **Axial Load Eccentricity** 0.0 in

Earth Pressure Seismic Load

Method: Uniform

Multiplier Used 7.000 (Multiplier used on soil density)

Lateral Load Applied to Stem

Lateral Load 0.0 #/ft 0.00 ft...Height to Top = ...Height to Bottom = 0.00 ft Wind (W) Load Type (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 = 0.00 ft Wall to Ftg CL Dist = Footing Type Line Load Base Above/Below Soil 0.0 ft at Back of Wall Poisson's Ratio 0.300

Uniform Seismic Force = 41.417 **Total Seismic Force** 245.049

Design Summary

Wall Stability Ratios

....for 1.5 Stability

Overturning Sliding	=	2.72 1.51		
Sharing				
Total Bearing Load	=	3,399		
resultant ecc.	=	8.27	in	
Soil Pressure @ Toe	=		psf OK	
Soil Pressure @ Heel	=	0	psf OK	
Allowable	=	3,000		
Soil Pressure Less	Than A	llowable	ė	
ACI Factored @ Toe	=	2,991	psf	
ACI Factored @ Heel	=	0	psf	
Footing Shear @ Toe	=	0.1	psi OK	
Footing Shear @ Heel	=	18.2	psi OK	
Allowable	=	75.0	psi	
Sliding Calcs				
Lateral Sliding Force	=	784.2	lbs	
less 100% Passive Force	= -	20.0	lbs	
less 100% Friction Force	= - 1	,205.5	lbs	
Added Force Req'd	=	0.0	lbs OK	

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

0.0 lbs OK

Load Factors —	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

Ste

em Construction		Bottom	
Design Usink Above Etc		Stem OK	
Design Height Above Ftg		0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
Thickness	=	8.00 # 4	
Rebar Size	=		
Rebar Spacing	=	16.00	
Rebar Placed at Design Data	=	Edge	
fb/FB + fa/Fa	=	0.411	
Total Force @ Section	_	0.411	
Service Level	lha		
	lbs =	007.4	
Strength Level	lbs =	907.1	
MomentActual			
Service Level	ft-# =	4 00 4 4	
Strength Level	ft-# =	1,684.4	
MomentAllowable	=	4,099.3	
ShearActual			
Service Level	psi =		
Strength Level	psi=	12.1	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.25	
Masonry Data		0.20	
f'm	psi=		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf=	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	eight
Masonry Design Method	=	ASD	•
Concrete Data			
f'c	psi =	2,500.0	
Fy	psi =	60,000.0	

Title Soil High and Soil Low Job #: Dsgnr: TMP

Description....

Horizontal Reinforcing

Min Stem T&S Reinf Area 1.152 in2

Horizontal Reinforcing Options:

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 2

Date: 18 OCT 2019

Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing

As (based on applied moment): 0.0631 in2/ft

0.0841 in2/ft (4/3) * As:

200bd/fy: 200(12)(6.25)/60000: 0.25 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

0.0014bh: 0.0014(12)(8): 0.1344 in2/ft

One layer of: Two layers of: Required Area: 0.1344 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.15 in2/ft #5@ 19.38 in Maximum Area: 0.8467 in 2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

ı			
	T 147: 141		0.50.4
	Toe Width	=	0.58 ft
	Heel Width	=	2.92
	Total Footing Width	= _	3.50
	Footing Thickness	=	11.00 in
	Key Width	=	0.00 in
	Key Depth	=	0.00 in
	Key Distance from Toe	=	0.00 ft
	f'c = 2,500 psi Footing Concrete Densit Min. As %	Fy = y = =	60,000 psi 150.00 pcf 0.0018
	Cover @ Top 2.00		3.00 in

Footing Design Results

		<u>Toe</u>	Heel
Factored Pressure	=	2,991	0 psf
Mu' : Upward	=	477	0 ft-#
Mu' : Downward	=	28	2,089 ft-#
Mu: Design	=	449	2,089 ft-#
Actual 1-Way Shear	=	0.06	18.20 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	# 4 @ 10.10 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not reg'd: Mu < phi*5*lambda*sqrt(f'c)*Sm

Heel: #4@ 10.10 in, #5@ 15.66 in, #6@ 22.22 in, #7@ 30.30 in, #8@ 39.90 in, #9@ 5

Key: No key defined

Min footing T&S reinf Area 0.83 in2 Min footing T&S reinf Area per foot 0.24 in2 /ft

If one layer of horizontal bars: If two layers of horizontal bars:

#4@ 10.10 in #4@ 20.20 in #5@ 15.66 in #5@ 31.31 in #6@ 22.22 in #6@ 44.44 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING)	<u> </u>		RE	SISTING	
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	612.6	1.97	1,208.2	Soil Over Heel	=	1,237.7	2.37	2,939.3
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Ster	m =	360.0	0.92	329.9
Load @ Stem Above So	oil =				* Axial Live Load on Stem	=	720.0	0.92	659.8
Seismic Earth Load	=	171.5	2.96	507.5	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		704.0	O.T.M.	1.715.7	Stem Weight(s)	=	600.0	0.92	549.8
Iotai		704.2	O. I . IVI.	1,715.7	Earth @ Stem Transition	ns=			
	=		=		Footing Weight	=	481.3	1.75	842.2
Resisting/Overturnin	g Rat	io	=	2.72	Key Weight	=			
Vertical Loads used f	or So	il Pressure :	= 3,398.	9 lbs	Vert. Component	=			
					Tota	al =	2.678.9 I	bs R.M.=	4.661.2

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

ı otal = 2,678.9 IDS **R.M.=** * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Title Soil High and Soil Low
Job #: Dsgnr: TMP
Description....

Page: 3

Date: 18 OCT 2019

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Code: IBC 2015,ACI 318-14,ACI 530-13
License To: Phillips Structural Engineering

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) 0.102 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.

Title Soil High and Soil Low Job #: Dsgnr: TMP Description....

12.00 in

Bottom

Page: 1 Date: 18 OCT 2019

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Cantilevered Retaining Wall

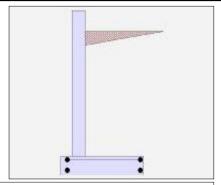
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height 6.00 ft Wall height above soil 1.00 ft Slope Behind Wall 0.00 Height of Soil over Toe 0.00 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 250.0 psf/ft Soil Density, Heel 110.00 pcf Soil Density, Toe 0.00 pcf Footing||Soil Friction 0.450 Soil height to ignore



Surcharge Loads

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

Axial Load Applied to Stem

Axial Dead Load	=	360.0 lbs
Axial Live Load	=	720.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method: Uniform

Multiplier Used 7.000 (Multiplier used on soil density)

Lateral Load Applied to Stem

for passive pressure

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 at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Uniform Seismic Force = 48.417 Total Seismic Force 334.882

Design Summary

Wall Stability Ratios

Overturning	=	2.80 Ok 1.50 Ok	
Sliding	=	1.50 Or	•
Total Bearing Load	=	4,347 lbs	
resultant ecc.	=	10.09 in	
Soil Pressure @ Toe	=	2,255 psf	OK
Soil Pressure @ Heel	=	0 psf	
Allowable	=	3,000 psf	
Soil Pressure Less	Than	Allowable	
ACI Factored @ Toe	=	3,156 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	0.1 psi	OK
Footing Shear @ Heel	=	28.2 psi	OK
Allowable	=	75.0 psi	
Sliding Calcs			
Lateral Sliding Force	=	1,071.6 lbs	

20.0 lbs

0.0 lbs OK

0.0 lbs OK

1,632.1 lbs

less 100% Passive Force = -

less 100% Friction Force = -

Added Force Req'dfor 1.5 Stability

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

Load Factors —	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

Stem Construction Stem OK **Design Height Above Ftg** ft = 0.00 Wall Material Above "Ht" Concrete Design Method **LRFD** Thickness 8.00 = Rebar Size # 4 Rebar Spacing 15.00 = Rebar Placed at Edge **Design Data** 0.662 fb/FB + fa/Fa **Total Force @ Section** Service Level lbs =Strength Level lbs = 1,298.5 Moment....Actual Service Level ft-# = Strength Level ft-# = 2,887.5 Moment.....Allowable 4,364.1 Shear.....Actual

Service Level	psi =	
Strength Level	psi=	17.3
ShearAllowable	psi=	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	6.25
laaamus Data		

Masonry Data f'm

Fs psi = Solid Grouting Modular Ratio 'n' Wall Weight 100.0 psf = Short Term Factor Equiv. Solid Thick.

psi =

Masonry Block Type Medium Weight Masonry Design Method = ASD

Concrete Data f'c psi = 2,500.0 60,000.0 Fy psi =

Title Soil High and Soil Low Job #: Dsgnr: TMP Description....

Horizontal Reinforcing

Min Stem T&S Reinf Area 1.344 in2

Horizontal Reinforcing Options:

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 2

Date: 18 OCT 2019

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Bottom Stem Vertical Reinforcing

As (based on applied moment): 0.1082 in2/ft

0.1442 in2/ft (4/3) * As:

200bd/fy: 200(12)(6.25)/60000: 0.25 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

0.0014bh: 0.0014(12)(8): 0.1344 in2/ft

One layer of: _____ Two layers of: Required Area: 0.1442 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.16 in2/ft #5@ 19.38 in Maximum Area: 0.8467 in 2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

ι				
	Toe Width	=	0.5	8 ft
	Heel Width	=	3.6	67
	Total Footing Width	= _	4.2	25
	Footing Thickness	=	11.0	0 in
	Key Width	=	0.0	0 in
	Key Depth	=	0.0	0 in
	Key Distance from Toe	=	0.0	0 ft
	f'c = 2,500 psi	Fy =	60,00	0 psi
	Footing Concrete Density	/ =	150.0	0 pcf
	Min. As %	=	0.001	8
	Cover @ Top 2.00	@ E	3tm.= 3	3.00 in

Footing Design Results

		<u>Toe</u>	Heel
Factored Pressure	=	3,156	0 psf
Mu' : Upward	=	509	0 ft-#
Mu' : Downward	=	28	4,316 ft-#
Mu: Design	=	481	4,316 ft-#
Actual 1-Way Shear	=	0.06	28.18 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	# 4 @ 10.10 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not reg'd: Mu < phi*5*lambda*sqrt(f'c)*Sm

Heel: #4@ 10.10 in, #5@ 15.66 in, #6@ 22.22 in, #7@ 30.30 in, #8@ 39.90 in, #9@ 5

Key: No key defined

Min footing T&S reinf Area 1.01 in2 Min footing T&S reinf Area per foot 0.24 in2 /ft

If one layer of horizontal bars: If two layers of horizontal bars:

#4@ 10.10 in #4@ 20.20 in #5@ 15.66 in #5@ 31.31 in #6@ 22.22 in #6@ 44.44 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING)			RE	SISTING	•
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	837.2	2.31	1,930.2	Soil Over Heel	=	1,982.2	2.75	5,453.7
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Ster	m =	360.0	0.92	329.9
Load @ Stem Above So	oil =				* Axial Live Load on Stem	=	720.0	0.92	659.8
Seismic Earth Load	=	234.4	3.46	810.7	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		1 071 6	O.T.M.	2.740.9	Stem Weight(s)	=	700.0	0.92	641.4
IOtai		1,071.6	O.T.IVI.	2,740.9	Earth @ Stem Transition	ns=			
	=		=		Footing Weight	=	584.8	2.13	1,243.6
Resisting/Overturnin	g Rat	io	=	2.80	Key Weight	=			
Vertical Loads used f	or So	il Pressure :	= 4,347.	0 lbs	Vert. Component	=			
					Tota	al =	3.627.0	bs R.M.=	7,668.6

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

ı otal = 3,627.0 IDS **R.M.=** * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Title Soil High and Soil Low
Job #: Dsgnr: TMP
Description....

Page: 3 Date: 18 OCT 2019

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Code: IBC 2015,ACI 318-14,ACI 530-13
License To: Phillips Structural Engineering

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) 0.103 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.

Title Soil High and Soil Low Job #: Dsgnr: TMP Description....

12.00 in

Page: 1 Date: 18 OCT 2019

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height 7.00 ft Wall height above soil 1.00 ft Slope Behind Wall 0.00 Height of Soil over Toe 0.00 in 0.0 ft Water height over heel

Soil Data

Allow Soil Bearing 3,000.0 psf Equivalent Fluid Pressure Method Active Heel Pressure 35.0 psf/ft Passive Pressure 250.0 psf/ft Soil Density, Heel 110.00 pcf Soil Density, Toe 0.00 pcf Footing||Soil Friction 0.450

Soil height to ignore for passive pressure

Surcharge Loads

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

Axial Load Applied to Stem

Axial Dead Load 360.0 lbs Axial Live Load 720.0 lbs **Axial Load Eccentricity** 0.0 in

Earth Pressure Seismic Load

Method: Uniform Multiplier Used

7.000 (Multiplier used on soil density)

Lateral Load Applied to Stem

Lateral Load 0.0 #/ft 0.00 ft...Height to Top = ...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

Uniform Seismic Force = 56.000 **Total Seismic Force** 448.000

Design Summary

Wall Stability Ratios

Overturning	=	2.82 OK
Sliding	=	1.51 OK
Total Bearing Load	=	5,521 lbs
resultant ecc.	=	11.77 in
Soil Pressure @ Toe	=	2,420 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	3,000 psf
Soil Pressure Less	Than	Allowable
ACI Factored @ Toe	=	3,389 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	0.2 psi OK
Footing Shear @ Heel	=	36.3 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	1,433.6 lbs

0.0 lbs

0.0 lbs OK

0.0 lbs OK

Fy

2,160.2 lbs

less 100% Passive Force = -

less 100% Friction Force = -

Added Force Req'dfor 1.5 Stability

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

Load Factors —	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

Ste

em 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	=	10.00		
Rebar Placed at	=	Edge		
Design Data ————				
fb/FB + fa/Fa	=	0.710		
Total Force @ Section				
Service Level	lbs=			
Strength Level	lbs =	1,764.0		
MomentActual				
00.1.00 20.0.	ft-# =			
Strength Level	ft-# =	4,573.3		
MomentAllowable	=	6,444.1		
ShearActual				
Service Level	psi=			
Strength Level	psi=	23.5		
ShearAllowable	psi =	75.0		
Anet (Masonry)	in2 =			
Rebar Depth 'd'	in =	6.25		
Masonry Data				
f'm	psi=			
Fs	psi =			
Solid Grouting	_ =			
Modular Ratio 'n'	=			
Wall Weight	psf=	100.0		
Short Term Factor				
Equiv. Solid Thick.	=			
Masonry Block Type	=	Medium W	/eight	
Masonry Design Method	=	ASD		
Concrete Data				
f'c	psi =	2,500.0		

psi =

60,000.0

Title Soil High and Soil Low Job #: Dsgnr: TMP Description....

Horizontal Reinforcing

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 2

Date: 18 OCT 2019

License To: Phillips Structural Engineering Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing

As (based on applied moment): 0.1713 in2/ft

0.2285 in2/ft Min Stem T&S Reinf Area 1.536 in2 (4/3) * As:

200bd/fy: 200(12)(6.25)/60000: 0.25 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

0.0014bh: 0.0014(12)(8): 0.1344 in2/ft Horizontal Reinforcing Options: One layer of : _____ Two layers of:

Required Area: 0.2285 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.24 in2/ft #5@ 19.38 in Maximum Area: 0.8467 in 2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

Toe Width	=	0	.58 ft
Heel Width	=	4	.42
Total Footing Wid	dth =	5	.00
Footing Thickness	S =	12	.00 in
Key Width	=	0.	.00 in
Key Depth	=	0	.00 in
Key Distance from	m Toe =	0	.00 ft
f'c = 2,500 Footing Concrete			000 psi .00 pcf
Min. As %	=	0.00)18
Cover @ Top	2.00	₿ Btm.=	3.00 in

Footing Design Results

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	3,389	0 psf
Mu' : Upward	=	551	0 ft-#
Mu': Downward	=	31	7,776 ft-#
Mu: Design	=	521	7,776 ft-#
Actual 1-Way Shear	=	0.19	36.35 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	# 4 @ 9.26 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not reg'd: Mu < phi*5*lambda*sqrt(f'c)*Sm

Heel: #4@ 9.26 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.78 in, #8@ 36.57 in, #9@ 46

Key: No key defined

Min footing T&S reinf Area 1.30 in2 Min footing T&S reinf Area per foot 0.26 in2 /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

Summary of Overturning & Resisting Forces & Moments

			ERTURNING	}			RE	SISTING	
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,120.0	2.67	2,986.7	Soil Over Heel	=	2,890.1	3.13	9,035.3
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Stem	า =	360.0	0.92	329.9
Load @ Stem Above So	oil =				* Axial Live Load on Stem	=	720.0	0.92	659.8
Seismic Earth Load	=	313.6	4.00	1,254.4	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		1,433.6		4.241.1	Stem Weight(s)	=	800.0	0.92	733.1
Iotai		1,433.6	O. I .IVI.	4,241.1	Earth @ Stem Transitions	s=			
	=		=		Footing Weight	=	750.5	2.50	1,877.3
Resisting/Overturnin	g Rat	tio	=	2.82	Key Weight	=			
Vertical Loads used f	for So	il Pressure :	= 5,520.	5 lbs	Vert. Component	=			
					Tota		4 800 5 I	he DM -	11 075 5

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

Total = 4,800.5 lbs **R.M.=** 11,975.5 * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Title Soil High and Soil Low
Job #: Dsgnr: TMP
Description....

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Date: 18 OCT 2019

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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) 0.108 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.

Title Soil High and Soil Low Job #: Description....

12.00 in

Dsgnr: TMP

Page: 1 Date: 18 OCT 2019

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height 8.00 ft Wall height above soil 1.00 ft 0.00 Slope Behind Wall Height of Soil over Toe 0.00 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 250.0 psf/ft Soil Density, Heel 110.00 pcf Soil Density, Toe 0.00 pcf Footing||Soil Friction 0.450

Soil height to ignore for passive pressure

Surcharge Loads

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

Axial Load Applied to Stem

Axial Dead Load 360.0 lbs Axial Live Load 720.0 lbs **Axial Load Eccentricity** 0.0 in

Earth Pressure Seismic Load

Method: Uniform Multiplier Used

7.000 (Multiplier used on soil density)

Lateral Load Applied to Stem

Lateral Load 0.0 #/ft 0.00 ft...Height to Top = ...Height to Bottom 0.00 ft Wind (W) Load Type (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

Uniform Seismic Force = 63.000 **Total Seismic Force** 567.000

Design Summary

Wall Stability Ratios

Lateral Sliding Force

Added Force Req'd

....for 1.5 Stability

less 100% Passive Force = -

less 100% Friction Force = -

Overturning Sliding	= =	3.07 OK 1.52 OK
Total Bearing Loadresultant ecc.	= =	6,831 lbs 12.20 in
Soil Pressure @ Toe	=	2,344 psf OK
Soil Pressure @ Heel	=	0 psf OK
Allowable	=	3,000 psf
Soil Pressure Less	Thar	n Allowable
ACI Factored @ Toe	=	3,281 psf
ACI Factored @ Heel	=	0 psf
Footing Shear @ Toe	=	1.1 psi OK
Footing Shear @ Heel	=	48.8 psi OK
Allowable	=	75.0 psi
Sliding Calcs		

=

1,814.4 lbs

2,749.9 lbs

0.0 lbs

0.0 lbs OK

0.0 lbs OK

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

Load Factors —	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

Ste

Masonry Design Method

Concrete Data

f'c

Fy

em Construction		Bottom	
5 · 11 · 1 · A · 5 ·		Stem OK	
Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
Thickness Rebar Size	=	8.00 # 4	
	=	9.00	
Rebar Spacing Rebar Placed at	=		
Design Data	=	Edge	
fb/FB + fa/Fa	=	0.954	
Total Force @ Section			
Service Level	lbs=		
Strength Level	lbs=	2,296.0	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	6,794.7	
MomentAllowable	=	7,122.4	
ShearActual			
Service Level	psi =		
Strength Level	psi=	30.6	
ShearAllowable	psi=	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.25	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	eight

= ASD

2,500.0 60,000.0

psi =

psi =

Title Soil High and Soil Low Job #: Dsgnr: TMP Description....

Horizontal Reinforcing

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 2

Date: 18 OCT 2019

Concrete Stem Rebar Area Details

As (based on applied moment):

(4/3) * As:

Bottom Stem Vertical Reinforcing

0.2546 in2/ft

0.3394 in2/ft Min Stem T&S Reinf Area 1.728 in2

200bd/fy: 200(12)(6.25)/60000: 0.25 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

0.0014bh: 0.0014(12)(8): 0.1344 in 2/ft Horizontal Reinforcing Options: One layer of : Two layers of:

Required Area: 0.2546 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.2667 in2/ft #5@ 19.38 in Maximum Area: 0.8467 in 2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

Toe Width		=	0	.75 ft
Heel Width		=	5	.17
Total Footing Wid	lth	=	5	.92
Footing Thickness	3	=	12.	.00 in
Key Width		=	0.	.00 in
Key Depth		=	0.	.00 in
Key Distance from	n Toe	=	0.	.00 ft
f'c = 2,500 Footing Concrete		=y = =		000 psi .00 pcf
Min. As %		=	0.00	18
Cover @ Top	2.00	@	Btm.=	3.00 in

Footing Design Results

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	3,281	0 psf
Mu' : Upward	=	883	0 ft-#
Mu': Downward	=	51	12,533 ft-#
Mu: Design	=	833	12,533 ft-#
Actual 1-Way Shear	=	1.07	48.83 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	# 4 @ 6.32 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm

Heel: #4@ 6.32 in, #5@ 9.79 in, #6@ 13.89 in, #7@ 18.95 in, #8@ 24.95 in, #9@ 31.

Key: No key defined

Min footing T&S reinf Area 1.53 in2 Min footing T&S reinf Area per foot 0.26 in2 /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

Summary of Overturning & Resisting Forces & Moments

			ERTURNING)				SISTING	
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,417.5	3.00	4,252.5	Soil Over Heel	=	3,962.9	3.67	14,537.4
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Sten	า =	360.0	1.08	390.0
Load @ Stem Above So	oil =				* Axial Live Load on Stem	=	720.0	1.08	780.0
Seismic Earth Load	=	396.9	4.50	1,786.1	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		1 01 1 1		6 020 6	Stem Weight(s)	=	900.0	1.08	975.0
Iotai		1,814.4	O. I . IVI.	6,038.6	Earth @ Stem Transition	s=			
	=		=		Footing Weight	=	888.0	2.96	2,628.5
Resisting/Overturnin	g Rat	tio	=	3.07	Key Weight	=			
Vertical Loads used f	for So	il Pressure :	= 6,830.	9 lbs	Vert. Component	=			
					Tota		6 1 1 0 0	he DM -	18 530 8

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

Total = 6,110.9 lbs **R.M.=** 18,530.8 * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Title Soil High and Soil Low
Job #: Dsgnr: TMP
Description....

Page: 3

Date: 18 OCT 2019

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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) 0.099 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.

Title Soil High and Soil Low Job #: Dsgnr: TMP Description....

Page: 1 Date: 18 OCT 2019

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Cantilevered Retaining Wall

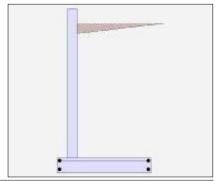
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height 9.00 ft Wall height above soil 1.00 ft Slope Behind Wall 0.00 Height of Soil over Toe 0.00 in 0.0 ft Water height over heel

Soil Data

Allow Soil Bearing 3,000.0 psf Equivalent Fluid Pressure Method Active Heel Pressure 35.0 psf/ft Passive Pressure 250.0 psf/ft Soil Density, Heel 110.00 pcf Soil Density, Toe 0.00 pcf Footing||Soil Friction 0.450 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 NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load	=	360.0 lbs
Axial Live Load	=	720.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load 0.0 #/ft 0.00 ft...Height to Top = ...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 at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Earth Pressure Seismic Load

Method: Uniform Multiplier Used 7.000 (Multiplier used on soil density)

Design Summary

Wall Stability Ratios Overturning

Sliding	=	1.52 OK
Total Bearing Loadresultant ecc.	=	8,281 lbs 13.45 in
Soil Pressure @ Toe Soil Pressure @ Heel	=	2,494 psf OK 0 psf OK
Allowable Soil Pressure Less	= Thar	3,000 psf n Allowable
ACI Factored @ Toe ACI Factored @ Heel	=	3,491 psf 0 psf
Footing Shear @ Toe	=	1.1 psi OK
Footing Shear @ Heel	=	63.0 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	2,240.0 lbs

less 100% Passive Force = -

less 100% Friction Force = -

Added Force Req'dfor 1.5 Stability

3.12 OK

3,402.6 lbs

0.0 lbs

0.0 lbs OK

0.0 lbs OK

f'c

Fy

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

Load Factors —	
	IBC 2015,ACI
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

Uniform Seismic Force = 70.000 Total Seismic Force 700.000

Stem Construction	7	Bottom	
		Stem OK	
Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
Thickness	=	8.00	
Rebar Size	=	# 5	
Rebar Spacing	=	8.00	
Rebar Placed at	=	Edge	
Design Data ————			
fb/FB + fa/Fa	=	0.817	
Total Force @ Section			
Service Level	lbs=		
Strength Level	lbs=	2,898.0	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	9,639.0	
MomentAllowable	=	11,799.2	
ShearActual			
Service Level	psi=		
Strength Level	psi =	39.0	
ShearAllowable	psi =	75.0	
	•	73.0	
Anet (Masonry)	in2 =	0.40	
Rebar Depth 'd'	in =	6.19	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'		400.0	
Wall Weight	psf =	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type		Medium Weigh	ht
Masonry Design Method	=	ASD	
Concrete Data			

psi =

psi =

2,500.0 60,000.0

Title Soil High and Soil Low Job #: Dsgnr: TMP

Description....

Horizontal Reinforcing

Page: 2 Date: 18 OCT 2019

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

License To: Phillips Structural Engineering Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing

As (based on applied moment): 0.365 in2/ft

0.4866 in2/ft Min Stem T&S Reinf Area 1.920 in2 (4/3) * As:

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

0.0014bh: 0.0014(12)(8): 0.1344 in 2/ft Horizontal Reinforcing Options: One layer of: Two layers of:

Required Area: 0.365 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.465 in2/ft #5@ 19.38 in Maximum Area: 0.8382 in2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

Toe Width		=	0	.75 ft
Heel Width		=	5	.92
Total Footing Wid	łth	=	6	.67
Footing Thickness	S	=	12.	.00 in
Key Width		=	0.	.00 in
Key Depth		=	0.	.00 in
Key Distance from	n Toe	=	0.	.00 ft
f'c = 2,500 Footing Concrete		=y = =		000 psi .00 pcf
Min. As %		=	0.00	18
Cover @ Top	2.00	@	Btm.=	3.00 in

Footing Design Results

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	3,491	0 psf
Mu' : Upward	=	945	0 ft-#
Mu': Downward	=	51	18,877 ft-#
Mu: Design	=	894	18,877 ft-#
Actual 1-Way Shear	=	1.15	63.04 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	# 4 @ 5.25 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm

Heel: #4@ 5.25 in, #5@ 8.14 in, #6@ 11.56 in, #7@ 15.76 in, #8@ 20.75 in, #9@ 26.

Key: No key defined

Min footing T&S reinf Area 1.73 in2 Min footing T&S reinf Area per foot 0.26 in2 /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

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING)			RE	SISTING	
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,750.0	3.33	5,833.3	Soil Over Heel	=	5,200.8	4.04	21,028.6
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Ster	m =	360.0	1.08	390.0
Load @ Stem Above So	oil =				* Axial Live Load on Stem	=	720.0	1.08	780.0
Seismic Earth Load	=	490.0	5.00	2,450.0	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		2.240.0	O.T.M.	8,283.3	Stem Weight(s)	=	1,000.0	1.08	1,083.3
IOIAI		2,240.0	O. I . IVI.	0,203.3	Earth @ Stem Transition	ns=			
	=		=		Footing Weight	=	1,000.5	3.34	3,336.7
Resisting/Overturnin	g Rat	tio	=	3.12	Key Weight	=			
Vertical Loads used f	or So	il Pressure :	= 8,281.	3 lbs	Vert. Component	=			
					Tota	al =	7 561 3 I	bs R.M.=	25.838.6

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

ı otal = 7,561.3 IDS **R.M.=** * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Title Soil High and Soil Low
Job #: Dsgnr: TMP
Description....

Page: 3

Date: 18 OCT 2019

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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) 0.104 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.

Title Soil High and Soil Low Job #: Dsgnr: TMP Description....

0.0 #/ft

0.00 ft

78.167

872.861

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height 10.00 ft Wall height above soil 1.00 ft Slope Behind Wall 0.00 Height of Soil over Toe 0.00 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 250.0 psf/ft Soil Density, Heel 110.00 pcf Soil Density, Toe 0.00 pcf Footing||Soil Friction 0.450

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 NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load 360.0 lbs Axial Live Load 720.0 lbs **Axial Load Eccentricity** 0.0 in

Earth Pressure Seismic Load

Method: Uniform Multiplier Used 7.000 (Multiplier used on soil density)

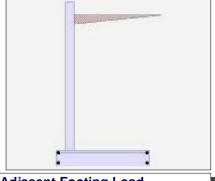
Lateral Load

...Height to Top

...Height to Bottom = 0.00 ft Load Type Wind (W) (Service Level) Wind on Exposed Stem _ 0.0 psf (Service Level)

=

Lateral Load Applied to Stem



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 at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Lateral Sliding Force

Added Force Req'dfor 1.5 Stability

less 100% Passive Force = -

less 100% Friction Force = -

Overturning 3.01 OK 1.51 OK Sliding = **Total Bearing Load** 9,967 lbs ...resultant ecc. 15.11 in Soil Pressure @ Toe 2,762 psf OK Soil Pressure @ Heel 0 psf OK 3,000 psf Allowable Soil Pressure Less Than Allowable ACI Factored @ Toe 3,867 psf ACI Factored @ Heel _ 0 psf Footing Shear @ Toe 0.2 psi OK = Footing Shear @ Heel 65.6 psi OK = Allowable 75.0 psi **Sliding Calcs**

=

2,793.2 lbs

4,161.3 lbs

45.1 lbs

0.0 lbs OK

0.0 lbs OK

=

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

Load Factors —	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

St

Uniform Seismic Force =

Total Seismic Force

Fy

tem Construction		Bottom	
Design Height Above Ftg	ft =	Stem OK 0.00	
Wall Material Above "Ht"	II = =	Concrete	
Design Method	_	LRFD	
Thickness	_	8.00	
Rebar Size	=	# 5	
Rebar Spacing	=	7.00	
Rebar Placed at	=	Edge	
Design Data —			
fb/FB + fa/Fa	=	0.996	
Total Force @ Section			
Service Level	lbs=		
Strength Level	lbs=	3,581.7	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	13,241.7	
MomentAllowable	=	13,297.3	
ShearActual			
Service Level	psi=		
Strength Level	psi=	48.2	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =	. 0.0	
Rebar Depth 'd'	in =	6.19	
Masonry Data		0.10	
f'm	psi=		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf=	100.0	
Short Term Factor	· =		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium We	eight
Masonry Design Method	=	ASD	-
Concrete Data			
f'c	psi =	2,500.0	

60,000.0

psi =

Title Soil High and Soil Low Job #: Dsgnr: TMP

Description....

Horizontal Reinforcing

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing

0.5014 in2/ft

As (based on applied moment): (4/3) * As:

0.6685 in2/ft Min Stem T&S Reinf Area 2.112 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

0.0014bh: 0.0014(12)(8): 0.1344 in 2/ft Horizontal Reinforcing Options: One layer of: Two layers of:

Required Area: 0.5014 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.5314 in2/ft #5@ 19.38 in Maximum Area: 0.8382 in2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

			<u> </u>
Toe Width	=	0.	75 ft
Heel Width	=	6.	58
Total Footing Widtl	h =	7.	33
Footing Thickness	=	14.	00 in
Key Width	=	0.	00 in
Key Depth	=	0.	00 in
Key Distance from	Toe =	0.	00 ft
f'c = 2,500 p	si Fy =		00 psi
Footing Concrete D	Density =	150.	00 pcf
Min. As %	=	0.00	18
Cover @ Top	2.00 @	Btm.=	$3.00 \ \text{in}$

Footing Design Results

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	3,867	0 psf
Mu': Upward	=	1,050	0 ft-#
Mu': Downward	=	59	26,750 ft-#
Mu: Design	=	991	26,750 ft-#
Actual 1-Way Shear	=	0.18	65.56 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	# 5 @ 6.00 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm

Heel: #4@ 4.51 in, #5@ 7.00 in, #6@ 9.93 in, #7@ 13.54 in, #8@ 17.83 in, #9@ 22.5

Key: No key defined

Min footing T&S reinf Area 2.22 in2 Min footing T&S reinf Area per foot 0.30 in2 /ft

If one layer of horizontal bars: If two layers of horizontal bars:

#4@ 7.94 in #4@ 15.87 in #5@ 12.30 in #5@ 24.60 in #6@ 17.46 in #6@ 34.92 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING)			RE	SISTING	
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	2,182.2	3.72	8,122.5	Soil Over Heel	=	6,504.7	4.37	28,447.1
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Ster	m =	360.0	1.08	390.0
Load @ Stem Above So	oil =				* Axial Live Load on Stem	=	720.0	1.08	780.0
Seismic Earth Load	=	611.0	5.58	3,411.4	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		2.793.2	O.T.M.	11,533.9	Stem Weight(s)	=	1,100.0	1.08	1,191.7
Iotai		2,793.2	O. I . IVI.	11,533.9	Earth @ Stem Transition	ns=			
	=		=		Footing Weight	=	1,282.8	3.67	4,701.3
Resisting/Overturnin	g Rat	tio	=	3.01	Key Weight	=			
Vertical Loads used f	or So	il Pressure :	= 9,967.	4 lbs	Vert. Component	=			
					Tota	al =	9 247 4 I	bs R.M.=	34.730.0

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

ı otal = 9,247.4 IDS **R.M.=** * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Title Soil High and Soil Low
Job #: Dsgnr: TMP
Description....

Page: 3 Date: 18 OCT 2019

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Cantilevered Retaining Wall
Code: IBC 2015,ACI 318-14,ACI 530-13
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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) 0.115 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.

Title Slab High and Slab Low Job #: Dsgnr: TMP Description....

12.00 in

Page: 1 Date: 18 OCT 2019

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Cantilevered Retaining Wall

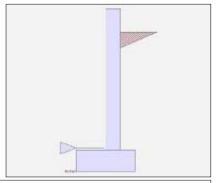
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height 5.00 ft Wall height above soil 1.00 ft Slope Behind Wall 0.00 Height of Soil over Toe 0.00 inWater 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 250.0 psf/ft Soil Density, Heel 110.00 pcf Soil Density, Toe 0.00 pcf Footing||Soil Friction 0.525 Soil height to ignore



Surcharge Loads

Surcharge Over Heel 40.0 psf Used To Resist Sliding & Overturning Surcharge Over Toe 40.0 NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load 360.0 lbs Axial Live Load 720.0 lbs **Axial Load Eccentricity** 0.0 in

Earth Pressure Seismic Load

Method: Uniform Multiplier Used 7.000 (Multiplier used on soil density)

Wall Stability Ratios

Lateral Sliding Force

Overturning 1.59 OK Slab Resists All Sliding!

Lateral Load Applied to Stem

for passive pressure

Lateral Load 0.0 #/ft ...Height to Top 0.00 ft= ...Height to Bottom 0.00 ft = Wind (W) Load Type (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

Uniform Seismic Force = 41.417 **Total Seismic Force** 245.049

Design Summary

841.7 lbs

Total Bearing Load 2,490 lbs ...resultant ecc. 4.68 in Soil Pressure @ Toe 1,759 psf OK Soil Pressure @ Heel 113 psf OK 3,000 psf Allowable Soil Pressure Less Than Allowable ACI Factored @ Toe 2,463 psf ACI Factored @ Heel _ 159 psf Footing Shear @ Toe 12.6 psi OK = Footing Shear @ Heel = 2.7 psi OK Allowable 75.0 psi **Sliding Calcs**

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

Land Frateur	
Load Factors ————————————————————————————————————	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

Bottom Stem Construction Stem OK **Design Height Above Ftg** ft = 0.00 Wall Material Above "Ht" Concrete = Design Method **LRFD** Thickness 8.00 = Rebar Size # 4 Rebar Spacing 16.00 = Rebar Placed at Edge **Design Data** 0.473 fb/FB + fa/Fa Total Force @ Section Service Level lbs =Strength Level lbs = 1,008.9 Moment....Actual Service Level ft-# = Strength Level ft-# = 1,938.9 Moment.....Allowable 4,099.3 Shear.....Actual Service Level psi = Strength Level psi = 13.5 Shear.....Allowable psi = 75.0 Anet (Masonry) in2 = Rebar Depth 'd' in= 6.25 Masonry Data f'm psi = Fs psi = Solid Grouting = Modular Ratio 'n' Wall Weight 100.0 psf = Short Term Factor Equiv. Solid Thick. Masonry Block Type Medium Weight Masonry Design Method = ASD **Concrete Data** f'c psi = 2,500.0 Fy psi = 60,000.0

Title Slab High and Slab Low Job #: Dsgnr: TMP

Description....

Horizontal Reinforcing

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 2

Date: 18 OCT 2019

License To: Phillips Structural Engineering Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing

As (based on applied moment): 0.0726 in2/ft

0.0969 in2/ft Min Stem T&S Reinf Area 1.152 in2 (4/3) * As:

200bd/fy: 200(12)(6.25)/60000: 0.25 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

0.0014bh: 0.0014(12)(8): 0.1344 in2/ft Horizontal Reinforcing Options: One layer of: Two layers of:

Required Area: 0.1344 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.15 in2/ft #5@ 19.38 in Maximum Area: 0.8467 in 2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

Toe Width		=	1	.33 ft
Heel Width		=	1	.33
Total Footing Wi	idth	=	2	.66
Footing Thicknes	SS	=	11.	.00 in
Key Width		=	0.	.00 in
Key Depth		=	0.	.00 in
Key Distance fro	m Toe	=	0.	.00 ft
f'c = 2,500 Footing Concrete		Fy = ′ =	150	000 psi .00 pcf
Min. As %		=	0.00	
Cover @ Top	2.00	@	Btm.=	3.00 in

Footing Design Results

		Toe	<u>Heel</u>
Factored Pressure	=	2,463	159 psf
Mu' : Upward	=	1,839	77 ft-#
Mu' : Downward	=	203	196 ft-#
Mu: Design	=	1,636	119 ft-#
Actual 1-Way Shear	=	12.59	2.72 psi
Allow 1-Way Shear	=	40.00	40.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not reg'd: Mu < phi*5*lambda*sqrt(f'c)*Sm Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm

Key: No key defined

Min footing T&S reinf Area 0.63 in2 Min footing T&S reinf Area per foot in2 /ft 0.24

If one layer of horizontal bars: If two layers of horizontal bars:

#4@ 10.10 in #4@ 20.20 in #5@ 15.66 in #5@ 31.31 in #6@ 22.22 in #6@ 44.44 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING	}	<u> </u>		RI	ESISTING	
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	612.6	1.97	1,208.2	Soil Over Heel	=	364.8	2.33	849.5
Surcharge over Heel	=	57.5	2.96	170.2	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	26.5	2.33	61.8
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Ster	m =	360.0	1.66	598.8
Load @ Stem Above So	oil =				* Axial Live Load on Stem	=	720.0	1.66	1,197.6
Seismic Earth Load	=	171.5	2.96	507.5	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		841.7	O.T.M.	1,885.9	Stem Weight(s)	=	600.0	1.66	998.0
IOlai		041.7	O. I . IVI.	1,000.9	Earth @ Stem Transition	ns=			
	=		=		Footing Weight	=	365.8	1.33	486.4
Resisting/Overturnin	g Rat	io	=	1.59	Key Weight	=			
Vertical Loads used f	or So	il Pressure :	= 2,490.	3 lbs	Vert. Component	=			
					Tot	al =	1.717.1	lbs R.M.=	2.994.5

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

ı otal = 1,/1/.1 IDS **R.M.=** * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Slab High and Slab Low Title Job #: Dsgnr: **TMP** Page: 3

Date: 18 OCT 2019

Description....

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License To : Phillips Structural Engineering Code: IBC 2015,ACI 318-14,ACI 530-13

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

250.0 pci Soil Spring Reaction Modulus Horizontal Defl @ Top of Wall (approximate only) 0.110 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.

Title Slab High and Slab Low Job #: Description....

12.00 in

Page: 1 Dsgnr: TMP Date: 18 OCT 2019

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Cantilevered Retaining Wall

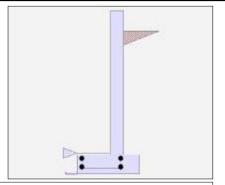
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height 6.00 ft Wall height above soil 1.00 ft Slope Behind Wall 0.00 Height of Soil over Toe 0.00 inWater 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 250.0 psf/ft Soil Density, Heel 110.00 pcf Soil Density, Toe 0.00 pcf Footing||Soil Friction 0.525 Soil height to ignore



Surcharge Loads

Surcharge Over Heel 40.0 psf Used To Resist Sliding & Overturning Surcharge Over Toe 40.0 NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load	=	360.0 lbs
Axial Live Load	=	720.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method: Uniform Multiplier Used

7.000 (Multiplier used on soil density)

Lateral Load Applied to Stem

for passive pressure

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

Wind on Exposed Stem _ 0.0 psf (Service Level)

Adjacent Footing Load

0.0 lbs Adjacent Footing Load 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

Design Summary

Lateral Sliding Force

Wall Stability Ratios Overturning 1.54 OK Slab Resists All Sliding!

Total Bearing Load 2,880 lbs ...resultant ecc. 6.27 in 1,741 psf OK Soil Pressure @ Toe Soil Pressure @ Heel 31 psf OK Allowable 3,000 psf Soil Pressure Less Than Allowable ACI Factored @ Toe 2,438 psf ACI Factored @ Heel _ 44 psf Footing Shear @ Toe 22.4 psi OK = Footing Shear @ Heel = 5.2 psi OK Allowable 75.0 psi **Sliding Calcs**

1,138.9 lbs

Fy

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

Load Factors —	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

Uniform Seismic Force = 48.417 **Total Seismic Force** 334.882

Bottom Stem Construction Stem OK **Design Height Above Ftg** ft = 0.00 Wall Material Above "Ht" Concrete Design Method **LRFD** Thickness 8.00 = Rebar Size # 4 14.00 Rebar Spacing = Rebar Placed at Edge **Design Data** 0.697 fb/FB + fa/Fa Total Force @ Section Service Level lbs =Strength Level lbs = 1,420.7 Moment....Actual Service Level ft-# = Strength Level ft-# = 3,254.0 Moment.....Allowable 4,665.4 Shear.....Actual Service Level psi = Strength Level psi = 18.9 Shear.....Allowable psi = 75.0 Anet (Masonry) in2 = Rebar Depth 'd' in= 6.25 Masonry Data f'm psi = Fs psi = Solid Grouting = Modular Ratio 'n' Wall Weight 100.0 psf = Short Term Factor Equiv. Solid Thick. Masonry Block Type Medium Weight Masonry Design Method = ASD **Concrete Data** f'c psi = 2,500.0

psi =

60,000.0

Title Slab High and Slab Low Job #: Dsgnr: TMP

Description....

Horizontal Reinforcing

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 2

Date: 18 OCT 2019

Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing

As (based on applied moment): 0.1219 in2/ft

0.1626 in2/ft (4/3) * As:

Min Stem T&S Reinf Area 1.344 in2

200bd/fy: 200(12)(6.25)/60000: 0.25 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

0.0014bh: 0.0014(12)(8): 0.1344 in 2/ft Horizontal Reinforcing Options: One layer of : Two layers of:

Required Area: 0.1626 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.1714 in2/ft #5@ 19.38 in Maximum Area: 0.8467 in 2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

L			
	Toe Width	=	1.75 ft
	Heel Width	=	1.50
	Total Footing Width	=	3.25
	Footing Thickness	=	11.00 in
	Key Width	=	0.00 in
	Key Depth	=	0.00 in
	Key Distance from Toe	=	0.00 ft
	f'c = 2,500 psi Footing Concrete Density Min. As % Cover @ Top 2.00	=	60,000 psi 150.00 pcf 0.0018 Btm.= 3.00 in

Footing Design Results

		<u>Toe</u>	Heel
Factored Pressure	=	2,438	44 psf
Mu' : Upward	=	3,075	86 ft-#
Mu' : Downward	=	351	355 ft-#
Mu: Design	=	2,724	268 ft-#
Actual 1-Way Shear	=	22.43	5.17 psi
Allow 1-Way Shear	=	75.00	40.00 psi
Toe Reinforcing	=	# 4 @ 10.10 in	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: #4@ 10.10 in, #5@ 15.66 in, #6@ 22.22 in, #7@ 30.30 in, #8@ 39.90 in, #9@ 5

Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm

Key: No key defined

Min footing T&S reinf Area 0.77 in2 Min footing T&S reinf Area per foot 0.24 in2 /ft

If one layer of horizontal bars: If two layers of horizontal bars:

#4@ 10.10 in #4@ 20.20 in #5@ 15.66 in #5@ 31.31 in #6@ 22.22 in #6@ 44.44 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING)			RE	SISTING	
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	837.2	2.31	1,930.2	Soil Over Heel	=	550.0	2.83	1,558.3
Surcharge over Heel	=	67.2	3.46	232.6	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	33.3	2.83	94.4
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Ster	n =	360.0	2.08	750.0
Load @ Stem Above Soi	l =				* Axial Live Load on Stem	=	720.0	2.08	1,500.0
Seismic Earth Load	=	234.4	3.46	810.7	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		1.138.9	O.T.M.	2.973.5	Stem Weight(s)	=	700.0	2.08	1,458.3
Total 1,138.		1,136.9	O. I . IVI.	2,973.5	Earth @ Stem Transition	ıs=			
	=		=		Footing Weight	=	446.9	1.63	726.2
Resisting/Overturning	Rat	io	=	1.54	Key Weight	=			
Vertical Loads used for	or So	il Pressure :	= 2,880.	2 lbs	Vert. Component	=			
					Tota	al =	2,090.2	os R.M.=	4,587.3

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

2,090.2 lbs **R.M.=** ı otal = * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Title Slab High and Slab Low
Job #: Dsgnr: TMP
Description....

Page: 3 Date: 18 OCT 2019

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Code: IBC 2015,ACI 318-14,ACI 530-13
License To: Phillips Structural Engineering

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) 0.104 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.

Title Slab High and Slab Low
Job #: Dsgnr: TMP
Description....

This Wall in File: Q:\0-PROJECTS\2015\PB Architectural\Wen Hu Residence\Retaining Wall Calcs\cantile

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 1

Date: 18 OCT 2019

Criteria

Retained Height = 7.00 ft

Wall height above soil = 1.00 ft

Slope Behind Wall = 0.00

Height of Soil over Toe = 0.00 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 = 250.0 psf/ft
Soil Density, Heel = 110.00 pcf
Soil Density, Toe = 0.00 pcf
Footing||Soil Friction = 0.525

for passive pressure = 12.00 in Lateral Load Applied to Stem

Soil height to ignore

Fy

 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

Surcharge Loads

Surcharge Over Heel = 40.0 psf Used To Resist Sliding & Overturning Surcharge Over Toe = 40.0 NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load = 360.0 lbs Axial Live Load = 720.0 lbs Axial Load Eccentricity = 0.0 in

Earth Pressure Seismic Load

Method: Uniform

Multiplier Used = 7.000
(Multiplier used on soil density)

Design Summary

Sliding Calcs Lateral Sliding Force

Wall Stability Ratios
Overturning = 1.56 OK
Slab Resists All Sliding!

Total Bearing Load 3,669 lbs ...resultant ecc. 9.57 in Soil Pressure @ Toe 2,188 psf OK Soil Pressure @ Heel 0 psf OK Allowable 3,000 psf Soil Pressure Less Than Allowable ACI Factored @ Toe 3,064 psf = ACI Factored @ Heel _ 0 psf Footing Shear @ Toe 23.9 psi OK = Footing Shear @ Heel = 10.4 psi OK Allowable 75.0 psi

1,511.4 lbs

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

Load Factors —	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

Uniform Seismic Force = 56.000 Total Seismic Force = 448.000

Stem Construction		Bottom			
		Stem OK			
Design Height Above Fto		0.00			
Wall Material Above "Ht"	=	Concrete			
Design Method	=	LRFD			
Thickness	=	8.00			
Rebar Size	=	# 4			
Rebar Spacing	=	9.00			
Rebar Placed at	=	Edge			
Design Data fb/FB + fa/Fa		0.712			
=	=	0.712			
Total Force @ Section	II. a				
Service Level	lbs =	4 000 5			
Strength Level	lbs =	1,906.5			
MomentActual					
Service Level	ft-# =	5 070 0			
Strength Level	ft-# =	5,072.2			
MomentAllowable	=	7,122.4			
ShearActual					
Service Level	psi =				
Strength Level	psi =	25.4			
ShearAllowable	psi =	75.0			
Anet (Masonry)	in2 =				
Rebar Depth 'd'	in =	6.25			
Masonry Data					
f'm	psi=				
Fs	psi =				
Solid Grouting	· =				
Modular Ratio 'n'	=				
Wall Weight	psf=	100.0			
Short Term Factor	· =				
Equiv. Solid Thick.	=				
Masonry Block Type	=	Medium Weig	ht		
Masonry Design Method	=	ASD			
Concrete Data					
f'c	psi=	2,500.0			

psi = 60,000.0

Title Slab High and Slab Low Job #: Dsgnr: TMP

Description....

Horizontal Reinforcing

Page: 2 Date: 18 OCT 2019

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

License To: Phillips Structural Engineering Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing

As (based on applied moment): 0.19 in2/ft

0.2534 in2/ft (4/3) * As:

Min Stem T&S Reinf Area 1.536 in2 200bd/fy: 200(12)(6.25)/60000: 0.25 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

0.0014bh: 0.0014(12)(8): 0.1344 in2/ft Horizontal Reinforcing Options:

One layer of : Two layers of: Required Area: 0.25 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.2667 in2/ft #5@ 19.38 in Maximum Area: 0.8467 in 2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

L					
	T 140		4	75 (
	Toe Width	=	1.	75 ft	
	Heel Width	=	2.	08	
	Total Footing Width	= -	3.	83	
	Footing Thickness	=	12.	00 in	
	Key Width	=	0.	00 in	
	Key Depth	=	0.	00 in	
	Key Distance from Toe	=	0.	00 ft	
	f'c = 2,500 psi	Fy =	60,0	00 psi	
	Footing Concrete Densit	ty =	150.	00 pcf	
	Min. As %	=	0.00	18	
	Cover @ Top 2.00	@ E	3tm.=	3.00 in	

Footing Design Results

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	3,064	0 psf
Mu' : Upward	=	3,875	125 ft-#
Mu' : Downward	=	374	1,167 ft-#
Mu: Design	=	3,502	1,041 ft-#
Actual 1-Way Shear	=	23.94	10.42 psi
Allow 1-Way Shear	=	75.00	40.00 psi
Toe Reinforcing	=	# 4 @ 9.26 in	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: #4@ 9.26 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.78 in, #8@ 36.57 in, #9@ 46

Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm

Key: No key defined

0.99 Min footing T&S reinf Area in2 Min footing T&S reinf Area per foot 0.26 in2 /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

Summary of Overturning & Resisting Forces & Moments

		ov	ERTURNING				RE	SISTING	
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,120.0	2.67	2,986.7	Soil Over Heel	=	1,088.3	3.12	3,399.0
Surcharge over Heel	=	77.8	4.00	311.1	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	56.5	3.12	176.6
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Sten	n =	360.0	2.08	750.0
Load @ Stem Above So	il =				* Axial Live Load on Stem	=	720.0	2.08	1,500.0
Seismic Earth Load	=	313.6	4.00	1,254.4	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		1,511.4		4,552.2	Stem Weight(s)	=	800.0	2.08	1,666.7
IOtal		1,511.4	O. I . IVI.	4,552.2	Earth @ Stem Transition	s=			
	=		=		Footing Weight	=	574.5	1.92	1,100.2
Resisting/Overturnin	g Rat	io	=	1.56	Key Weight	=			
Vertical Loads used f	or So	il Pressure :	= 3,669.	3 lbs	Vert. Component	=			
					Tota	.I _	2 870 3 1	he DM -	7 002 /

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

Total = 2,879.3 lbs **R.M.=** * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Title Slab High and Slab Low
Job #: Dsgnr: TMP
Description....

Page: 3

Date: 18 OCT 2019

This Wall in File: Q:\0-PROJECTS\2015\PB Architectural\Wen Hu Residence\Retaining Wall Calcs\cantile

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Cantilevered Retaining Wall
Code: IBC 2015,ACI 318-14,ACI 530-13
License To: Phillips Structural Engineering

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) 0.127 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.

Title Slab High and Slab Low
Job #: Dsgnr: TMP
Description....

12.00 in

Page: 1 Date: 18 OCT 2019

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height = 8.00 ft

Wall height above soil = 1.00 ft

Slope Behind Wall = 0.00

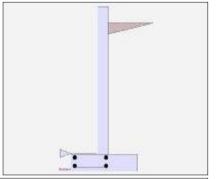
Height of Soil over Toe = 0.00 in

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 = 250.0 psf/ft
Soil Density, Heel = 110.00 pcf
Soil Density, Toe = 0.00 pcf
Footing||Soil Friction = 0.525
Soil height to ignore



Surcharge Loads

Surcharge Over Heel = 40.0 psf Used To Resist Sliding & Overturning Surcharge Over Toe = 40.0 NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load = 360.0 lbs Axial Live Load = 720.0 lbs Axial Load Eccentricity = 0.0 in

Lateral Load Applied to Stem

for passive pressure

 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

Earth Pressure Seismic Load

Method: Uniform

Multiplier Used = 7.000
(Multiplier used on soil density)

Design Summary

Wall Stability Ratios Overturning = 1.55 OK Slab Resists All Sliding!

Total Bearing Load 4,460 lbs ...resultant ecc. 12.26 in Soil Pressure @ Toe 2,601 psf OK Soil Pressure @ Heel 0 psf OK 3,000 psf Allowable Soil Pressure Less Than Allowable ACI Factored @ Toe 3,641 psf = ACI Factored @ Heel _ 0 psf Footing Shear @ Toe 29.0 psi OK = Footing Shear @ Heel = 16.2 psi OK

75.0 psi

Allowable Sliding Calcs

Lateral Sliding Force = 1,901.9 lbs

Uniform Seismic Force = 63.000 Total Seismic Force = 567.000

Stem Construction

f'm

Stem OK **Design Height Above Ftg** ft = 0.00 Wall Material Above "Ht" Concrete = Design Method **LRFD** Thickness 8.00 = Rebar Size # 4 Rebar Spacing 8.00 = Rebar Placed at Edge **Design Data** 0.936 fb/FB + fa/Fa Total Force @ Section Service Level lbs =Strength Level lbs = 2,458.9 Moment....Actual Service Level ft-# = Strength Level ft-# = 7,446.3 Moment.....Allowable 7,959.6 Shear.....Actual Service Level psi = Strength Level psi = 32.8 Shear.....Allowable psi = 75.0 Anet (Masonry) in2 = Rebar Depth 'd' in= 6.25 Masonry Data

Bottom

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

Load Factors	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

Fs 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

psi =

 Concrete Data
 psi = 2,500.0

 f'c
 psi = 60,000.0

Title Slab High and Slab Low Job #: Dsgnr: TMP

Description....

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As (based on applied moment):

(4/3) * As:

Cantilevered Retaining Wall

License To: Phillips Structural Engineering

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 2

Date: 18 OCT 2019

Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing

0.279 in2/ft

0.372 in2/ft Min Stem T&S Reinf Area 1.728 in2

Horizontal Reinforcing

200bd/fy: 200(12)(6.25)/60000: 0.25 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

0.0014bh: 0.0014(12)(8): 0.1344 in2/ft Horizontal Reinforcing Options: _____ One layer of : Two layers of:

Required Area: 0.279 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.3 in2/ft #5@ 19.38 in Maximum Area: 0.8467 in 2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

ι				
	Toe Width	=	1.7	75 ft
	Heel Width	=	2.	58
	Total Footing Width	= _	4.3	33
	Footing Thickness	=	12.0	00 in
	Key Width	=	0.0	00 in
	Key Depth	=	0.0	00 in
	Key Distance from Toe	=	0.0	00 ft
	f'c = 2,500 psi	Fy =	60,00	00 psi
	Footing Concrete Density	/ =	150.0	00 pcf
	Min. As %	=	0.00°	18
	Cover @ Top 2.00	@ E	8tm.=	3.00 in

Footing Design Results

		<u>Toe</u>	Heel
Factored Pressure	=	3,641	0 psf
Mu' : Upward	=	4,627	184 ft-#
Mu' : Downward	=	374	2,380 ft-#
Mu: Design	=	4,254	2,196 ft-#
Actual 1-Way Shear	=	29.05	16.19 psi
Allow 1-Way Shear	=	75.00	40.00 psi
Toe Reinforcing	=	# 4 @ 9.26 in	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: #4@ 9.26 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.78 in, #8@ 36.57 in, #9@ 46

Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm

Key: No key defined

Min footing T&S reinf Area 1.12 in2 Min footing T&S reinf Area per foot 0.26 in2 /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

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING)	<u> </u>		RE	SISTING	
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,417.5	3.00	4,252.5	Soil Over Heel	=	1,683.7	3.37	5,679.8
Surcharge over Heel	=	87.5	4.50	393.8	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	76.5	3.37	258.2
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Ster	m =	360.0	2.08	750.0
Load @ Stem Above So	oil =				* Axial Live Load on Stem	=	720.0	2.08	1,500.0
Seismic Earth Load	=	396.9	4.50	1,786.1	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		1 001 0	O.T.M.	6 422 2	Stem Weight(s)	=	900.0	2.08	1,875.0
Iotai		1,901.9	O. I . IVI.	6,432.3	Earth @ Stem Transition	ns=			
	=		=		Footing Weight	=	649.5	2.17	1,406.2
Resisting/Overturnin	g Rat	tio	=	1.55	Key Weight	=			
Vertical Loads used f	or So	il Pressure :	= 4,459.	8 lbs	Vert. Component	=			
					Tota	al –	3 669 8 1	hs RM =	9 969 1

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

3,669.8 lbs **R.M.=** 9,969.1 ı otal = * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Slab High and Slab Low Title Job #: Dsgnr: **TMP** Description....

Page: 3

Date: 18 OCT 2019

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Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

250.0 pci Soil Spring Reaction Modulus Horizontal Defl @ Top of Wall (approximate only) 0.150 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.

Title Slab High and Slab Low Job #: Dsgnr: TMP Description....

12.00 in

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Page: 1

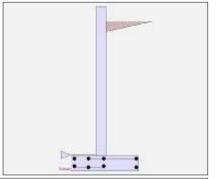
Date: 18 OCT 2019

Criteria

Retained Height 9.00 ft Wall height above soil 1.00 ft Slope Behind Wall 0.00 Height of Soil over Toe 0.00 in 0.0 ft Water height over heel

Soil Data

Allow Soil Bearing 3,000.0 psf Equivalent Fluid Pressure Method Active Heel Pressure 35.0 psf/ft Passive Pressure 250.0 psf/ft Soil Density, Heel 110.00 pcf Soil Density, Toe 0.00 pcf Footing||Soil Friction 0.525 Soil height to ignore



Surcharge Loads

Surcharge Over Heel 40.0 psf Used To Resist Sliding & Overturning Surcharge Over Toe 40.0 NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load 360.0 lbs Axial Live Load 720.0 lbs **Axial Load Eccentricity** 0.0 in

Earth Pressure Seismic Load

Method: Uniform Multiplier Used

7.000 (Multiplier used on soil density)

Lateral Load Applied to Stem

for passive pressure

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

Design Summary

Wall Stability Ratios Overturning 1.54 OK Slab Resists All Sliding!

Total Bearing Load 5,281 lbs ...resultant ecc. 14.55 in 2,927 psf OK Soil Pressure @ Toe Soil Pressure @ Heel 0 psf OK 3,000 psf Allowable Soil Pressure Less Than Allowable ACI Factored @ Toe 4,098 psf ACI Factored @ Heel _ 0 psf Footing Shear @ Toe 35.4 psi OK = Footing Shear @ Heel 23.2 psi OK = Allowable

75.0 psi

Sliding Calcs Lateral Sliding Force 2,337.2 lbs Uniform Seismic Force = 70.000 **Total Seismic Force** 700.000

Ste

Fy

em Construction		Bottom	
Design Usinht Above Etc		Stem OK	
Design Height Above Ftg		0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method Thickness	=	LRFD	
Rebar Size	=	8.00 # 5	
Rebar Spacing	=	8.00	
Rebar Placed at	_	Edge	
Design Data		Luge	
fb/FB + fa/Fa	=	0.887	
Total Force @ Section			
Service Level	lbs=		
Strength Level	lbs=	3,081.3	
MomentActual		•	
Service Level	ft-# =		
Strength Level	ft-# =	10,463.7	
MomentAllowable	=	11,799.2	
ShearActual			
Service Level	psi =		
Strength Level	psi =	41.5	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.19	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type		Medium W	eight
Masonry Design Method	=	ASD	
Concrete Data		0.500.0	
f'c	psi =	2,500.0	

60,000.0

psi =

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

Load Factors —	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

Title Slab High and Slab Low Job #: Dsgnr: TMP

Description....

Horizontal Reinforcing

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 2

Date: 18 OCT 2019

License To: Phillips Structural Engineering Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing

As (based on applied moment): 0.3962 in2/ft

0.5283 in2/ft Min Stem T&S Reinf Area 1.920 in2 (4/3) * As: 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

0.0014bh: 0.0014(12)(8): 0.1344 in 2/ft Horizontal Reinforcing Options:

One layer of : Two layers of: Required Area: 0.3962 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.465 in2/ft #5@ 19.38 in Maximum Area: 0.8382 in2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

Toe Width		=	1	.83 ft
Heel Width		=	3	.00
Total Footing Wid	łth	=	4	.83
Footing Thickness	S	=	12.	.00 in
Key Width		=	0.	.00 in
Key Depth		=	0.	.00 in
Key Distance from	n Toe	=	0.	.00 ft
f'c = 2,500 Footing Concrete		=y =	150	000 psi .00 pcf
Min. As %		=_	0.00	
Cover @ Top	2.00	@	Btm.=	3.00 in

Footing Design Results

		<u>Toe</u>	Heel
Factored Pressure	=	4,098	0 psf
Mu' : Upward	=	5,702	260 ft-#
Mu': Downward	=	409	3,898 ft-#
Mu: Design	=	5,294	3,638 ft-#
Actual 1-Way Shear	=	35.38	23.16 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	#5@14.00 in	
Heel Reinforcing	=	# 4 @ 9.26 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: #4@ 9.26 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.78 in, #8@ 36.57 in, #9@ 46 Heel: #4@ 9.26 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.78 in, #8@ 36.57 in, #9@ 46 Key: No key defined

Min footing T&S reinf Area 1.25 in2 Min footing T&S reinf Area per foot 0.26 in2 /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

Summary of Overturning & Resisting Forces & Moments

	OV		RTURNING				RESISTING		
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,750.0	3.33	5,833.3	Soil Over Heel	=	2,310.0	3.66	8,462.3
Surcharge over Heel	=	97.2	5.00	486.1	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	93.3	3.66	341.9
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Sten	n =	360.0	2.16	778.8
Load @ Stem Above So	oil =				* Axial Live Load on Stem	=	720.0	2.16	1,557.6
Seismic Earth Load	=	490.0	5.00	2,450.0	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		2.337.2		9.760.4	Stem Weight(s)	=	1,000.0	2.16	2,163.3
Iotai		2,337.2	O. I . IVI.	8,769.4	Earth @ Stem Transition	s=			
	=		=		Footing Weight	=	724.5	2.42	1,749.7
Resisting/Overturnin	g Rat	tio	=	1.54	Key Weight	=			
Vertical Loads used f	or So	il Pressure	= 5,281.	0 lbs	Vert. Component	=			
					Tota	.I _	1 187 B I	he DM -	13 /06 0

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

Total = 4,487.8 lbs **R.M.=** 13,496.0 * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Slab High and Slab Low Title Job #: Dsgnr: **TMP** Description....

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Page: 3

Date: 18 OCT 2019

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

250.0 pci Soil Spring Reaction Modulus Horizontal Defl @ Top of Wall (approximate only) 0.168 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.

Page: 1 18 OCT 2019

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height 10.00 ft Wall height above soil 1.00 ft 0.00 Slope Behind Wall Height of Soil over Toe 0.00 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 250.0 psf/ft Soil Density, Heel 110.00 pcf Soil Density, Toe 0.00 pcf Footing||Soil Friction 0.525 Soil height to ignore for passive pressure 12.00 in

Surcharge Loads

Surcharge Over Heel 40.0 psf Used To Resist Sliding & Overturning Surcharge Over Toe 40.0 NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load 360.0 lbs Axial Live Load 720.0 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 _ 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

Earth Pressure Seismic Load

Method: Uniform Multiplier Used 7.000 (Multiplier used on soil density)

Design Summary

Wall Stability Ratios Overturning

1.66 OK Slab Resists All Sliding!

Total Bearing Load 6,489 lbs ...resultant ecc. 15.60 in 2,818 psf OK Soil Pressure @ Toe 0 psf OK Soil Pressure @ Heel Allowable 3,000 psf Soil Pressure Less Than Allowable ACI Factored @ Toe 3,945 psf ACI Factored @ Heel _ 0 psf Footing Shear @ Toe 32.0 psi OK = Footing Shear @ Heel = 23.0 psi OK Allowable 75.0 psi

Sliding Calcs

Lateral Sliding Force 2,901.7 lbs Uniform Seismic Force = 78.167 **Total Seismic Force** 872.861

Ste

f'c

Fy

em Construction	7.	Bottom	
Design Height Above Ftg	ft =	Stem OK 0.00	
Wall Material Above "Ht"	II = =	Concrete	
Design Method	=	LRFD	
Thickness	_	8.00	
Rebar Size	_	# 5	
Rebar Spacing	=	6.00	
Rebar Placed at	=	Edge	
Design Data		_~90	
fb/FB + fa/Fa	=	0.937	
Total Force @ Section			
Service Level	lbs=		
Strength Level	lbs=	3,785.3	
MomentActual			
Service Level	ft-#=		
Strength Level	ft-# =	14,259.8	
MomentAllowable	=	15,222.0	
ShearActual			
Service Level	psi=		
Strength Level	psi=	51.0	
ShearAllowable	psi=	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in=	6.19	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	_ =		
Modular Ratio 'n'	=		
Wall Weight	psf=	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	eight
Masonry Design Method	=	ASD	
Concrete Data			

psi =

psi =

2,500.0 60,000.0

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

Load Factors —	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

Title Slab High and Slab Low Job #: Dsgnr: TMP Page: 2

Date: 18 OCT 2019

Description....

Horizontal Reinforcing

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Cantilevered Retaining Wall Code: IBC 2015,ACI 318-14,ACI 530-13 License To: Phillips Structural Engineering

Concrete Stem Rebar Area Details

As (based on applied moment):

Bottom Stem Vertical Reinforcing

0.54 in2/ft

0.7199 in2/ft (4/3) * As:

Min Stem T&S Reinf Area 2.112 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

0.0014bh: 0.0014(12)(8): 0.1344 in 2/ft Horizontal Reinforcing Options: One layer of : Two layers of:

Required Area: 0.54 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.62 in2/ft #5@ 19.38 in Maximum Area: 0.8382 in2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

Toe Width	=	2.17 ft	
Heel Width	=	3.50	
Total Footing Wid	dth =	5.67	
Footing Thickness	S =	14.00 in	
Key Width	=	0.00 in	
Key Depth	=	= 0.00 in	
Key Distance from	m Toe =	= 0.00 ft	
f'c = 2,500 Footing Concrete Min. As %		, - ' '	
Cover @ Top	2.00	@ Btm.= 3.00	in

Footing Design Results

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	3,945	0 psf
Mu' : Upward	=	7,829	791 ft-#
Mu': Downward	=	645	6,398 ft-#
Mu: Design	=	7,184	5,608 ft-#
Actual 1-Way Shear	=	32.03	23.01 psi
Allow 1-Way Shear	=	75.00	75.00 psi
Toe Reinforcing	=	#5@12.30 in	
Heel Reinforcing	=	# 4 @ 7.94 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: #4@ 7.94 in, #5@ 12.30 in, #6@ 17.46 in, #7@ 23.81 in, #8@ 31.35 in, #9@ 39 Heel: #4@ 7.94 in, #5@ 12.30 in, #6@ 17.46 in, #7@ 23.81 in, #8@ 31.35 in, #9@ 39 Key: No key defined

0.30

in2 /ft

Min footing T&S reinf Area 1.71 in2 Min footing T&S reinf Area per foot

If one layer of horizontal bars: If two layers of horizontal bars:

#4@ 7.94 in #4@ 15.87 in #5@ 12.30 in #5@ 24.60 in #6@ 17.46 in #6@ 34.92 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING)	<u> </u>		RE	SISTING	•
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	2,182.2	3.72	8,122.5	Soil Over Heel	=	3,116.7	4.25	13,256.2
Surcharge over Heel	=	108.6	5.58	606.2	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	113.3	4.25	482.0
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Ster	m =	360.0	2.50	901.2
Load @ Stem Above So	oil =				* Axial Live Load on Stem	=	720.0	2.50	1,802.4
Seismic Earth Load	=	611.0	5.58	3,411.4	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		2.901.7	O.T.M.	12,140.0	Stem Weight(s)	=	1,100.0	2.50	2,753.7
IOtai		2,901.7	O. I .IVI.	12,140.0	Earth @ Stem Transition	ns=			
	=		=		Footing Weight	=	992.3	2.84	2,813.0
Resisting/Overturnin	g Rat	tio	=	1.66	Key Weight	=			
Vertical Loads used f	for So	il Pressure :	= 6,489.	1 lbs	Vert. Component	=			
					Tota	al –	5 682 3 I	hs RM=	20 206 2

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

5,682.3 lbs **R.M.=** 20,206.2 ı otal = * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Slab High and Slab Low Title Job #: Dsgnr: **TMP** Description....

Page: 3

Date: 18 OCT 2019

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License To : Phillips Structural Engineering Code: IBC 2015,ACI 318-14,ACI 530-13

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

250.0 pci Soil Spring Reaction Modulus Horizontal Defl @ Top of Wall (approximate only) 0.152 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.

Page: 1 Date: 18 OCT 2019

This Wall in File: Q:\0-PROJECTS\2015\PB Architectural\Wen Hu Residence\Retaining Wall Calcs\cantile

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height 5.00 ft Wall height above soil 1.00 ft Slope Behind Wall 0.00 Height of Soil over Toe 0.00 in Water height over heel 0.0 ft

Soil Data

3,000.0 psf Allow Soil Bearing Equivalent Fluid Pressure Method Active Heel Pressure 35.0 psf/ft Passive Pressure 250.0 psf/ft Soil Density, Heel 110.00 pcf Soil Density, Toe 0.00 pcf 0.450 Footing||Soil Friction Soil height to ignore 12.00 in

Surcharge Loads

Surcharge Over Heel 40.0 psf Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load	=	360.0 lbs
Axial Live Load	=	720.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method: Uniform Multiplier Used 7.000 (Multiplier used on soil density)

Lateral Load	Applied	to Stem
--------------	---------	---------

for passive pressure

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

=	0.0 lbs
=	0.00 ft
=	0.00 in
=	0.00 ft
	Line Load
=	0.0 ft
=	0.300
	= = =

Design Summary

Sliding Calcs Lateral Sliding Force

less 100% Passive Force = -

less 100% Friction Force =

Added Force Req'dfor 1.5 Stability

Wall Stability Ratios Overturning Sliding	=	2.81 OK 1.52 OK
Total Bearing Loadresultant ecc.	= =	3,608 lbs 8.43 in
Soil Pressure @ Toe Soil Pressure @ Heel Allowable Soil Pressure Less	= = = The	2,130 psf OK 0 psf OK 3,000 psf
ACI Factored @ Toe ACI Factored @ Heel	= = =	2,982 psf 0 psf
Footing Shear @ Toe Footing Shear @ Heel Allowable	= = =	0.1 psi OK 21.0 psi OK 75.0 psi

=

841.7 lbs

1,299.4 lbs 0.0 lbs OK

20.0 lbs

0.0 lbs OK

Fy

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

Load Factors —	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

Uniform Seismic Force = 41.417 Total Seismic Force 245.049

Stem Construction

Stem OK **Design Height Above Ftg** ft = 0.00 Wall Material Above "Ht" Concrete Design Method **LRFD** Thickness 8.00 = Rebar Size # 4 16.00 Rebar Spacing = Rebar Placed at Edge **Design Data** 0.472

fb/FB + fa/Fa	=	0.473	
Total Force @ Section			
Service Level	lbs=		
Strength Level	lbs=	1,008.9	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	1,938.9	
MomentAllowable	=	4,099.3	
ShearActual			
Service Level	psi=		
Strength Level	psi =	13.5	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.25	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf=	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	eight /
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	2,500.0	

60,000.0

psi =

Bottom

Description....

Horizontal Reinforcing

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 2

Date: 18 OCT 2019

License To: Phillips Structural Engineering Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing

As (based on applied moment): 0.0726 in2/ft

0.0969 in2/ft Min Stem T&S Reinf Area 1.152 in2 (4/3) * As:

200bd/fy: 200(12)(6.25)/60000: 0.25 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

0.0014bh: 0.0014(12)(8): 0.1344 in2/ft Horizontal Reinforcing Options: One layer of: Two layers of:

Required Area: 0.1344 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.15 in2/ft #5@ 19.38 in Maximum Area: 0.8467 in 2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

Toe Width		=	0	.58 ft
Heel Width		=	3	.08
Total Footing W	'idth	=	3	.66
Footing Thickne	SS	=	11.	.00 in
Key Width		=	0.	.00 in
Key Depth		=	0.	.00 in
Key Distance from	om Toe	=	0.	.00 ft
f'c = 2,500	0 psi F	-y =	60,0	000 psi
Footing Concret	e Density	=	150	.00 pcf
Min. As %		=	0.00	18
Cover @ Top	2.00	@	Btm.=	3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	2,982	0 psf
Mu' : Upward	=	478	0 ft-#
Mu': Downward	=	28	2,589 ft-#
Mu: Design	=	450	2,589 ft-#
Actual 1-Way Shear	=	0.06	21.03 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	# 4 @ 10.10 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not reg'd: Mu < phi*5*lambda*sqrt(f'c)*Sm

Heel: #4@ 10.10 in, #5@ 15.66 in, #6@ 22.22 in, #7@ 30.30 in, #8@ 39.90 in, #9@ 5

Key: No key defined

Min footing T&S reinf Area 0.87 in2 Min footing T&S reinf Area per foot 0.24 in2 /ft

If one layer of horizontal bars: If two layers of horizontal bars:

#4@ 10.10 in #4@ 20.20 in #5@ 15.66 in #5@ 31.31 in #6@ 22.22 in #6@ 44.44 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING	3			RE	SISTING	•
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	612.6	1.97	1,208.2	Soil Over Heel	=	1,327.3	2.46	3,260.4
Surcharge over Heel	=	57.5	2.96	170.2	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	96.5	2.46	237.1
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Ster	n =	360.0	0.92	329.9
Load @ Stem Above So	oil =				* Axial Live Load on Stem	=	720.0	0.92	659.8
Seismic Earth Load	=	171.5	2.96	507.5	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		841.7	O.T.M.	1 005 0	Stem Weight(s)	=	600.0	0.92	549.8
Iotai		041.7	O. I .IVI.	1,885.9	Earth @ Stem Transitions				
	=		=		Footing Weight	=	503.7	1.83	922.5
Resisting/Overturnin	g Rat	io	=	2.81	Key Weight	=			
Vertical Loads used f	for So	il Pressure :	= 3,607	.5 lbs	Vert. Component	=			
					Tota		2 887 5 I	hs RM=	5 299 6

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

Total = 2,887.5 lbs **R.M.=** 5,299.6 * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Slab High and Soil Low Title Job #: Dsgnr: **TMP** Description....

Page: 3

Date: 18 OCT 2019

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Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

250.0 pci Soil Spring Reaction Modulus Horizontal Defl @ Top of Wall (approximate only) 0.097 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.

Page: 1 Date: 18 OCT 2019

This Wall in File: Q:\0-PROJECTS\2015\PB Architectural\Wen Hu Residence\Retaining Wall Calcs\cantile

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height 6.00 ft Wall height above soil 1.00 ft Slope Behind Wall 0.00 Height of Soil over Toe 0.00 in 0.0 ft Water height over heel

Soil Data

Soil height to ignore for passive pressure

Allow Soil Bearing 3,000.0 psf Equivalent Fluid Pressure Method Active Heel Pressure 35.0 psf/ft Passive Pressure 250.0 psf/ft Soil Density, Heel 110.00 pcf Soil Density, Toe 0.00 pcf Footing||Soil Friction 0.450

Surcharge Loads

Surcharge Over Heel 40.0 psf 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 0.00 ft...Height to Top = ...Height to Bottom = 0.00 ft Load Type Wind (W) (Service Level)

0.0 psf Poisson's Ratio

12.00 in

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

0.0 lbs

0.300

Adjacent Footing Load

Adjacent Footing Load

Axial Load Applied to Stem

Axial Dead Load 360.0 lbs Axial Live Load 720.0 lbs **Axial Load Eccentricity** 0.0 in

Earth Pressure Seismic Load

Method: Uniform Multiplier Used

7.000 (Multiplier used on soil density)

Uniform Seismic Force = 48.417 Total Seismic Force 334.882

Wind on Exposed Stem _

(Service Level)

Design Summary

Overturning Sliding	=	2.89 OK 1.52 OK
Total Bearing Loadresultant ecc.	= =	4,601 lbs 10.14 in
Soil Pressure @ Toe Soil Pressure @ Heel	=	2,252 psf OK 0 psf OK
Allowable Soil Pressure Less	= Thai	3,000 psf n Allowable
ACI Factored @ Toe ACI Factored @ Heel	=	3,153 psf 0 psf
Footing Shear @ Toe	=	0.1 psi OK
Footing Shear @ Heel	=	31.7 psi OK
Allowable	=	75.0 psi
Cliding Colos		

Wall Stability Ratios Sliding Calcs Lateral Sliding Force 1,138.9 lbs = less 100% Passive Force = -20.0 lbs less 100% Friction Force = -1,746.5 lbs 0.0 lbs OK Added Force Req'dfor 1.5 Stability 0.0 lbs OK

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

IBC 2015,ACI
1.200
1.600
1.600
1.000
1 000

Ste

em Construction		Bottom	
Design Usinht Above Etc	- ,.	Stem OK	
Design Height Above Ftg Wall Material Above "Ht"	ft =	0.00	
	=	Concrete	
Design Method Thickness	=	LRFD 8.00	
Rebar Size	=	# 4	
Rebar Spacing	=	14.00	
Rebar Placed at	_	Edge	
Design Data		Luge	
fb/FB + fa/Fa	=	0.697	
Total Force @ Section			
Service Level	lbs=		
Strength Level	lbs=	1,420.7	
MomentActual		.,	
Service Level	ft-# =		
Strength Level	ft-# =	3,254.0	
MomentAllowable	=	4,665.4	
ShearActual			
Service Level	psi=		
Strength Level	psi=	18.9	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.25	
Masonry Data			
f'm	psi=		
Fs	psi=		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	eight
Masonry Design Method	=	ASD	
Concrete Data		0.500.0	
f'c	psi =	2,500.0	
Fy	psi =	60,000.0	

Description....

Horizontal Reinforcing

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License To: Phillips Structural Engineering

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 2

Date: 18 OCT 2019

Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing

As (based on applied moment): 0.1219 in2/ft

0.1626 in2/ft (4/3) * As:

Min Stem T&S Reinf Area 1.344 in2 200bd/fy: 200(12)(6.25)/60000: 0.25 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

0.0014bh: 0.0014(12)(8): 0.1344 in 2/ft Horizontal Reinforcing Options:

One layer of : Two layers of: Required Area: 0.1626 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.1714 in2/ft #5@ 19.38 in Maximum Area: 0.8467 in 2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

Toe Width		=	0	.58 ft
Heel Width		=	3	.83
Total Footing W	/idth	=	4	.41
Footing Thickne	ess	=	11.	.00 in
Key Width		=	0.	.00 in
Key Depth		=	0.	.00 in
Key Distance from	om Toe	=	0.	.00 ft
f'c = 2,50	0 psi l	=y =	60,0	000 psi
Footing Concret	te Density	=	150	.00 pcf
Min. As %	·	=	0.00	18
Cover @ Top	2.00	@	Btm.=	3.00 in

Footing Design Results

		<u>Toe</u>	Heel
Factored Pressure	=	3,153	0 psf
Mu' : Upward	=	510	0 ft-#
Mu' : Downward	=	28	5,108 ft-#
Mu: Design	=	482	5,108 ft-#
Actual 1-Way Shear	=	0.06	31.66 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	# 4 @ 10.10 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not reg'd: Mu < phi*5*lambda*sqrt(f'c)*Sm

Heel: #4@ 10.10 in, #5@ 15.66 in, #6@ 22.22 in, #7@ 30.30 in, #8@ 39.90 in, #9@ 5

Key: No key defined

Min footing T&S reinf Area 1.05 in2 Min footing T&S reinf Area per foot 0.24 in2 /ft

If one layer of horizontal bars: If two layers of horizontal bars:

#4@ 10.10 in #4@ 20.20 in #5@ 15.66 in #5@ 31.31 in #6@ 22.22 in #6@ 44.44 in

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING	}			RE	SISTING	•
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	837.2	2.31	1,930.2	Soil Over Heel	=	2,087.8	2.83	5,911.3
Surcharge over Heel	=	67.2	3.46	232.6	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	126.5	2.83	358.3
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Ster	m =	360.0	0.92	329.9
Load @ Stem Above So	il =				* Axial Live Load on Stem	=	720.0	0.92	659.8
Seismic Earth Load	=	234.4	3.46	810.7	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		1 120 0	O.T.M.	2.072.5	Stem Weight(s)	=	700.0	0.92	641.4
iotai		1,138.9	O. I .IVI.	2,973.5	Earth @ Stem Transition	ns=			
	=		=		Footing Weight	=	606.8	2.21	1,338.9
Resisting/Overturnin	g Rat	io	=	2.89	Key Weight	=			
Vertical Loads used f	or So	il Pressure :	= 4,601.	1 lbs	Vert. Component	=			
					Tota	al –	3 881 1 I	hs RM=	8 579 7

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

8,579.7 3,881.1 lbs **R.M.=** ı otal = * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Slab High and Soil Low Title Job #: Dsgnr: **TMP** Description....

Page: 3

Date: 18 OCT 2019

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License To : Phillips Structural Engineering Code: IBC 2015,ACI 318-14,ACI 530-13

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

250.0 pci Soil Spring Reaction Modulus Horizontal Defl @ Top of Wall (approximate only) 0.099 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.

0.450

12.00 in

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 1

Date: 18 OCT 2019

Criteria

Retained Height 7.00 ft Wall height above soil 1.00 ft Slope Behind Wall 0.00 Height of Soil over Toe 0.00 in 0.0 ft Water height over heel

Soil Data

Allow Soil Bearing 3,000.0 psf Equivalent Fluid Pressure Method Active Heel Pressure 35.0 psf/ft Passive Pressure 250.0 psf/ft Soil Density, Heel 110.00 pcf Soil Density, Toe 0.00 pcf

Footing||Soil Friction Soil height to ignore for passive pressure

Surcharge Loads

Surcharge Over Heel 40.0 psf Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load 360.0 lbs Axial Live Load 720.0 lbs **Axial Load Eccentricity** 0.0 in

Earth Pressure Seismic Load

Method: Uniform

Multiplier Used 7.000 (Multiplier used on soil density)

Lateral Load Applied to Stem

Lateral Load 0.0 #/ft 0.00 ft...Height to Top = ...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 = 0.00 ft Wall to Ftg CL Dist = Footing Type Line Load Base Above/Below Soil 0.0 ft at Back of Wall Poisson's Ratio 0.300

Uniform Seismic Force = 56.000 **Total Seismic Force** 448.000

Design Summary

Wall Stability Ratios

Lateral Sliding Force

Added Force Req'dfor 1.5 Stability

less 100% Passive Force = -

less 100% Friction Force = -

Sliding	=	2.91 OK 1.52 OK
Total Bearing Loadresultant ecc.	= =	5,824 lbs 11.75 in
Soil Pressure @ Toe Soil Pressure @ Heel	=	2,423 psf OK 0 psf OK
Allowable Soil Pressure Less	= Thar	3,000 psf Allowable
ACI Factored @ Toe ACI Factored @ Heel	=	3,392 psf 0 psf
Footing Shear @ Toe	=	0.2 psi OK
Footing Shear @ Heel	=	40.1 psi OK
Allowable	=	75.0 psi
Sliding Calcs		

=

1,511.4 lbs

2,296.9 lbs

0.0 lbs

0.0 lbs OK

0.0 lbs OK

Fy

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

Load Factors —	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

Ste

em 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	=	9.00	
Rebar Placed at	=	Edge	
Design Data —			
fb/FB + fa/Fa	=	0.712	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs=	1,906.5	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	5,072.2	
MomentAllowable	=	7,122.4	
ShearActual			
Service Level	psi =		
Strength Level	psi =	25.4	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in=	6.25	
Masonry Data			
f'm	psi=		
Fs	psi=		
Solid Grouting			
Modular Ratio 'n'	=		
Wall Weight	psf=	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium W	eight
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	2,500.0	

psi =

60,000.0

Description....

Horizontal Reinforcing

This Wall in File: Q:\0-PROJECTS\2015\PB Architectural\Wen Hu Residence\Retaining Wall Calcs\cantile

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 2

Date: 18 OCT 2019

License To: Phillips Structural Engineering Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing

As (based on applied moment): 0.19 in2/ft

0.2534 in2/ft (4/3) * As:

Min Stem T&S Reinf Area 1.536 in2 0.25 in2/ft

200bd/fy: 200(12)(6.25)/60000: Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft 0.1344 in2/ft

0.0014bh: 0.0014(12)(8): Horizontal Reinforcing Options: One layer of : Two layers of: 0.25 in2/ft #4@ 12.50 in

Required Area: #4@ 25.00 in Provided Area: #5@ 38.75 in 0.2667 in2/ft #5@ 19.38 in Maximum Area: 0.8467 in 2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

Toe Width		=	0	.58 ft
Heel Width		=	4	.58
Total Footing Wid	th	=	5	.16
Footing Thickness	;	=	12.	00 in
Key Width		=	0.	00 in
Key Depth		=	0.	00 in
Key Distance from	n Toe	=	0.	00 ft
f'c = 2,500 p Footing Concrete		/ = =		00 psi .00 pcf
Min. As %		=	0.00	18
Cover @ Top	2.00	@	Btm.=	3.00 in

Footing Design Results

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	3,392	0 psf
Mu' : Upward	=	553	0 ft-#
Mu' : Downward	=	31	8,943 ft-#
Mu: Design	=	523	8,943 ft-#
Actual 1-Way Shear	=	0.19	40.09 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	# 4 @ 8.00 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not reg'd: Mu < phi*5*lambda*sqrt(f'c)*Sm

Heel: #4@ 8.32 in, #5@ 12.89 in, #6@ 18.29 in, #7@ 24.95 in, #8@ 32.85 in, #9@ 41

Key: No key defined

Min footing T&S reinf Area 1.34 in2 Min footing T&S reinf Area per foot 0.26 in2 /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

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING	}		,	RE	SISTING	•
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,120.0	2.67	2,986.7	Soil Over Heel	=	3,013.3	3.21	9,661.5
Surcharge over Heel	=	77.8	4.00	311.1	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	156.5	3.21	501.9
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Sten	า =	360.0	0.92	329.9
Load @ Stem Above So	oil =				* Axial Live Load on Stem	=	720.0	0.92	659.8
Seismic Earth Load	=	313.6	4.00	1,254.4	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		1,511.4		4 552 2	Stem Weight(s)	=	800.0	0.92	733.1
lotai		1,511.4	O. I . IVI.	4,552.2	Earth @ Stem Transition	s=			
	=		=		Footing Weight	=	774.5	2.58	1,999.2
Resisting/Overturnin	g Rat	tio	=	2.91	Key Weight	=			
Vertical Loads used f	for So	il Pressure :	= 5,824.	3 lbs	Vert. Component	=			
					Tota	ī -	5 104 3 I	hs RM =	13 225 6

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

Total = 5,104.3 lbs **R.M.=** 13,225.6 * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Slab High and Soil Low Title Job #: Dsgnr: **TMP** Description....

This Wall in File: Q:\0-PROJECTS\2015\PB Architectural\Wen Hu Residence\Retaining Wall Calcs\cantile

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License To : Phillips Structural Engineering

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 3

Date: 18 OCT 2019

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

250.0 pci Soil Spring Reaction Modulus Horizontal Defl @ Top of Wall (approximate only) 0.104 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.

12.00 in

This Wall in File: Q:\0-PROJECTS\2015\PB Architectural\Wen Hu Residence\Retaining Wall Calcs\cantile

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 1

Date: 18 OCT 2019

Criteria

Retained Height 8.00 ft Wall height above soil 1.00 ft Slope Behind Wall 0.00 Height of Soil over Toe 0.00 in 0.0 ft Water height over heel

Soil Data

Allow Soil Bearing 3,000.0 psf Equivalent Fluid Pressure Method Active Heel Pressure 35.0 psf/ft Passive Pressure 250.0 psf/ft Soil Density, Heel 110.00 pcf Soil Density, Toe 0.00 pcf Footing||Soil Friction 0.450

Soil height to ignore for passive pressure

Surcharge Loads

Surcharge Over Heel 40.0 psf Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load	=	360.0 lbs
Axial Live Load	=	720.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method: Uniform Multiplier Used 7.000 (Multiplier used on soil density)

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 at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Uniform Seismic Force = 63.000 **Total Seismic Force** 567.000

Design Summary

Wall Stability Ratios

Sliding	=	3.07 OK 1.52 OK
Total Bearing Loadresultant ecc.	= =	6,831 lbs 12.20 in
Soil Pressure @ Toe Soil Pressure @ Heel	=	2,344 psf OK 0 psf OK
Allowable Soil Pressure Less	= Thar	3,000 psf n Allowable
ACI Factored @ Toe ACI Factored @ Heel	=	3,281 psf 0 psf
Footing Shear @ Toe	=	1.1 psi OK
Footing Shear @ Heel	=	48.8 psi OK
Allowable	=	75.0 psi
Sliding Calcs		
Lateral Sliding Force	=	1,814.4 lbs

0.0 lbs

0.0 lbs OK

0.0 lbs OK

2,749.9 lbs

less 100% Passive Force = -

less 100% Friction Force = -

Added Force Req'dfor 1.5 Stability

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

Load Factors —	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

Ste

Short Term Factor Equiv. Solid Thick. Masonry Block Type

Concrete Data

f'c

Fy

Masonry Design Method

1	Bottom	
	Stem OK	
ft =		
=		
=		
=		
=		
=		
=	Edge	
	0.054	
=	0.954	
lbs =		
lbs =	2,296.0	
ft-# =		
ft-# =	6,794.7	
=	7,122.4	
psi=		
psi =	30.6	
psi =	75.0	
in2 =		
in =	6.25	
psi=		
psi =		
· =		
=		
psf=	100.0	
	= = = = = = = = = = = = = = = = = = =	Stem OK

Medium Weight

2,500.0 60,000.0

= ASD

psi =

psi =

Description....

Page: 2 Date: 18 OCT 2019

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As (based on applied moment):

(4/3) * As:

License To: Phillips Structural Engineering

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing

0.2546 in2/ft

0.3394 in2/ft Min Stem T&S Reinf Area 1.728 in2

Horizontal Reinforcing

200bd/fy: 200(12)(6.25)/60000: 0.25 in2/ft Min Stem T&S Reinf Area per ft of stem Height: 0.192 in2/ft

0.0014bh: 0.0014(12)(8): 0.1344 in 2/ft Horizontal Reinforcing Options: One layer of: Two layers of:

Required Area: 0.2546 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.2667 in2/ft #5@ 19.38 in Maximum Area: 0.8467 in 2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

Toe Width	=	0.75 ft
Heel Width	=	5.17
Total Footing Width	= _	5.92
Footing Thickness	=	12.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.00 ft
f'c = 2,500 psi Footing Concrete Density Min. As %	,	60,000 psi 150.00 pcf 0.0018
Cover @ Top 2.00	= @ E	3.00 in

Footing Design Results

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	3,281	0 psf
Mu' : Upward	=	883	0 ft-#
Mu': Downward	=	51	12,533 ft-#
Mu: Design	=	833	12,533 ft-#
Actual 1-Way Shear	=	1.07	48.83 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing		None Spec'd	
Heel Reinforcing	=	# 4 @ 6.32 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not reg'd: Mu < phi*5*lambda*sqrt(f'c)*Sm

Heel: #4@ 6.32 in, #5@ 9.79 in, #6@ 13.89 in, #7@ 18.95 in, #8@ 24.95 in, #9@ 31.

Key: No key defined

Min footing T&S reinf Area 1.53 in2 Min footing T&S reinf Area per foot 0.26 in2 /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

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING	.			RE	SISTING	
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,417.5	3.00	4,252.5	Soil Over Heel	=	3,962.9	3.67	14,537.4
Surcharge over Heel	=				Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=			
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Ster	n =	360.0	1.08	390.0
Load @ Stem Above So	il =				* Axial Live Load on Stem	=	720.0	1.08	780.0
Seismic Earth Load	=	396.9	4.50	1,786.1	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		1,814.4		6 020 6	Stem Weight(s)	=	900.0	1.08	975.0
IOtal		1,014.4	O. I . IVI.	6,038.6	Earth @ Stem Transition	s=			
	=		=		Footing Weight	=	888.0	2.96	2,628.5
Resisting/Overturnin	g Rat	io	=	3.07	Key Weight	=			
Vertical Loads used f	or So	il Pressure :	= 6,830.	9 lbs	Vert. Component	=			
					Tota		6 1 1 0 9 I	hs RM=	18 530 8

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

Total = 6,110.9 lbs **R.M.=** 18,530.8 * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Slab High and Soil Low Title Job #: Dsgnr: **TMP** Description....

Page: 3

Date: 18 OCT 2019

This Wall in File: Q:\0-PROJECTS\2015\PB Architectural\Wen Hu Residence\Retaining Wall Calcs\cantile

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License To : Phillips Structural Engineering Code: IBC 2015,ACI 318-14,ACI 530-13

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

250.0 pci Soil Spring Reaction Modulus Horizontal Defl @ Top of Wall (approximate only) 0.099 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.

12.00 in

Page: 1 Date: 18 OCT 2019

This Wall in File: Q:\0-PROJECTS\2015\PB Architectural\Wen Hu Residence\Retaining Wall Calcs\cantile

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License : KW-06061509 License To : Phillips Structural Engineering

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height 9.00 ft Wall height above soil 1.00 ft Slope Behind Wall 0.00 Height of Soil over Toe 0.00 in 0.0 ft Water height over heel

Soil Data

Allow Soil Bearing 3,000.0 psf Equivalent Fluid Pressure Method Active Heel Pressure 35.0 psf/ft Passive Pressure 250.0 psf/ft Soil Density, Heel 110.00 pcf Soil Density, Toe 0.00 pcf Footing||Soil Friction 0.450

Soil height to ignore for passive pressure

Surcharge Loads

Surcharge Over Heel 40.0 psf Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load 360.0 lbs Axial Live Load 720.0 lbs **Axial Load Eccentricity** 0.0 in

Earth Pressure Seismic Load

Method: Uniform

Multiplier Used 7.000 (Multiplier used on soil density)

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 = 0.00 ft Wall to Ftg CL Dist = Footing Type Line Load Base Above/Below Soil 0.0 ft at Back of Wall Poisson's Ratio 0.300

Uniform Seismic Force = 70.000 **Total Seismic Force** 700.000

Design Summary

Wall Stability Ratios

Lateral Sliding Force

Added Force Req'dfor 1.5 Stability

less 100% Passive Force = -

less 100% Friction Force = -

= =			
= =	- ,		
=	2,542	psf	OK
=			
= Than A			
=	3,559	psf	
=	3	psf	
=	1.2	psi	OK
=	67.0	psi	OK
=	75.0	psi	
	= = = = = = = = = = = = = = = = = = =	= 1.51 = 8,586 = 13.48 = 2,542 = 2 = 3,000 Than Allowable = 3,559 = 3 = 1.2 = 67.0	= 8,586 lbs = 13.48 in = 2,542 psf = 2 psf = 3,000 psf Than Allowable = 3,559 psf = 3 psf = 1.2 psi = 67.0 psi

=

2,337.2 lbs

3,539.6 lbs

0.0 lbs

0.0 lbs OK

0.0 lbs OK

f'c

Fy

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

Load Factors —	
Building Code	IBC 2015,ACI
•	•
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

Bottom Ste

em Construction		Bottom	
Docian Height Above Etg		Stem OK	
Design Height Above Ftg Wall Material Above "Ht"		0.00	
Design Method	=	Concrete LRFD	
Thickness	=	8.00	
Rebar Size	_	# 5	
Rebar Spacing	=	8.00	
Rebar Placed at	=	Edge	
Design Data			
fb/FB + fa/Fa	=	0.887	
Total Force @ Section			
Service Level	lbs=		
Strength Level	lbs=	3,081.3	
MomentActual			
Service Level	ft-# =		
Strength Level	ft-# =	10,463.7	
MomentAllowable	=	11,799.2	
ShearActual			
Service Level	psi =		
Strength Level	psi =	41.5	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in=	6.19	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type		Medium We	ight
Masonry Design Method	=	ASD	
Concrete Data		0.500.0	

psi =

psi =

2,500.0 60,000.0

Title Slab Ḥigh and Soil Low Job #: Dsgnr: TMP

Description....

Horizontal Reinforcing

This Wall in File: Q:\0-PROJECTS\2015\PB Architectural\Wen Hu Residence\Retaining Wall Calcs\cantile

RetainPro (c) 1987-2017, Build 11.17.11.01 License : KW-06061509

Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 2

Date: 18 OCT 2019

License To: Phillips Structural Engineering Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing

As (based on applied moment): 0.3962 in2/ft

0.5283 in2/ft Min Stem T&S Reinf Area 1.920 in2 (4/3) * As:

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

0.0014bh: 0.0014(12)(8): 0.1344 in 2/ft Horizontal Reinforcing Options: One layer of: Two layers of:

Required Area: 0.3962 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.465 in2/ft #5@ 19.38 in Maximum Area: 0.8382 in2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

ι				
	Toe Width	=	0.	75 ft
	Heel Width	=	6.0	00
	Total Footing Width	= _	6.	75
	Footing Thickness	=	12.0	00 in
	Key Width	=	0.0	00 in
	Key Depth	=	0.0	00 in
	Key Distance from Toe	=	0.0	00 ft
	f'c = 2,500 psi	Fy =	60,00	00 psi
	Footing Concrete Density	/ =	150.0	00 pcf
	Min. As %	=	0.00°	18
	Cover @ Top 2.00	@ E	8tm.=	3.00 in

Footing Design Results

		<u>Toe</u>	Heel	
Factored Pressure	=	3,559	3	psf
Mu' : Upward	=	964	0	ft-#
Mu' : Downward	=	51	20,366	ft-#
Mu: Design	=	913	20,366	ft-#
Actual 1-Way Shear	=	1.17	66.99	psi
Allow 1-Way Shear	=	40.00	75.00	psi
Toe Reinforcing	=	None Spec'd		
Heel Reinforcing	=	# 5 @ 7.50 in		
Key Reinforcing	=	None Spec'd		

Other Acceptable Sizes & Spacings

Toe: Not rea'd: Mu < phi*5*lambda*sart(f'c)*Sm

Heel: #4@ 4.87 in, #5@ 7.55 in, #6@ 10.71 in, #7@ 14.61 in, #8@ 19.23 in, #9@ 24.

Key: No key defined

Min footing T&S reinf Area 1.75 in2 Min footing T&S reinf Area per foot 0.26 in2 /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

Summary of Overturning & Resisting Forces & Moments

		OV	ERTURNING	}			RE	SISTING	
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	1,750.0	3.33	5,833.3	Soil Over Heel	=	5,280.0	4.08	21,560.0
Surcharge over Heel	=	97.2	5.00	486.1	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	213.3	4.08	871.1
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Ster	m =	360.0	1.08	390.0
Load @ Stem Above So	oil =				* Axial Live Load on Stem	=	720.0	1.08	780.0
Seismic Earth Load	=	490.0	5.00	2,450.0	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		2.337.2	O.T.M.	9.760.4	Stem Weight(s)	=	1,000.0	1.08	1,083.3
Iotai		2,337.2	O. I .IVI.	8,769.4	Earth @ Stem Transition	ns=			
	=		=		Footing Weight	=	1,012.5	3.38	3,417.2
Resisting/Overturnin	g Rat	tio	=	3.12	Key Weight	=			
Vertical Loads used f	for So	il Pressure :	= 8,585.	8 lbs	Vert. Component	=			
					Tota	al –	7 865 8 I	hs RM=	27 321 6

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

27,321.6 Total = 7,865.8 lbs **R.M.=** * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Title Slab High and Soil Low
Job #: Dsgnr: TMP
Description....

Page: 3 Date: 18 OCT 2019

This Wall in File: Q:\0-PROJECTS\2015\PB Architectural\Wen Hu Residence\Retaining Wall Calcs\cantile

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Cantilevered Retaining Wall
Code: IBC 2015,ACI 318-14,ACI 530-13
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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.

Page: 1 Date: 18 OCT 2019

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height 10.00 ft Wall height above soil 1.00 ft 0.00 Slope Behind Wall Height of Soil over Toe 0.00 in Water height over heel 0.0 ft

Soil Data

Soil height to ignore

S

2,901.7 lbs

4,321.0 lbs

45.1 lbs

0.0 lbs OK

0.0 lbs OK

Allow Soil Bearing 3,000.0 psf Equivalent Fluid Pressure Method Active Heel Pressure 35.0 psf/ft Passive Pressure 250.0 psf/ft Soil Density, Heel 110.00 pcf Soil Density, Toe 0.00 pcf Footing||Soil Friction 0.450

12.00 in for passive pressure Lateral Load Applied to Stem

Lateral Load 0.0 #/ft ...Height to Top 0.00 ft= ...Height to Bottom 0.00 ft Wind (W) Load Type (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

Surcharge Loads

Surcharge Over Heel 40.0 psf Used To Resist Sliding & Overturning Surcharge Over Toe 0.0 NOT Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load 360.0 lbs Axial Live Load 720.0 lbs **Axial Load Eccentricity** 0.0 in

Earth Pressure Seismic Load

Method: Uniform Multiplier Used 7.000 (Multiplier used on soil density)

		_	
Desi	an	Sum	marv

Wall Stability Ratios

Lateral Sliding Force

Added Force Req'd

....for 1.5 Stability

less 100% Passive Force = -

less 100% Friction Force = -

Overturning Sliding	=	3.02 OK 1.50 OK
Total Bearing Loadresultant ecc.	=	10,322 lbs 15.13 in
Soil Pressure @ Toe Soil Pressure @ Heel	=	2,810 psf OK 0 psf OK
Allowable Soil Pressure Less	= Thai	3,000 psf
ACI Factored @ Toe ACI Factored @ Heel	=	3,934 psf 0 psf
Footing Shear @ Toe	=	0.2 psi OK
Footing Shear @ Heel	=	69.3 psi OK
Allowable	=	75.0 psi
Sliding Calcs		

=

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

Load Factors —	
Building Code	IBC 2015,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic F	1 000

Uniform Seismic Force = 78.167 **Total Seismic Force** 872.861

Concrete Data

psi =

psi =

2,500.0 60,000.0

f'c

Fy

Stem Construction	1_	Bottom	
Design Height Above Ftg	ft =	Stem OK 0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
Thickness	_	8.00	
Rebar Size	=	# 5	
Rebar Spacing	=	6.00	
Rebar Placed at	=	Edge	
Design Data ————			
fb/FB + fa/Fa	=	0.937	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	3,785.3	
MomentActual			
0000 =0.0.	ft-# =		
Strength Level	ft-# =	14,259.8	
MomentAllowable	=	15,222.0	
ShearActual			
Service Level	psi=		
Strength Level	psi=	51.0	
ShearAllowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	6.19	
Masonry Data			
f'm	psi=		
Fs	psi=		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	100.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=		eight
Masonry Design Method	=	ASD	

Description....

Horizontal Reinforcing

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Cantilevered Retaining Wall

Code: IBC 2015,ACI 318-14,ACI 530-13

Page: 2

Date: 18 OCT 2019

License To: Phillips Structural Engineering Concrete Stem Rebar Area Details

Bottom Stem Vertical Reinforcing

As (based on applied moment): 0.54 in2/ft

0.7199 in2/ft (4/3) * As:

Min Stem T&S Reinf Area 2.112 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

0.0014bh: 0.0014(12)(8): 0.1344 in 2/ft Horizontal Reinforcing Options:

One layer of : Two layers of:

Required Area: 0.54 in2/ft #4@ 12.50 in #4@ 25.00 in Provided Area: #5@ 38.75 in 0.62 in2/ft #5@ 19.38 in Maximum Area: 0.8382 in2/ft #6@ 27.50 in #6@ 55.00 in

Footing Dimensions & Strengths

				9
Toe Width		=	0	.75 ft
Heel Width		=	6	.67
Total Footing Wi	dth	=	7	.42
Footing Thicknes	SS	=	14.	.00 in
Key Width		=	0.	.00 in
Key Depth		=	0.	.00 in
Key Distance fro	m Toe	=	0.	.00 ft
f'c = 2,500 Footing Concrete		Fy =		000 psi .00 pcf
Min. As %		=	0.00	18
Cover @ Top	2.00	@	Btm.=	3.00 in

Footing Design Results

		<u>Toe</u>	<u>Heel</u>
Factored Pressure	=	3,934	0 psf
Mu' : Upward	=	1,069	0 ft-#
Mu': Downward	=	59	28,724 ft-#
Mu: Design	=	1,010	28,724 ft-#
Actual 1-Way Shear	=	0.18	69.34 psi
Allow 1-Way Shear	=	40.00	75.00 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	# 5 @ 6.00 in	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: Not reg'd: Mu < phi*5*lambda*sqrt(f'c)*Sm

Heel: #4@ 4.20 in, #5@ 6.52 in, #6@ 9.25 in, #7@ 12.61 in, #8@ 16.61 in, #9@ 21.0

Key: No key defined

Min footing T&S reinf Area 2.24 in2 Min footing T&S reinf Area per foot 0.30 in2 /ft

If one layer of horizontal bars: If two layers of horizontal bars:

#4@ 7.94 in #4@ 15.87 in #5@ 12.30 in #5@ 24.60 in #6@ 17.46 in #6@ 34.92 in

Summary of Overturning & Resisting Forces & Moments

		OVERTURNING					RE		
Item		Force lbs	Distance ft	Moment ft-#			Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	2,182.2	3.72	8,122.5	Soil Over Heel	=	6,603.7	4.42	29,177.2
Surcharge over Heel	=	108.6	5.58	606.2	Sloped Soil Over Heel	=			
Surcharge Over Toe	=				Surcharge Over Heel	=	240.1	4.42	1,061.0
Adjacent Footing Load	=				Adjacent Footing Load	=			
Added Lateral Load	=				Axial Dead Load on Ster	m =	360.0	1.08	390.0
Load @ Stem Above Soil =					* Axial Live Load on Stem	=	720.0	1.08	780.0
Seismic Earth Load	=	611.0	5.58	3,411.4	Soil Over Toe	=			
	=				Surcharge Over Toe	=			
Total		2.901.7	O.T.M.	12,140.0	Stem Weight(s)	=	1,100.0	1.08	1,191.7
IOIAI		2,901.7	O. I . IVI.	12,140.0	Earth @ Stem Transitions =				
	=		=		Footing Weight	=	1,298.5	3.71	4,817.4
Resisting/Overturning Ratio = 3.02			3.02	Key Weight	=				
Vertical Loads used for Soil Pressure = 10,322.3 lbs				Vert. Component	=				
					Tota	al –	9 602 3 1	hs RM=	36 637 3

If seismic is included, the OTM and sliding ratios be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

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.

36,637.3 9,602.3 lbs **R.M.=** ı otal = * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

Slab High and Soil Low Title Job #: Dsgnr: **TMP** Page: 3

Date: 18 OCT 2019

Description....

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Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

250.0 pci Soil Spring Reaction Modulus Horizontal Defl @ Top of Wall (approximate only) 0.116 in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe.