STRUCTURAL CALCULATIONS

FOR

ALTMAN MIDDLE LOT
64TH STREET SE
MERCER ISLAND, WA 98040

FOR
BENJAMIN ALTMAN

PROJECT NO. 2020-0198

June 15, 2020

CALCULATIONS

BY

JACOB GUSTAFSON, E.I.T.

REVIEWED AND STAMPED

BY

JESSE M CHASE, PE, SE

MC SQUARED, INC.
1235 EAST 4TH AVENUE, SUITE 101
OLYMPIA, WASHINGTON 98506-4211
(360) 754-9339 FAX (360) 352-2044

STRUCTURAL CALCULATIONS

FOR

ALTMAN MIDDLE LOT
64TH ST SE
MERCER ISLAND, WA 98040

SITE SPECIFIC
LATERAL ANALYSIS
AND DESIGN
(DO NOT REUSE)

FOR
BENJAMIN ALTMAN

PROJECT #2020-0198

BY
MC SQUARED, INC.

JACOB A GUSTAFSON, EIT

REVIEWED BY

JESSE M CHASE, PE, SE

06-15-2020

SCOPE: CLIENT REQUESTED STRUCTURAL ENGINEERING TO PROVIDE LATERAL ENGINEERING FOR A TWO-STORY WOOD FRAMED BUILDING IN KING COUNTY, WA.

BASIS OF DESIGN IS DRAWINGS PROVIDED BY CLIENT. NO ANALYSIS AND DESIGN OF BRACING, TEMPORARY OR PERMANENT, REQUESTED OR CONDUCTED. ALL BRACING, TEMPORARY AND PERMANENT, SHALL BE RESPONSIBILITY OF CONTRACTOR.

LOADS: 2015 IBC/ASCE 7-10

VERTICAL:

ROOF	DL=	15 PSF
	SL=	25 PSF
FLOOR	DL=	15 PSF
	LL=	40 PSF

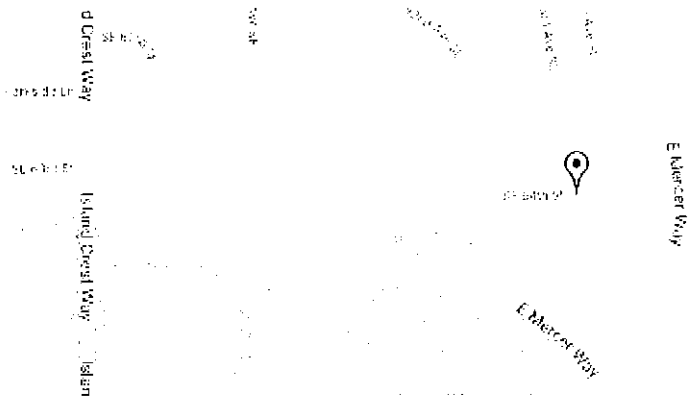
LATERAL:

WIND: 2015 IBC, PER ASCE 7-10, SECTION 26. RISK CATEGORY II, ENCLOSED, 110 MPH EXPOSURE B. SEE ATTACHED WIND CALCULATIONS.

APPROX. MEAN ROOF HT = 23'

SEISMIC: 2015 IBC, PER ASCE 7-10, SECTION 12,
RISK CATEGORY II, IMPORTANCE FACTOR I = 1.0,
SITE CLASSIFICATION D, DESIGN CATEGORY D
OMEGA= 3.0
R= 6.5 LIGHT FRAMED WOOD SHEARWALLS,
USE BOTH DIRECTIONS.

COEFF= 0.193 STRENGTH LEVEL, 0.135 SERVICE



Lat: 47.54586070, Lng: -122.21369750

9301 SE 64th St, Mercer Island, WA 98040, USA
Latitude, Longitude: 47.5458607, -122.2136975

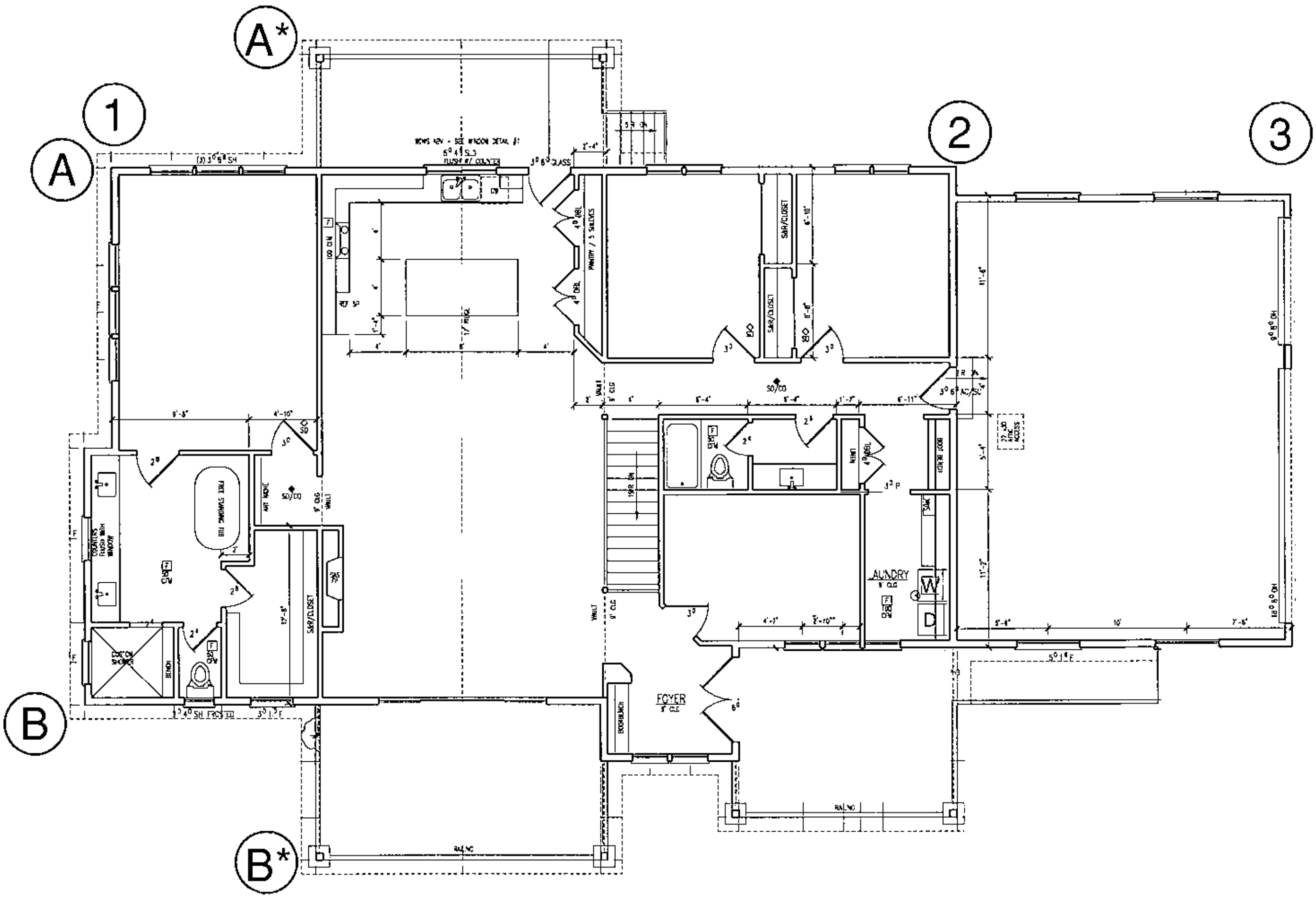
OSHPD Seismic Design Maps

Date	4/29/2020, 4:24:03 PM
Design Code Reference Document	ASCE7-10
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.449	MCE_R ground motion. (for 0.2 second period)
S_1	0.555	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.449	Site-modified spectral acceleration value
S_{M1}	0.832	Site-modified spectral acceleration value
S_{DS}	0.966	Numeric seismic design value at 0.2 second SA
S_{D1}	0.555	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	1.5	Site amplification factor at 1.0 second
PGA	0.602	MCE_G peak ground acceleration
F_{PGA}	1	Site amplification factor at PGA
PGA_M	0.602	Site modified peak ground acceleration
T_L	6	Long-period transition period in seconds
SsRT	1.449	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.527	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	3.608	Factored deterministic acceleration value. (0.2 second)
S1RT	0.555	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.598	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
S1D	1.307	Factored deterministic acceleration value. (1.0 second)
PGAd	1.368	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.949	Mapped value of the risk coefficient at short periods
C_{R1}	0.928	Mapped value of the risk coefficient at a period of 1 s

GRID LINES



MC SQUARED, INC.
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Job:	Altman Middle Lot		2020-0198
Date:	5/21/2020	By:	JAG
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Scope of Work: Structural calculations for the lateral of a two story house located in King County, WA.

Site Address: Mercer Island, Washington 98040

Design Loads:

Roof Dead load = 15.0 psf
Snow load = 25.0 psf I_S = 1.0

Wall Dead Load = 12.0 psf

Floor Dead Load = 15.0 psf
Live Load = 40.0 psf

Conc. Dead Load = 150 pcf

Lateral Forces per the 2015 IBC/ASCE 7-10

Wind:
V_{LRFD} = 110.0 mph
V_{ASD} = 85.0 mph
Occupancy Cat. II
Exposure = B
Roof Pitch = 5:12

Seismic:
Ss = 1.449
S_1 = 0.554
I_E = 1.0
Fa = 1.000
Fv = 1.500
Ω = 2.5
S_{DS} = 0.966
S_{DL} = 0.554
Wood Sheathed Shear Walls R= 6.5
Cs = S_{DS}/(R/I)
ρ = 1.3
V_{LRFD}= 0.193 W
V_{ASD}= 0.135 W

Soil:
= 1500 PSF, Bearing Capacity
= 400 PCF, Passive Resistance
= 35 PCF, Active Pressure
= 0.50, Coefficient of Friction
= 6H, Seismic Loading

MWFRS Wind Loads (ASCE 7-10, Ch. 28)

Exposure: B
Height: 30 ft
Speed: 110 MPH (LRFD)

Pitch: 5:12 = 22.6 deg
λ = 1.00
Kzt = 1.00

Wall Ht1: 12
Wall Ht2: 9 ft
Roof Ht: 9 ft

Zone	Pressure			
A	25.4	x 1.00 x 1.0 =	25.4	PSF
B	-1.6	x 1.00 x 1.0 =	-1.6	PSF
C	17.6	x 1.00 x 1.0 =	17.6	PSF
D	0.1	x 1.00 x 1.0 =	0.1	PSF

Avg of A & C = (25.4 + 17.6)/2 = 21.5 PSF (LRFD)

21.5*0.6 = 12.9 PSF (ASD)

Components and Cladding

Horizontal

Exposure: B

λ = 1.00
Kzt = 1.00
V = 110 MPH (LRFD)

Area (sf)	Zone	Pressure (PSF)			Avg. 4&5 (LRFD)	Avg. 4&5 (ASD)
10	4	-23.6	x 1.00 x 1.0 =	-23.6	-26.4	-15.8
	5	-29.1	x 1.00 x 1.0 =	-29.1		
20	4	-22.6	x 1.00 x 1.0 =	-22.6	-24.9	-14.9
	5	-27.2	x 1.00 x 1.0 =	-27.2		
50	4	-21.3	x 1.00 x 1.0 =	-21.3	-23.0	-13.8
	5	-24.6	x 1.00 x 1.0 =	-24.6		
100	4	-20.4	x 1.00 x 1.0 =	-20.4	-21.5	-12.9
	5	-22.6	x 1.00 x 1.0 =	-22.6		

Vertical

Area (sf)	Zone	Pressure (PSF)			Avg. 4&5 (LRFD)	Avg. 4&5 (ASD)
10	2	-36.9	x 1.00 x 1.0 =	-36.9	-36.9	-22.1
	3	-36.9	x 1.00 x 1.0 =	-36.9		
20	2	-35.8	x 1.00 x 1.0 =	-35.8	-35.8	-21.5
	3	-35.8	x 1.00 x 1.0 =	-35.8		
50	2	-34.3	x 1.00 x 1.0 =	-34.3	-34.3	-20.6
	3	-34.3	x 1.00 x 1.0 =	-34.3		
100	2	-33.2	x 1.00 x 1.0 =	-33.2	-33.2	-19.9
	3	-33.2	x 1.00 x 1.0 =	-33.2		

Seismic Base Shear

Roof weight = **15 psf**
Interior Wall weight = **10 psf**
Exterior Wall weight = **12 psf**
Typ. Wall Height = **9 ft**

Weights

Level	Label	R/F Area (sf)	R/F Wt (psf)	Deck Area (sf)	Deck Wt (psf)	Ext. Walls (ft)	Int. Walls (ft)	Total Wt (lbs)
2	Upper Roof	3835	15 psf	0	0	248	239	81672
1	Floor/Deck	3074	15 psf	581	10 psf	204	154	94013
							Σ =	175685 #

Base Shear (E) = ρ*Cs*W
Base Shear (E) = 0.193 W (LRFD)
= 0.135 W (ASD)
E = 33942 # (LRFD)
= 23760 # (ASD)

Sds =	0.966
I =	1
ρ =	1.3
R =	6.5
Cs =	(Sds*I)/R
=	0.149

Base Shear	Level	Wt (#)	H (ft)	WH	%	E (#)
23760	2	81672	21	1715112	60%	14332
	1	94013	12	1128156	40%	9427
	Σ	175685				23760

gm Loads

**Loads to A* & B* cantilevered back to A & B respectively

W = 12.9 PSF **No Wind Loads to lines A & B at Level 1

Line	H (ft)	ω (plf)	L (ft)	B (ft)	V (#)	v (#)	v (plf)	M (FT-#)	T = C
A-B	13.5	174.2	40	86	6966	3483	41	34830	405
1-2	13.5	174.2	61	40	10623	5312	133	81002	2025
2-3	13.5	174.2	25	40	4354	2177	54	13605	340
A-B	10.5	0	38	59	0	0	0	0	0
1-2	10.5	135	59	38	7992	3996	105	58938	1551

Total Base Shear: A-B = 6966 #
1-3 = 22968 #

Level	Line	E (#)	ω (plf)	L (ft)	B (ft)	v (#)	v (plf)	M (FT-#)	T = C
2	A-B	14332	358	40	86	7166	83	71661	833
	1-2	11283	185	61	40	5641	141	86030	2151
	2-3	3050	122	25	40	1525	38	9530	238
1	A-B	9427	248	38	59	4714	80	44780	759
	1-2	9427	160	59	38	4714	124	69527	1830

Total Base Shear = 23760 #

oads:

).966 (Fp)min = 0.2*(Sds)*I*W/1.4

ΣF/ΣW) (Fp)max = 0.4*(Sds)*I*W/1.4

Level	Fx (#)	$\sum_{i=x}^{n} Fi$	Wx (#)	$\sum_{i=x}^{n} Wi$	Fpx (#)	Fmin (#)	Fmax	Design Base Shear (#)	Wind Load (#)	v (plf)
2	14332	14332	81672	81672	14332	11271	22541	14332	14977	-
1	9427	23760	94013	175685	12714	12974	25948	12974	7992	171

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CANTILEVERED DIAPHRAGMS

@ (B*)

L = 11'

B = 21'

G_t = 83,500 PSI (W/ 24/16 OSB); (21,000 W/ 1/2 PLY)

$e_n = \left(\frac{59}{616}\right)^{3.018} = 0.000842$

E = 15 PSF × 11' × 21' × 0.135 = 468 #

W = 12.9 PSF × 11' × 10.5' = 1490 #

$V = \frac{1490\#}{21'} = 71$ PLF (WIND CONTROLS)

w = 12.9 PSF × 10.5' = 135 PLF

$M = \frac{135 \times 11^2}{2} = 8168$ #-ft

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DIAPHRAGM DEFLECTION

NAIL LOAD = $\frac{117\#}{2}$ = 59# (8d's @ 6" O.C.)

$\Delta_s = \frac{r \times L}{2G_t} = \frac{71\ PLF \times 11'}{2 \times 83{,}500} = 0.00468$ (OSB)

$= 0.0186$ (1/2" PLY)

$\Delta_n = 0.376 \times L \times e_n$

$= 0.376 \times 11' \times 0.000842 = 0.00348$

$\Delta_b = 0$

$\Delta_c = 0$

$\Sigma\Delta = 0.00468 + 0.00348 = 0.0082''$ (OSB)

$= 0.0221''$ (PLY)

$\Rightarrow$ NO DIAPHRAGM STRENGTHENING REQ'D

$\therefore$ GOOD @ A*

Loads To Lines

--> See Earthquake base shears and Wind base shears for loads

Load Case	Level	Line	V1 (#)	V2 (#)	Total	Sum
Wind	2	A	3483		3483	6966
		B	3483		3483	
		1	5312		5312	14977
		2	5312	2177	7488	
		3	2177		2177	
	1	A	3483		3483	6966
		B	3483		3483	
		1	3996	5312	9307	22968
		2	3996	7488	11484	
		3			2177	
Seismic	2	A	7166		7166	14332
		B	7166		7166	
		1	5641		5641	14332
		2	5641	1525	7166	
		3	1525		1525	
	1	A	4714	7166	11880	23760
		B	4714	7166	11880	
		1	4714	5641	10355	23760
		2	4714	7166	11880	
		3			1525	

Line Dead Loads (Excluding Wall weights)

Line	Level	Wt (psf)	TW (ft)	Weight at Line (plf)
A	2	15	20	300
	1	15	2	30
B	2	15	20	300
	1	15	2	30
1	2	15	2	30
	1	15	8	120
2	2	15	2	30
	1	15	10	150
3	2	15	8	120

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1/2" AB $Z_{||}$:	944 lb
Wall Wt:	12 psf

Level	V	Wall Available	Total Wall	v	Wall Type	Anchor Bolts #	Anchor Bolts o.c.	Wall Height	Wall Section	Uplift	H/B	Roof Weight	Total Weight	Net Uplift	Total Uplift	Required Holdown
2R	7166	10+5.5+8+4.25+ 5.5+5.25+3.4	36.8	195	1	8	48	9	10	1751	0.9	300	354	-19		LTT20B
								9	8	1751	1.125	300	354	335		LTT20B
								9	5.5	1751	1.636	300	354	778		LTT20B
								9	5.25	1751	1.714	300	354	822		LTT20B
								9	4.25	1751	2.118	300	354	999		LTT20B
								9	3.4	1751	2.647	300	354	1149		LTT20B
2R	7166	5.3+5.3+8+3.8+4.4 +6+7	40.0	179	1			9	8	1614	1.125	300	354	198		MST37
								9	7	1614	1.286	300	354	375		MST37
								9	6	1614	1.5	300	354	552		MST37
								9	5.3	1614	1.698	300	354	676		MST37
								9	4.4	1614	2.045	300	354	836		MST37
								9	3.8	1614	2.368	300	354	942		MST37
1F	11880	3.33+3.33+4.33+5+ 10	26.0	457	3	13	32	12	10	5485	1.2	30	102	4975	5351	HDU8
								12	5	5485	2.4	30	102	5230	5783	HDU8
								12	4.33	5485	2.771	30	102	5264	6100	HDU8
								8.50	3.33	5485	2.553	30	81	5350	6027	HDU8
2R	5641	5.3+5.3+5+5.5	21.0	269	2	6	48	9	5.5	2418	1.636	30	84	2187		HDU2
								9	5	2418	1.8	30	84	2208		HDU2
								9	5.3	2418	1.698	30	84	2195		HDU2
2R	7488	14+16	30.0	250	1	8	48	9	5.5	2247	1.636	30	84	2016		HDU2
								9	5	2247	1.8	30	84	2037		HDU2
2R	2177	1.67+1.67+1.67	5.0	435	4	2	48	5.5	1.67	2395	3.293	30	63	2342		HDU2

1 sheathing nailed with 8d's at 6" on center all edges. (Capacity= 260 plf)
2 sheathing nailed with 8d's at 4" on center all edges with 3X or 4X studs at adjoining panel edges. (Capacity= 380 plf)
3 sheathing nailed with 8d's at 2" on center all edges with 3X or 4X studs at adjoining panel edges. (Capacity= 640 plf)
4 sheathing nailed with 10d's at 2" on center all edges with 3X or 4X studs at adjoining panel edges. (Capacity= 770 plf)

*** Concrete Retaining walls at Level 1 lines A, 1, & 2
*** Shearwall strapping Required @ Wall Line B - Level 1
*** (2) Simpson WSW18x10's required @ Wall line 3

g Adjustment
)/(2b/h)

lvl	Section	H	v	v*
2R	3.4	9	195	257.5
2R	3.8	9	179	212.4
1F	4.33	12	457	633.4
1F	3.33	8.5	457	583.4
2R	1.67	5.5	435	716.9

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trapping

B - 1

$\frac{11880\ \#}{59.00\ ft} = 201\ plf$

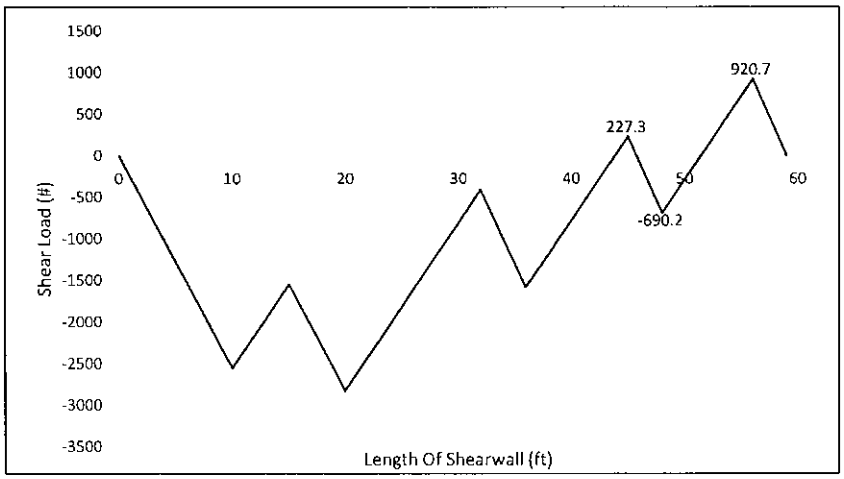
$\frac{11880\ \#}{26.00\ ft} = 457\ plf$

-690 #

921 #

921 #

2050 # ∴ **GOOD**



trapping

3

$\frac{2177\ \#}{32.00\ ft} = 68\ plf$

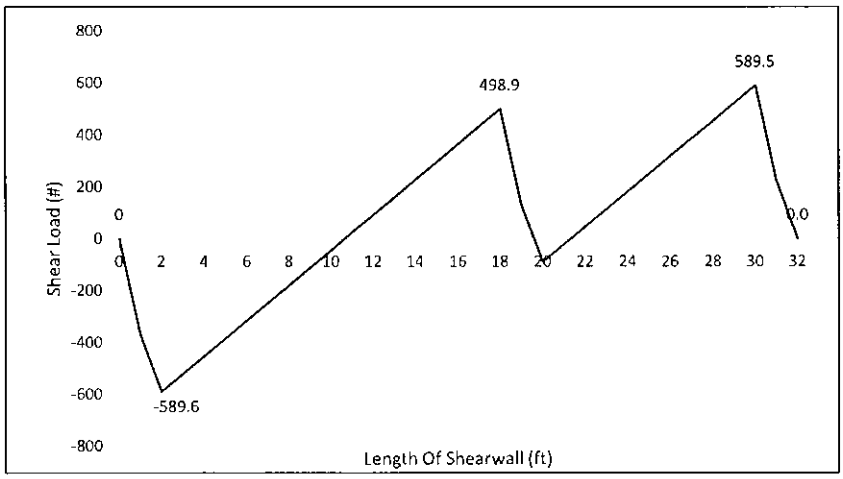
$\frac{2177\ \#}{5.00\ ft} = 435\ plf$

-590 #

590 #

590 #

2050 # ∴ **GOOD**



TYPICAL SHEAR WALL NOTES

Use 1/2" dia. by 10" Anchor Bolts (AB's) with single plates or 1/2" dia. by 12" AB's with 3X or double plates spaced as shown on the drawings. AB's shall have 7" of embedment into footing, shall be centered in the stud wall, and shall project through the bottom plate of the wall. All anchor bolts shall be placed within 12" from corners, and 12" from the ends of both plates at splices. All anchor bolts shall have a 3" square, 1/4" thick plate washers between the top of the sill plate and the nut. (If using expansion anchors as substitutes for anchor bolts, embed a minimum of 3-1/2" into concrete.)

All wall sheathing shall be 1/2" COX plywood, 5/8" T1-11 siding, or 7/16" OSB with exterior exposure glue and span rated "SR 24/0" or better. All free sheathing edges shall be blocked with 2x4 or 2x6 flat blocking except where noted on the drawings or below.

All nails shall be 8d or 10d common (8d common nails must be 0.131 inch diameter, Senco KC27 Nails are equivalent. If 10d common nails are called for the diameter must be 0.148 inches, Senco MD23 Nails are equivalent when used with ½" plywood). Nail size and spacing at all sheathing edges shall be as required below or as in the drawings. Nail spacings shall be 12" o.c. for all field nailing except as noted.

Hold downs are Simpson "Strong Tie" and shall be installed per the manufacture's recommendation. Equivalent holdowns by United Steel Products Company "Kant-Sag" that have ICC approval can be substituted in place of Simpson holdowns.

The nailing of the sole plate to the floor shall be 16d common nails to match the spacing of the shear wall edge nailing.

Wall framing shall be #2 Doug-Fir or better. 3X, 4X, or 6X studs can be made from multiple 2X studs glued and nailed together with (2) rows of 10d's at 8" on center each row.

3x sill plates can be a combination of (1) pressure treated 2X sill directly in contact with concrete and another non-treated 2X sill plate nailed to the lower plate with (2) rows of 10d common nails at 6" on center each row.

All fasteners in pressure treated wood shall be hot dipped galvanized or stainless steel. Anchor bolts are not required to be of stainless steel or galvanized.

ROOF DIAPHRAGM

½" plywood or 7/16" OSB, span rated 24/16 or better, nail with 8d common nails at 6" on center edges and 12" on center field. Sheathing shall lay perpendicular to framing.

FLOOR DIAPHRAGM

3/4" tongue and groove plywood or OSB sheathing span rated 48/24 or better. Glue and nail with 10d commons at 6" on center edges, and 12" on center field. Sheathing shall lay perpendicular to framing.

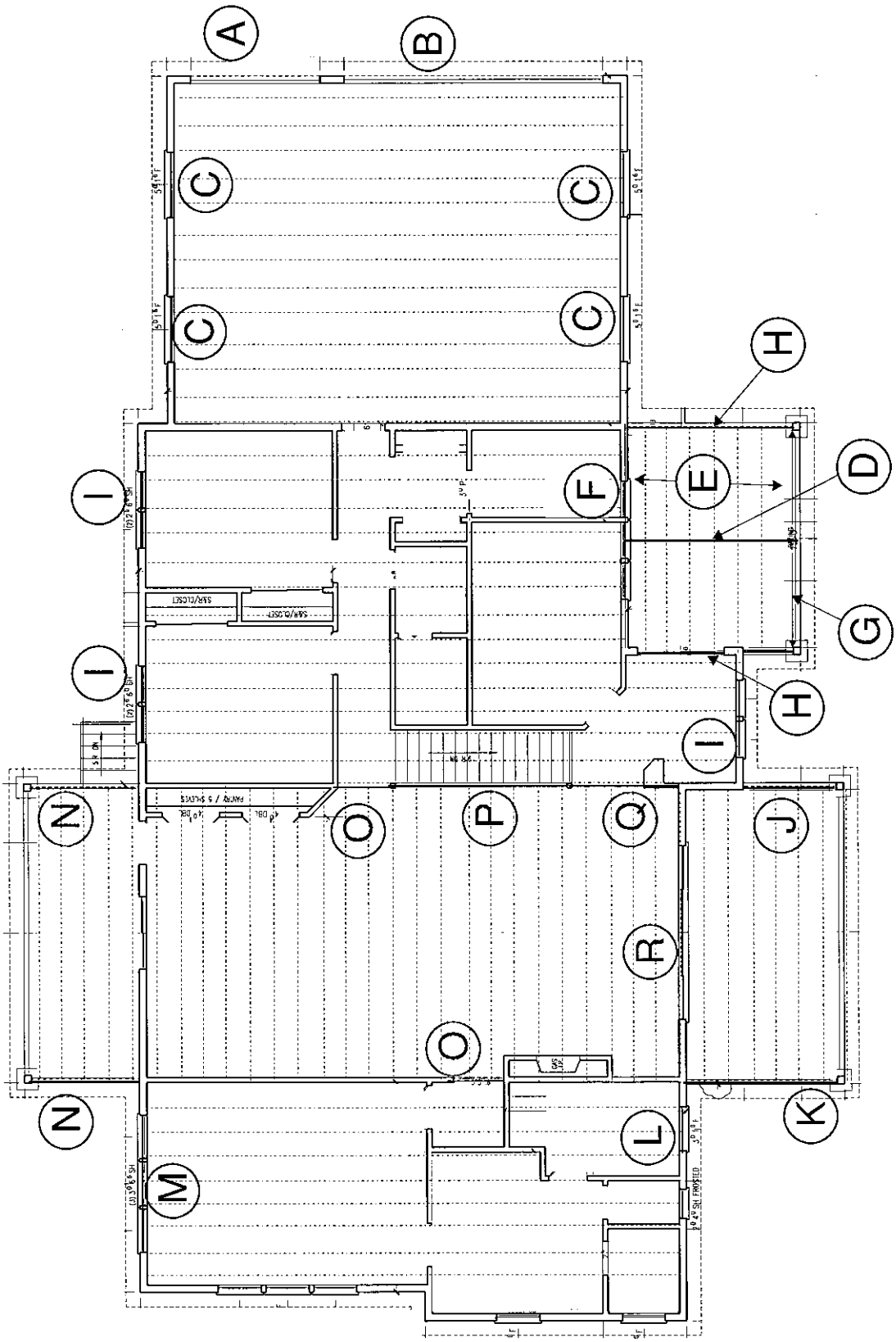
SHEAR WALL SCHEDULE

1	sheathing nailed with 8d's at 6" on center all edges. (Capacity= 260 plf)
2	sheathing nailed with 8d's at 4" on center all edges with 3X or 4X studs at adjoining panel edges. (Capacity= 380 plf)
3	sheathing nailed with 8d's at 2" on center all edges with 3X or 4X studs at adjoining panel edges. (Capacity= 640 plf)
4	sheathing nailed with 10d's at 2" on center all edges with 3X or 4X studs at adjoining panel edges. (Capacity= 770 plf)

HOLDOWN SCHEDULE

LTT20B	LTT20B attaches to foundation with 1/2" diameter anchor bolt with 7" minimum embedment for cast in place construction. Use ½" diameter threaded rod in cleaned 5/8" diameter hole 6" deep and epoxy with Simpson AT-XP if installed after concrete has been cast. LTT20B attaches to double stud minimum with (10) 16d sinker nails. (Cap = 1500)
HDU2	HDU2 attaches to foundation with a 5/8" diameter anchor bolt with 14" minimum embedment for cast in place construction. Use 5/8" diameter threaded rod in cleaned 3/4" diameter hole 7" deep and epoxy with Simpson AT-XP if installed after concrete has been cast. HDU2 attaches to double studs with (6) Simpson SDS1/4X3 screws. (Cap = 3075)
HDU8	HDU8 attaches to foundation with a 7/8" diameter anchor bolt with 18" minimum embedment into a 8" concrete stem wall for cast in place construction. Use 7/8" diameter threaded rod in cleaned 1" diameter hole 12" deep and epoxy with Simpson AT-XP if installed after concrete has been cast. HDU8 attaches to double studs with (20) Simpson SDS1/4X3 screws. (Cap = 6765)

ROOF FRAMING



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Header: **A**
Span = 9.0 ft
TW = 2.0 ft

DL = 15 psf × 2.0 ft = 30 plf
SL = 25 psf × 2.0 ft = 50 plf — Use: *#2 DF 4x6*
** USE 3.5x12 GLB PER ARCH

Header: **B**
Span = 18.0 ft
TW = 2.0 ft

DL = 15 psf × 2.0 ft = 30 plf
SL = 25 psf × 2.0 ft = 50 plf — Use: *#1 DF 6x10*
** USE 3.5x12 GLB PER ARCH

Header: **C**
Span = 5.0 ft
TW = 17.0 ft

DL = 15 psf × 17.0 ft = 255 plf
5L = 25 psf × 17.0 ft = 425 plf — Use: *#2 DF 4x8*

Beam: **D**
Span = 12.0 ft
TW = 8.0 ft

DL = 15 psf × 8.0 ft = 120 plf
SL = 25 psf × 8.0 ft = 200 plf — Use: *#1 DF 6x8*

Rafters: **E**
Span = 8.0 ft
TW = 2.0 ft

DL = 15 psf × 2.0 ft = 30 plf
SL = 25 psf × 2.0 ft = 50 plf — Use: *#2 DF 2x6*

Header: **F**
Span = 8.0 ft
TW = 17.5 ft
DL = 15 psf × 17.5 ft = 263 plf
SL = 25 psf × 17.5 ft = 438 plf
PL = 720+1200 (D+S) Via D — Use: *#1 DF 6x10*

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Job:	Altman Middle Lot	2020-0198
Date:	5/21/2020	By: JAG
Sheet:	Roof Framing	Page of

Beam: **G**
Span = 16.0 ft
TW = 2.0 ft

PL = 720+1200 (D+S) Via D Use: *#1 DF 6x10*

Beam: **H**
Span = 12.0 ft
TW = 4.0 ft

DL = 15 psf × 4.0 ft = 60 plf
SL = 25 psf × 4.0 ft = 100 plf Use: *#2 DF 4x8*

Header: **I**
Span = 6.0 ft
TW = 21.5 ft

DL = 15 psf × 21.5 ft = 323 plf
SL = 25 psf × 21.5 ft = 538 plf Use: *#2 DF 4x10*

Beam: **J**
Span = 6.5 ft
TW = 5.0 ft

DL = 15 psf × 5.0 ft = 75 plf
SL = 25 psf × 5.0 ft = 125 plf Use: *#2 DF 4x6*

Beam: **K**
Span = 10.5 ft
TW = 5.0 ft

DL = 15 psf × 5.0 ft = 75 plf
SL = 25 psf × 5.0 ft = 125 plf Use: *#2 DF 4x8*

Header: **L**
Span = 3.0 ft
TW = 20.0 ft

DL = 15 psf × 20.0 ft = 300 plf
SL = 25 psf × 20.0 ft = 500 plf Use: *#2 DF (2)2x6*

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Header: **M**
Span = 9.5 ft
TW = 20.0 ft

DL = 15 psf × 20.0 ft = 300 plf
SL = 25 psf × 20.0 ft = 500 plf Use: *#1 DF 6x10*

Beam: **N**
Span = 7.5 ft
TW = 11.0 ft

DL = 15 psf × 11.0 ft = 165 plf
SL = 25 psf × 11.0 ft = 275 plf Use: *#2 DF 4x8*

Header: **O**
Span = 3.7 ft
TW = 11.0 ft

DL = 15 psf × 11.0 ft = 165 plf
5L = 25 psf × 11.0 ft = 275 plf Use: *#2 DF (2)2x6*

Header: **P**
Span = 12.0 ft
TW = 11.0 ft

DL = 15 psf × 11.0 ft = 165 plf
SL = 25 psf × 11.0 ft = 275 plf Use: *#1 DF 6x10*

Beam: **Q**
Span = 7.5 ft
TW = 11.0 ft

DL = 15 psf × 11.0 ft = 165 plf
SL = 25 psf × 11.0 ft = 275 plf Use: *#2 DF 4x10*

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Job: _____

Date: _____ By: _____

Sheet: _____ Page 20 of _____

ROOF FRAMING @ WINDOWS (ABOVE R)

TW = 2'-0"

SPAN = 10'-0"

D = 15 x 2' = 30 PLF

S = 25 x 2' = 50 PLF

⇒ USE #2 DF 2x8's

(R) SPAN = 12'-0"

PL @ CENTER = 2x(150# + 250#)
D S

D = 300#

S = 500#

⇒ #2 D F 4x10 GOOD

⇒ USE #1 DF
6x6
MIN.

Multiple Simple Beam

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Lic. # : KW-06005122 Licensee : MC SQUARED, INC.

Description : ROOF I

Wood Beam Design : A

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **4x6, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch					Wood Grade :	No.2		
Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

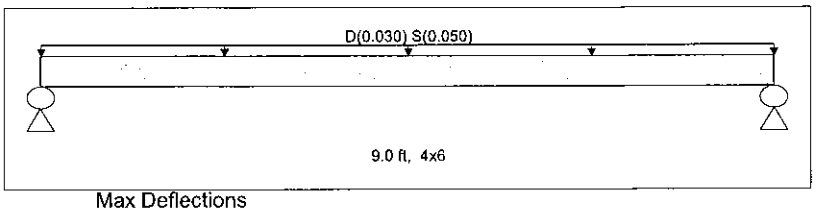
Applied Loads

Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 2.0 ft

Design Summary

Max fb/Fb Ratio = **0.409** : 1
fb : Actual : 550.84 psi at 4.500 ft in Span # 1
Fb : Allowable : 1,345.50 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.122** : 1
fv : Actual : 25.25 psi at 0.000 ft in Span # 1
Fv : Allowable : 207.00 psi
Load Comb : +D+S+H



Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.14			0.23			
Right Support	0.14			0.23			

Max Deflections

Downward L+Lr+S	0.096 in	Downward Total	0.153 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	1130 >360	Total Defl Ratio	706 >240

Wood Beam Design : B

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **3.5x12, GLB, Fully Unbraced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	DF/DF					Wood Grade :	24F - V4		
Fb - Tension	2400 psi	Fc - Prll	1650 psi	Fv	265 psi	Ebend- xx	1800 ksi	Density	31.2 pcf
Fb - Compr	1850 psi	Fc - Perp	650 psi	Ft	1100 psi	Eminbend - xx	950 ksi		

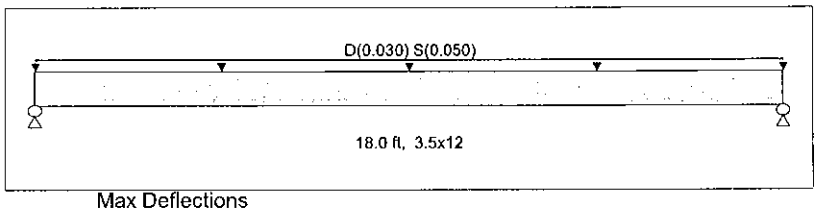
Applied Loads

Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 2.0 ft

Design Summary

Max fb/Fb Ratio = **0.168** : 1
fb : Actual : 462.86 psi at 9.000 ft in Span # 1
Fb : Allowable : 2,760.00 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.075** : 1
fv : Actual : 22.97 psi at 0.000 ft in Span # 1
Fv : Allowable : 304.75 psi
Load Comb : +D+S+H



Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.27			0.45			
Right Support	0.27			0.45			

Max Deflections

Downward L+Lr+S	0.131 in	Downward Total	0.209 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	1650 >360	Total Defl Ratio	1031 >240

Wood Beam Design : C

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **4x8, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch					Wood Grade :	No.2		
Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

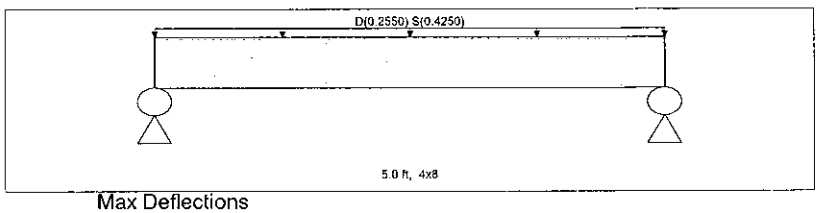
Applied Loads

Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 17.0 ft

Design Summary

Max fb/Fb Ratio = **0.618** : 1
fb : Actual : 831.66 psi at 2.500 ft in Span # 1
Fb : Allowable : 1,345.50 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.369** : 1
fv : Actual : 76.37 psi at 4.400 ft in Span # 1
Fv : Allowable : 207.00 psi
Load Comb : +D+S+H



Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.64			1.06			
Right Support	0.64			1.06			

Max Deflections

Downward L+Lr+S	0.034 in	Downward Total	0.054 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	1775 >360	Total Defl Ratio	1109 >240

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Multiple Simple Beam

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Wood Beam Design : D

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **6x8, Sawn, Fully Braced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch				Wood Grade : No.1				
Fb - Tension	1,200.0 psi	Fc - Prll	1,000.0 psi	Fv	170.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	1,200.0 psi	Fc - Perp	625.0 psi	Ft	825.0 psi	Eminbend - xx	580.0 ksi		

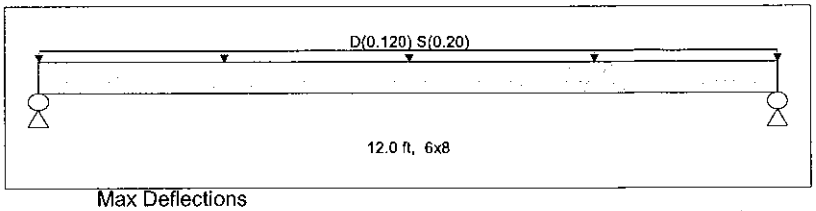
Applied Loads

Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 8.0 ft

Design Summary

Max fb/Fb Ratio = **0.971** : 1
fb : Actual : 1,340.51 psi at 6.000 ft in Span # 1
Fb : Allowable : 1,380.00 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.321** : 1
fv : Actual : 62.84 psi at 11.400 ft in Span # 1
Fv : Allowable : 195.50 psi
Load Comb : +D+S+H



Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.72			1.20			
Right Support	0.72			1.20			

Max Deflections

Downward L+Lr+S	0.303 in	Downward Total	0.485 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	474 >360	Total Defl Ratio	296 >240

Wood Beam Design : E

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **2x6, Sawn, Fully Braced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch				Wood Grade : No.2				
Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

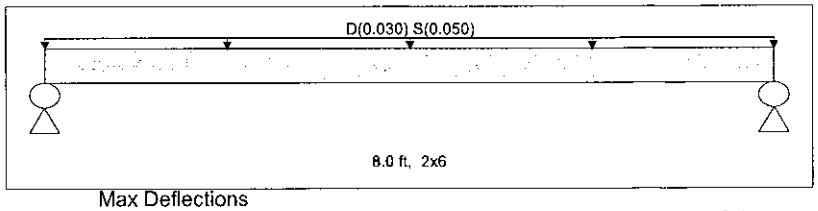
Applied Loads

Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 2.0 ft

Design Summary

Max fb/Fb Ratio = **0.656** : 1
fb : Actual : 1,015.54 psi at 4.000 ft in Span # 1
Fb : Allowable : 1,547.33 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.249** : 1
fv : Actual : 51.59 psi at 0.000 ft in Span # 1
Fv : Allowable : 207.00 psi
Load Comb : +D+S+H



Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.12			0.20			
Right Support	0.12			0.20			

Max Deflections

Downward L+Lr+S	0.139 in	Downward Total	0.223 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	689 >360	Total Defl Ratio	430 >240

Wood Beam Design : F

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **6x10, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch				Wood Grade : No.1				
Fb - Tension	1,350.0 psi	Fc - Prll	925.0 psi	Fv	170.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	1,350.0 psi	Fc - Perp	625.0 psi	Ft	675.0 psi	Eminbend - xx	580.0 ksi		

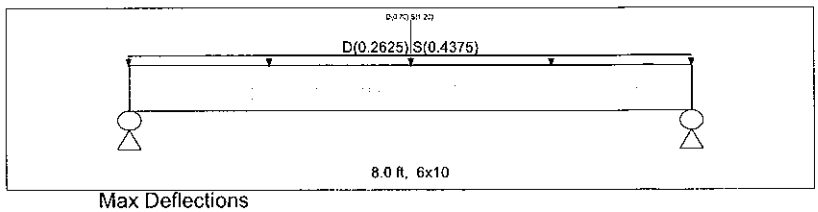
Applied Loads

Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 17.50 ft
Point: D = 0.70, S = 1.20 k @ 4.0 ft

Design Summary

Max fb/Fb Ratio = **0.878** : 1
fb : Actual : 1,363.49 psi at 4.000 ft in Span # 1
Fb : Allowable : 1,552.50 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.471** : 1
fv : Actual : 92.11 psi at 0.000 ft in Span # 1
Fv : Allowable : 195.50 psi
Load Comb : +D+S+H



Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	1.40			2.35			
Right Support	1.40			2.35			

Max Deflections

Downward L+Lr+S	0.100 in	Downward Total	0.159 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	961 >360	Total Defl Ratio	603 >240

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Multiple Simple Beam

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Wood Beam Design : G

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **6x10, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch				Wood Grade : No.1				
Fb - Tension	1,350.0 psi	Fc - Prll	925.0 psi	Fv	170.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	1,350.0 psi	Fc - Perp	625.0 psi	Ft	675.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

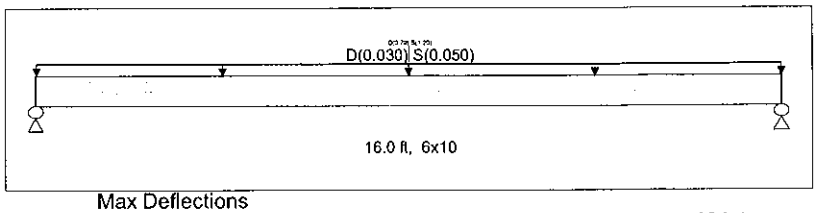
Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 2.0 ft
Point: D = 0.70, S = 1.20 k @ 8.0 ft

Design Summary

Max fb/Fb Ratio = **0.949** : 1
fb : Actual : 1,473.72 psi at 8.000 ft in Span # 1
Fb : Allowable : 1,552.50 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.225** : 1
fv : Actual : 43.93 psi at 0.000 ft in Span # 1
Fv : Allowable : 195.50 psi
Load Comb : +D+S+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.59			1.00			
Right Support	0.59			1.00			



Max Deflections

Downward L+Lr+S	0.401 in	Downward Total	0.636 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	479 >360	Total Defl Ratio	301 >240

Wood Beam Design : H

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **4x8, Sawn, Fully Braced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch				Wood Grade : No.2				
Fb - Tension	900 psi	Fc - Prll	1350 psi	Fv	180 psi	Ebend- xx	1600 ksi	Density	31.2 pcf
Fb - Compr	900 psi	Fc - Perp	625 psi	Ft	575 psi	Eminbend - xx	580 ksi		

Applied Loads

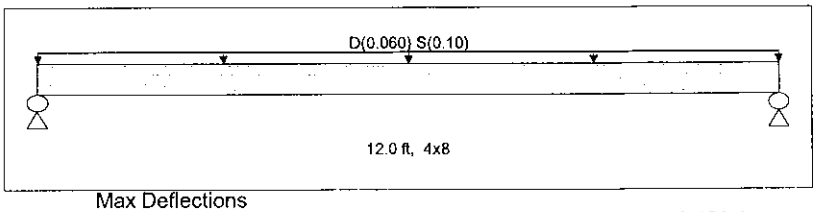
Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 4.0 ft

Design Summary

Max fb/Fb Ratio = **0.838** : 1
fb : Actual : 1,127.15 psi at 6.000 ft in Span # 1
Fb : Allowable : 1,345.50 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.247** : 1
fv : Actual : 51.07 psi at 11.400 ft in Span # 1
Fv : Allowable : 207.00 psi
Load Comb : +D+S+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.36			0.60			
Right Support	0.36			0.60			



Max Deflections

Downward L+Lr+S	0.264 in	Downward Total	0.422 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	545 >360	Total Defl Ratio	341 >240

Wood Beam Design : I

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **4x10, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch				Wood Grade : No.2				
Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

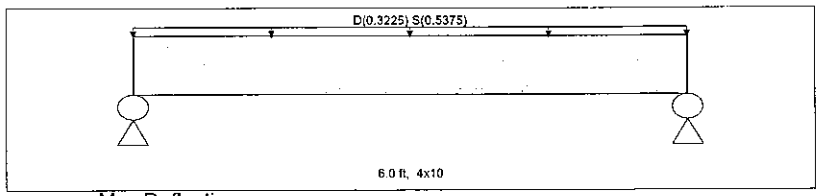
Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 21.50 ft

Design Summary

Max fb/Fb Ratio = **0.749** : 1
fb : Actual : 930.45 psi at 3.000 ft in Span # 1
Fb : Allowable : 1,242.00 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.431** : 1
fv : Actual : 89.25 psi at 5.240 ft in Span # 1
Fv : Allowable : 207.00 psi
Load Comb : +D+S+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.97			1.61			
Right Support	0.97			1.61			



Max Deflections

Downward L+Lr+S	0.043 in	Downward Total	0.068 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	1687 >360	Total Defl Ratio	1054 >240

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Multiple Simple Beam

Lic. # : KW-06005122

Wood Beam Design : J

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **4x6, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch				Wood Grade : No.2				
Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

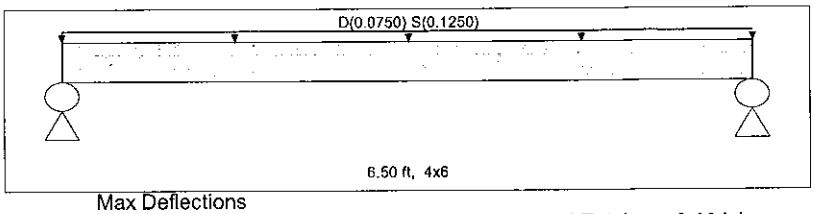
Applied Loads

Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 5.0 ft

Design Summary

Max fb/Fb Ratio = **0.534** : 1
fb : Actual : 718.30 psi at 3.250 ft in Span # 1
Fb : Allowable : 1,345.50 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.210** : 1
fv : Actual : 43.56 psi at 6.045 ft in Span # 1
Fv : Allowable : 207.00 psi
Load Comb : +D+S+H



Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.24			0.41			
Right Support	0.24			0.41			

Max Deflections

Downward L+Lr+S	0.065 in	Downward Total	0.104 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	1199 >360	Total Defl Ratio	749 >240

Wood Beam Design : K

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **4x8, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch				Wood Grade : No.2				
Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

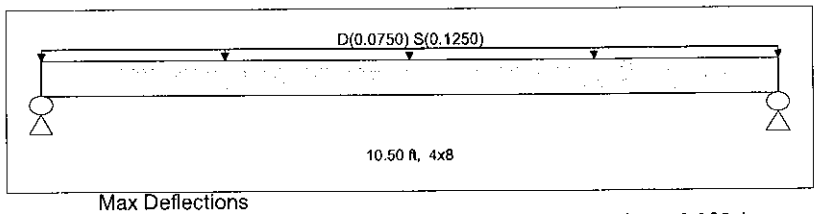
Applied Loads

Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 5.0 ft

Design Summary

Max fb/Fb Ratio = **0.802** : 1
fb : Actual : 1,078.72 psi at 5.250 ft in Span # 1
Fb : Allowable : 1,345.50 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.266** : 1
fv : Actual : 55.03 psi at 9.905 ft in Span # 1
Fv : Allowable : 207.00 psi
Load Comb : +D+S+H



Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.39			0.66			
Right Support	0.39			0.66			

Max Deflections

Downward L+Lr+S	0.193 in	Downward Total	0.309 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	651 >360	Total Defl Ratio	407 >240

Wood Beam Design : L

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **2-2x6, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch				Wood Grade : No.2				
Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

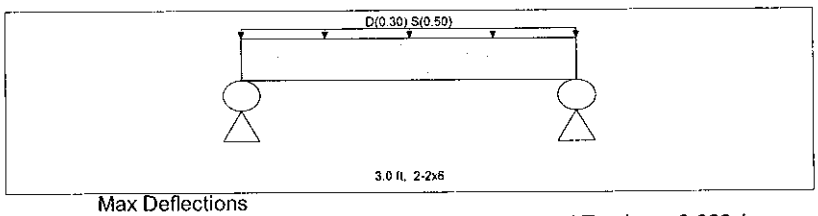
Applied Loads

Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 20.0 ft

Design Summary

Max fb/Fb Ratio = **0.531** : 1
fb : Actual : 714.05 psi at 1.500 ft in Span # 1
Fb : Allowable : 1,345.50 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.369** : 1
fv : Actual : 76.36 psi at 2.550 ft in Span # 1
Fv : Allowable : 207.00 psi
Load Comb : +D+S+H



Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.45			0.75			
Right Support	0.45			0.75			

Max Deflections

Downward L+Lr+S	0.014 in	Downward Total	0.022 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	2615 >360	Total Defl Ratio	1634 >240

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Multiple Simple Beam

Lic. # : KW-06005122

Licensee : MC SQUARED, INC.

Description : ROOF II

Wood Beam Design : M

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **6x10, Sawn, Fully Unbraced**

Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species : Douglas Fir - Larch — Wood Grade : No.1

Fb - Tension	1,350.0 psi	Fc - Prll	925.0 psi	Fv	170.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	1,350.0 psi	Fc - Perp	625.0 psi	Ft	675.0 psi	Eminbend - xx	580.0 ksi		

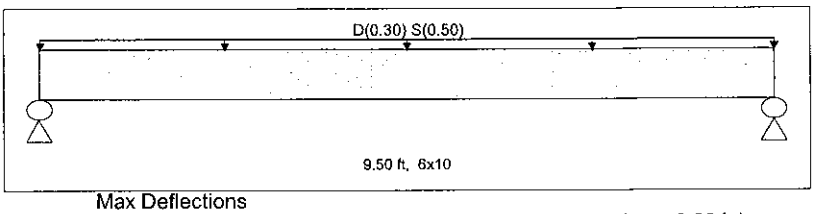
Applied Loads

Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 20.0 ft

Design Summary

Max fb/Fb Ratio = **0.843** : 1
fb : Actual : 1,309.09 psi at 4.750 ft in Span # 1
Fb : Allowable : 1,552.50 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.469** : 1
fv : Actual : 91.64 psi at 8.740 ft in Span # 1
Fv : Allowable : 195.50 psi
Load Comb : +D+S+H



Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	1.43			2.38			
Right Support	1.43			2.38			

Max Deflections

Downward L+Lr+S	0.147 in	Downward Total	0.234 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	778 >360	Total Defl Ratio	486 >240

Wood Beam Design : N

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **4x8, Sawn, Fully Braced**

Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

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

Fb - Tension	900 psi	Fc - Prll	1350 psi	Fv	180 psi	Ebend- xx	1600 ksi	Density	31.2 pcf
Fb - Compr	900 psi	Fc - Perp	625 psi	Ft	575 psi	Eminbend - xx	580 ksi		

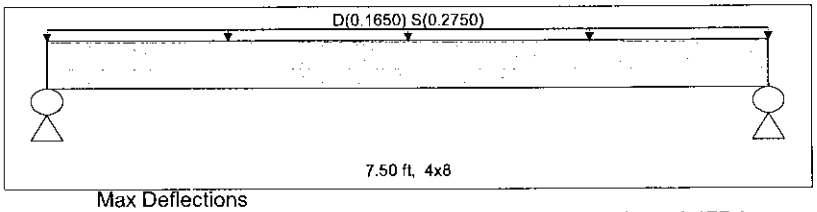
Applied Loads

Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 11.0 ft

Design Summary

Max fb/Fb Ratio = **0.900** : 1
fb : Actual : 1,210.80 psi at 3.750 ft in Span # 1
Fb : Allowable : 1,345.50 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.396** : 1
fv : Actual : 81.93 psi at 0.000 ft in Span # 1
Fv : Allowable : 207.00 psi
Load Comb : +D+S+H



Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.62			1.03			
Right Support	0.62			1.03			

Max Deflections

Downward L+Lr+S	0.111 in	Downward Total	0.177 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	813 >360	Total Defl Ratio	508 >240

Wood Beam Design : O

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **2-2x6, Sawn, Fully Unbraced**

Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

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

Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

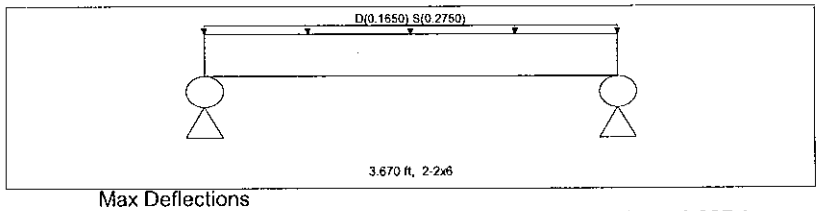
Applied Loads

Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 11.0 ft

Design Summary

Max fb/Fb Ratio = **0.437** : 1
fb : Actual : 587.73 psi at 1.835 ft in Span # 1
Fb : Allowable : 1,345.50 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.267** : 1
fv : Actual : 55.29 psi at 0.000 ft in Span # 1
Fv : Allowable : 207.00 psi
Load Comb : +D+S+H



Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.30			0.50			
Right Support	0.30			0.50			

Max Deflections

Downward L+Lr+S	0.017 in	Downward Total	0.027 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	2597 >360	Total Defl Ratio	1623 >240

Multiple Simple Beam

Wood Beam Design : P

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **6x10, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch					Wood Grade :	No.1		
Fb - Tension	1,350.0 psi	Fc - Prll	925.0 psi	Fv	170.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	1,350.0 psi	Fc - Perp	625.0 psi	Ft	675.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

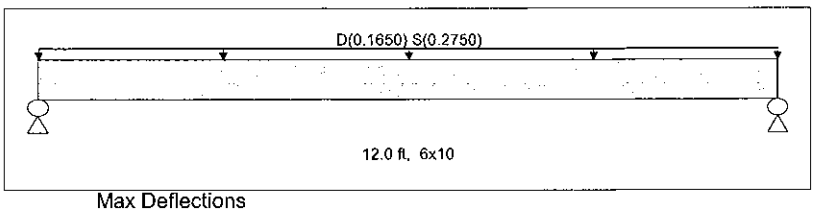
Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 11.0 ft

Design Summary

Max fb/Fb Ratio = **0.740** : 1
fb : Actual : 1,148.81 psi at 6.000 ft in Span # 1
Fb : Allowable : 1,552.50 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.339** : 1
fv : Actual : 66.19 psi at 11.240 ft in Span # 1
Fv : Allowable : 195.50 psi
Load Comb : +D+S+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.99			1.65			
Right Support	0.99			1.65			



Max Deflections

Downward L+Lr+S	0.205 in	Downward Total	0.328 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	701 >360	Total Defl Ratio	438 >240

Wood Beam Design : Q

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **4x10, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch					Wood Grade :	No.2		
Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

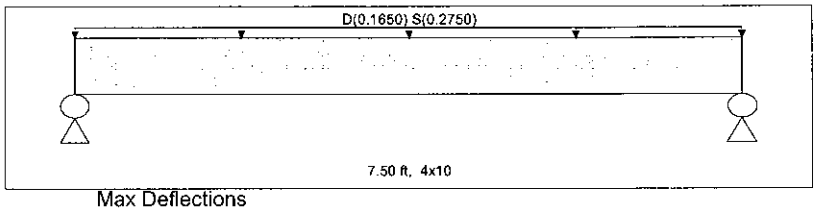
Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 11.0 ft

Design Summary

Max fb/Fb Ratio = **0.599** : 1
fb : Actual : 743.82 psi at 3.750 ft in Span # 1
Fb : Allowable : 1,242.00 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.295** : 1
fv : Actual : 61.16 psi at 0.000 ft in Span # 1
Fv : Allowable : 207.00 psi
Load Comb : +D+S+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.62			1.03			
Right Support	0.62			1.03			



Max Deflections

Downward L+Lr+S	0.053 in	Downward Total	0.085 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	1688 >360	Total Defl Ratio	1055 >240

Wood Beam Design : RAFTERS ABOVE R

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **2x8, Sawn, Fully Braced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch					Wood Grade :	No.2		
Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

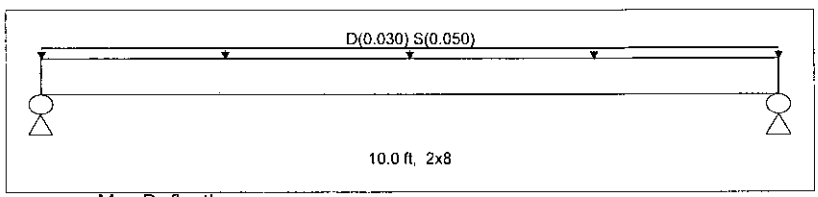
Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 2.0 ft

Design Summary

Max fb/Fb Ratio = **0.735** : 1
fb : Actual : 913.20 psi at 5.000 ft in Span # 1
Fb : Allowable : 1,242.00 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.235** : 1
fv : Actual : 48.55 psi at 9.400 ft in Span # 1
Fv : Allowable : 207.00 psi
Load Comb : +D+S+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.15			0.25			
Right Support	0.15			0.25			



Max Deflections

Downward L+Lr+S	0.148 in	Downward Total	0.237 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	808 >360	Total Defl Ratio	505 >240

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ENERCALC, INC. 1983-2017, Build:6.17.3.29, Ver:6.17.3.29

Multiple Simple Beam

Lic. # : KW-06005122
Licensee : MC SQUARED, INC.

Wood Beam Design : R

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **6x6, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch					Wood Grade :	No.1		
Fb - Tension	1200 psi	Fc - Prll	1000 psi	Fv	170 psi	Ebend- xx	1600 ksi	Density	31.2 pcf
Fb - Compr	1200 psi	Fc - Perp	625 psi	Ft	825 psi	Eminbend - xx	580 ksi		

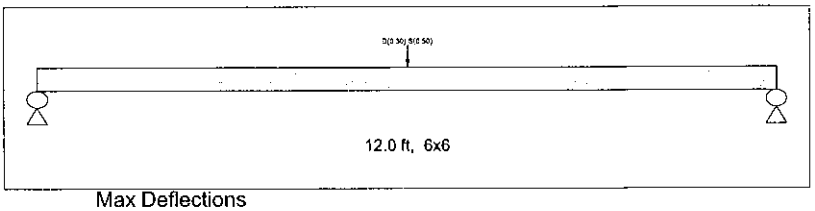
Applied Loads

Point: D = 0.30, S = 0.50 k @ 6.0 ft

Design Summary

Max fb/Fb Ratio = **0.753** : 1
fb : Actual : 1,038.62 psi at 6.000 ft in Span # 1
Fb : Allowable : 1,380.00 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.101** : 1
fv : Actual : 19.83 psi at 0.000 ft in Span # 1
Fv : Allowable : 195.50 psi
Load Comb : +D+S+H



Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.15			0.25			
Right Support	0.15			0.25			

Max Deflections

Downward L+Lr+S	0.256 in	Downward Total	0.410 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	562 >360	Total Defl Ratio	351 >240

C&C Wind	
A (ft^2)	W (PSF)
10	15.81
20	14.94
50	13.77

F_b = 1.6*900 = 1440 psi

ID	Opening (ft)	Height (ft)	TA (ft^2)	Wind load (PSF)	Design Wind (plf)	Axial TW (ft)	Dead Load (#)	Snow Load (#)	M (ft-#)	Smin (in^3)	Min. Stud Size	Approx. F_b (psi)	Bending Capacity	
A	9	10	45.0	14.94	67	2	30	100	840.375	7.00	2x6	1333	93%	-> Use (2) 2x
B	18	10	90.0	13.77	124	2	30	100	1549	12.91	(2)2x6	1229	85%	
C	5	10	25.0	14.94	37	17	255	850	467	3.89	2x6	741	51%	
F	8	10	40.0	14.94	60	17.5	262.5	875	747	6.23	2x6	1185	82%	
H	8	10	40.0	14.94	60	4	60	200	747	6.23	2x6	1185	82%	
I	6	10	30.0	14.94	45	21.5	322.5	1075	560	4.67	2x6	889	62%	
L	3	10	15.0	15.81	24	20	300	1000	296	2.47	2x6	470	33%	
M	9.5	10	47.5	14.94	71	20	300	1000	887	7.39	2x6	1408	98%	-> Use (2) 2x
R	12	10	60.0	13.77	83	0	0	0	1033	8.61	(2)2x6	819	57%	

:/ Columns:

405 psi (Sill Plate)

ads via Enercalc)

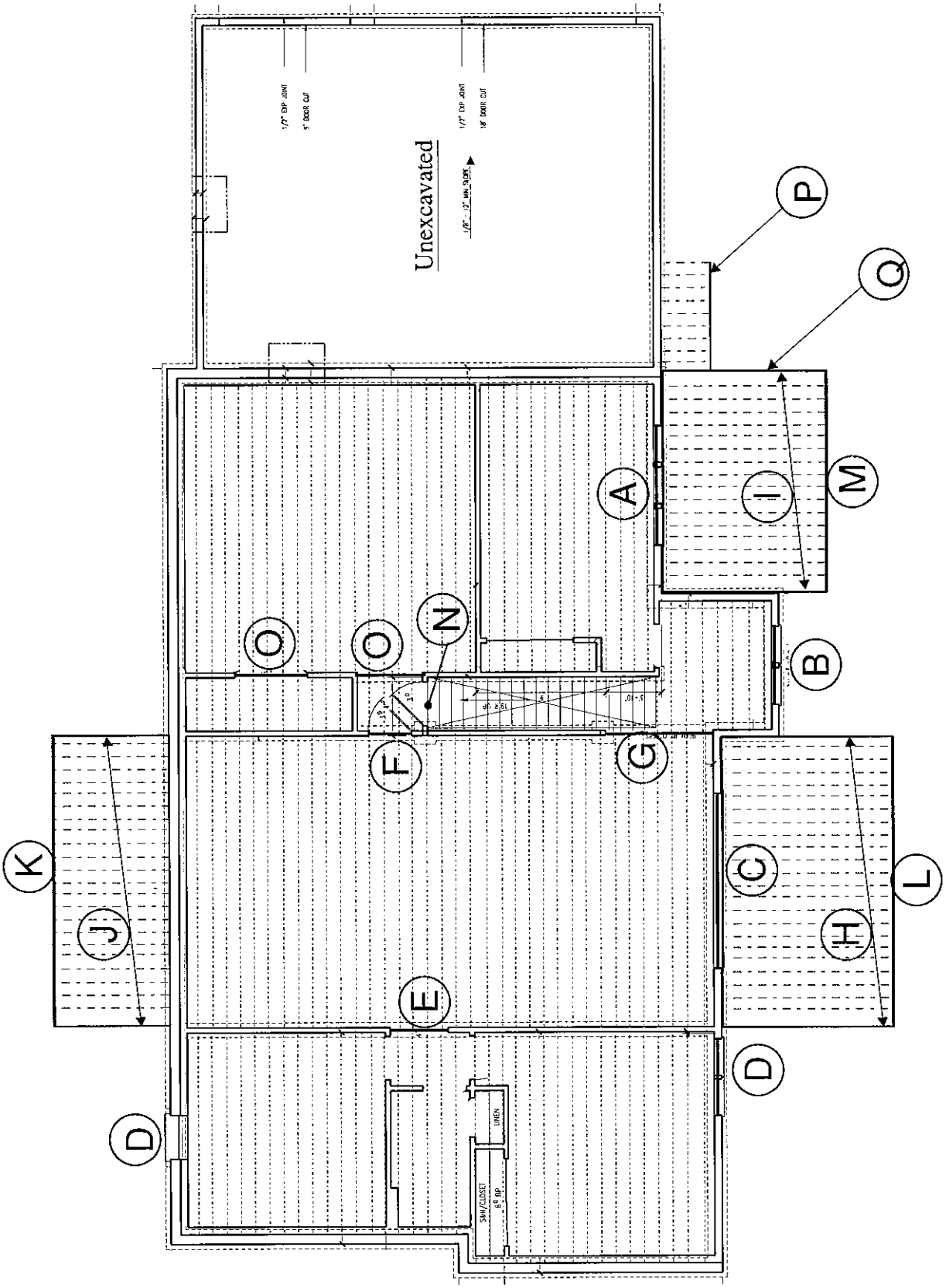
ertical oad (#)	Min. Area (in^2)	Min. Stud Size	
370	0.9	2x6	
720	1.8	2x6	
1700	4.2	2x6	
1920	4.7	2x6	
3750	9.3	(2)2x6	
1590	3.9	2x6	
960	2.4	2x6	
2580	6.4	2x6	
650	1.6	2x6	
1050	2.6	2x6	
1200	3.0	2x6	
3810	9.4	(2)2x6	
1650	4.1	2x6	
800	2.0	2x6	
3440	8.5	(2)2x6	-> Use 6x6
3740	9.2	(2)2x6	-> Use 6x6
400	1.0	2x6	

Beam Crushing:

F_{c1}= 625 psi

ID	Vertical Load (#)	8rg Area (in^2)	F_{c1}	
A	370	8.25	44.8	
B	720	8.25	87.3	
C	1700	8.25	206.1	
D	1920	8.25	232.7	
F	3750	16.50	227.3	
G	1590	8.25	192.7	
H	960	8.25	116.4	
I	2580	8.25	312.7	
J	650	8.25	78.8	
K	1050	8.25	127.3	
L	1200	8.25	145.5	
M	3810	16.50	230.9	
N	1650	8.25	200.0	
O	800	4.13	193.9	(Half of Column Area)
P	2640	15.13	174.5	(Half of Column Area)
Q	1650	15.13	109.1	(Half of Column Area)
R	400	8.25	48	

FLOOR FRAMING



APPROX. FLOOR TRUSS SIZING

MAXIMUM SPAN = 20' - 0"

TRUSS SPACING = 1' - 4"

LIVE LOAD = 1.33' x 40 PSF = 60 PLF

DEAD LOAD = 1.33' x (10 + 25) PSF = 33.3 PLF

USE: MIN. 16" DEEP REDBUILT RED-L
OPEN WEB TRUSS @ 16" O.C.

RED-L™ TRUSS ALLOWABLE UNIFORM LOAD TABLE (PLF) / PARALLEL CHORD

SEE PAGE 4 FOR ECONOMICAL TRUSS DESIGN

	Depth													
	14"		16"		18"		20"		22"		24"		26"	
Span	100% TL 100% LL	115% TL 125% TL	100% TL 100% LL	115% TL 125% TL	100% TL 100% LL	115% TL 125% TL	100% TL 100% LL	115% TL 125% TL	100% TL 100% LL	115% TL 125% TL	100% TL 100% LL	115% TL 125% TL	100% TL 100% LL	115% TL 125% TL
14'	232	341	329	383	370	400	330	412	340	390	309	330	299	[illegible]
	228	370	254	395	323	412	357	429		422		335		388
16'	265	[illegible]	305	340	341	331	342	[illegible]	325	309	338	351	305	[illegible]
	143	311	193	361	232	370	270	376	318	380		375		380
18'	215	[illegible]	200	[illegible]	232	319	339	[illegible]	301	[illegible]	315	334	301	[illegible]
	110	271	145	306	180	329	215	333	252	340	278	336		333
20'	184	208	171	245	184	[illegible]	203	[illegible]	227	297	282	[illegible]	231	[illegible]
	84	223	108	260	139	232	157	258	197	303	220	335	255	310

84 PLF> 67 PLF

MC SQUARED, INC.
OLYMPIA, WASHINGTON 98506
(360) 754-9339
FAX (360) 352-2044

Job:	Altman Middle Lot	2020-0198
Date:	5/21/2020	By: JAG
Sheet:	Page	of

Floor: DL = 15 psf, LL = 40 psf
Deck: DL = 10 psf, LL = 60 psf

Header: **A**
Span = 8.0 ft
TW = 6.0 ft

DL =	10 psf	× 6.0 ft =	60 plf	
LL =	60 psf	× 6.0 ft =	360 plf	Use: *#2 DF 4x10*
Wall =	12 psf	× 5.0 ft =	60 plf	

Header: **B**
Span = 5.0 ft
TW = 2.0 ft

DL =	15 psf	× 2.0 ft =	30 plf	
LL =	40 psf	× 2.0 ft =	80 plf	Use: *#2 DF (2) 2x6*
Wall =	12 psf	× 5.0 ft =	60 plf	

Header: **C**
Span = 12.0 ft
TW = 5.5 ft

DL =	10 psf	× 5.5 ft =	55 plf	
LL =	60 psf	× 5.5 ft =	330 plf	Use: *#1 DF 6x10*

Header: **D**
Span = 5.0 ft
TW = 2.0 ft
PL @ 1'&4' 450+750 (Via L)

DL =	15 psf	× 2.0 ft =	30 plf	
LL =	40 psf	× 2.0 ft =	80 plf	Use: *#2 DF 4x6*
Wall =	12 psf	× 12.0 ft =	144 plf	

Header: **E**
Span = 4.0 ft
TW = 16.8 ft

DL =	15 psf	× 16.8 ft =	2S1 plf	
LL =	40 psf	× 16.8 ft =	670 plf	Use: *#2 DF 4x8*
Wall =	10 psf	× 12.0 ft =	120 plf	

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Job:	Altman Middle Lot		2020-0198
Date:	5/21/2020	By:	JAG
Sheet:		Page	of

Header: **F**
Span = 3.0 ft
TW = 22.5 ft

DL = 15 psf × 22.5 ft = 338 plf
LL = 40 psf × 22.5 ft = 900 plf — Use: *#2 DF 4x6*

Header: **G**
Span = 7.5 ft
TW1 = 14.5 ft
TW2 = 11.8 ft

DL1 = 15 psf × 14.5 ft = 218 plf
LL1 = 40 psf × 14.5 ft = 580 plf — Use: *#2 DF 4x12*

DL2 = 15 psf × 11.8 ft = 176 plf
LL2 = 40 psf × 11.8 ft = 470 plf

Joist: **H**
Span = 10.5 ft
TW = 1.3 ft

DL = 10 psf × 1.3 ft = 13 plf
LL = 60 psf × 1.3 ft = 80 plf — Use: *PT #2 DF 2x10 (Per Arch)*

Joist: **I**
Span = 11.5 ft
TW = 1.3 ft

DL = 10 psf × 1.3 ft = 13 plf
LL = 60 psf × 1.3 ft = 80 plf — Use: *PT #2 DF 2x10 (Per Arch)*

Joist: **J**
Span = 7.5 ft
TW = 1.3 ft

DL = 10 psf × 1.3 ft = 13 plf
LL = 60 psf × 1.3 ft = 80 plf — Use: *PT #2 DF 2x10 (Per Arch)*

MC SQUARED, INC.
OLYMPIA, WASHINGTON 98506
(360) 754-9339
FAX (360) 352-2044

Job:	Altman Middle Lot		2020-0198
Date:	5/21/2020	By:	JAG
Sheet:		Page	of

Beam: **K**
Span = 20.0 ft
TW = 4.0 ft

DL = 10 psf × 4.0 ft = 40 plf
LL = 40 psf × 4.0 ft = 160 plf — Use: *MIN 5.5x13.5 AC GLB*

Beam: **L**
Span = 20.0 ft
TW = 5.5 ft

DL = 10 psf × 5.5 ft = 55 plf
LL = 40 psf × 5.5 ft = 220 plf — Use: *MIN 5.5x15 AC GLB*

Beam: **M**
Span = 15.0 ft
TW = 6.0 ft

DL = 10 psf × 6.0 ft = 60 plf
LL = 40 psf × 6.0 ft = 240 plf — Use: *MIN 5.5x12 AC GLB*

Beam: **N**
Span = 3.0 ft
TW = 6.0 ft

DL = 15 psf × 6.0 ft = 90 plf
LL = 100 psf × 6.0 ft = 600 plf — Use: *#2 DF 4x6*

Beam: **O**
Span = 5.0 ft
TW = 12 ft

DL = 15 psf × 12 ft = 180 plf
LL = 40 psf × 12 ft = 480 plf — Use: *#2 DF 4x8*

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Job:	Altman Middle Lot	2020-0198
Date:	5/21/2020	By: JAG
Sheet:		Page of

Beam: **P**
Span = 14 ft
TW = 4 ft

DL = 15 psf × 4 ft = 60 plf
LL = 40 psf × 4 ft = 160 plf

Use: *#1 DF 6x10*

Beam: **Q**
Span = 11.5 ft
TW = .67 ft

DL = 15 psf × .67 ft = 10 plf
LL = 40 psf × .67 ft = 27 plf

Use: *#2 DF 4x10*

PL @ 4'-0" = 140# + 840#

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Multiple Simple Beam

ENERCALC, INC. 1983-2017, Build:6.17.3.29, Ver:6.17.3.29

Lic. # : KW-06005122

Licensee : MC SQUARED, INC.

Description : FLOOR

Wood Beam Design : A

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **4x10, Sawn, Fully Unbraced**

Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch					Wood Grade :	No.2		
Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

Unif Load: D = 0.010, L = 0.060 k/ft, Trib= 6.0 ft

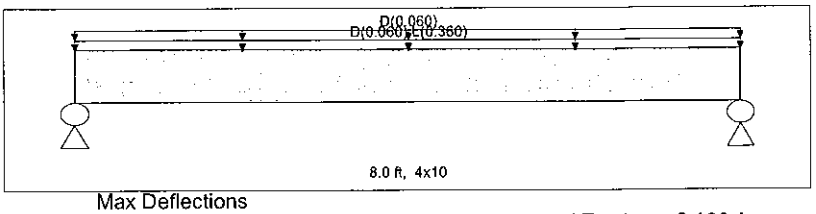
Unif Load: D = 0.0120 k/ft, Trib= 5.0 ft

Design Summary

Max fb/Fb Ratio = **0.855** : 1
fb : Actual : 923.23 psi at 4.000 ft in Span # 1
Fb : Allowable : 1,080.00 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.402** : 1
fv : Actual : 72.35 psi at 0.000 ft in Span # 1
Fv : Allowable : 180.00 psi
Load Comb : +D+L+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.48	1.44					
Right Support	0.48	1.44					



Max Deflections

Downward L+Lr+S	0.090 in	Downward Total	0.120 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	1063 >360	Total Defl Ratio	797 >360

Wood Beam Design : B

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **2-2x6, Sawn, Fully Unbraced**

Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch					Wood Grade :	No.2		
Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

Unif Load: D = 0.0150, L = 0.040 k/ft, Trib= 2.0 ft

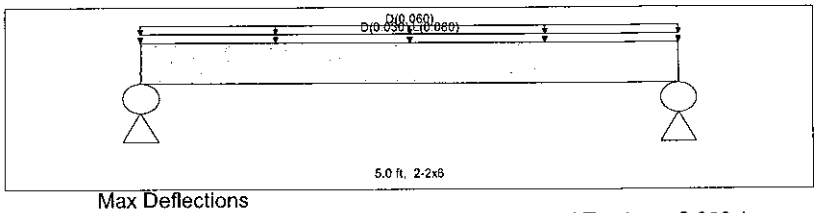
Unif Load: D = 0.0120 k/ft, Trib= 5.0 ft

Design Summary

Max fb/Fb Ratio = **0.360** : 1
fb : Actual : 421.49 psi at 2.500 ft in Span # 1
Fb : Allowable : 1,170.00 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.176** : 1
fv : Actual : 31.68 psi at 4.550 ft in Span # 1
Fv : Allowable : 180.00 psi
Load Comb : +D+L+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.23	0.20					
Right Support	0.23	0.20					



Max Deflections

Downward L+Lr+S	0.017 in	Downward Total	0.036 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	3530 >360	Total Defl Ratio	1661 >360

Wood Beam Design : C

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **6x10, Sawn, Fully Unbraced**

Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch					Wood Grade :	No.1		
Fb - Tension	1,350.0 psi	Fc - Prll	925.0 psi	Fv	170.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	1,350.0 psi	Fc - Perp	625.0 psi	Ft	675.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

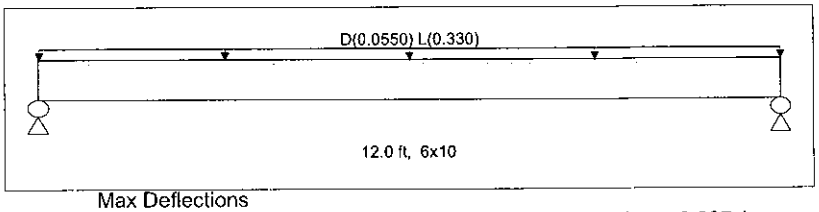
Unif Load: D = 0.010, L = 0.060 k/ft, Trib= 5.50 ft

Design Summary

Max fb/Fb Ratio = **0.745** : 1
fb : Actual : 1,005.21 psi at 6.000 ft in Span # 1
Fb : Allowable : 1,350.00 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.341** : 1
fv : Actual : 57.92 psi at 11.240 ft in Span # 1
Fv : Allowable : 170.00 psi
Load Comb : +D+L+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.33	1.98					
Right Support	0.33	1.98					



Max Deflections

Downward L+Lr+S	0.246 in	Downward Total	0.287 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	584 >360	Total Defl Ratio	501 >360

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Multiple Simple Beam

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Lic. # : KW-06005122
Licensee : MC SQUARED, INC.

Wood Beam Design : D

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **4x6, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch					Wood Grade :	No.2		
Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

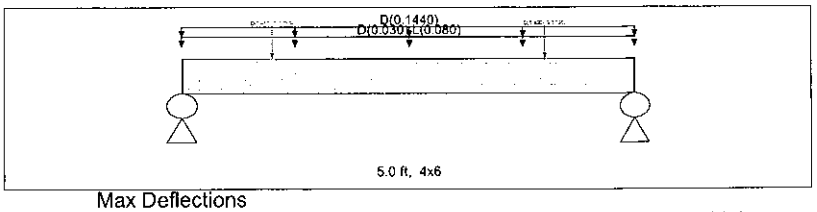
Unif Load: D = 0.0150, L = 0.040 k/ft, Trib= 2.0 ft
Unif Load: D = 0.0120 k/ft, Trib= 12.0 ft
Point: D = 0.450, S = 0.750 k, at 1.0 ft and placed every 3.0 ft thereafter

Design Summary

Max fb/Fb Ratio = **0.881** : 1
fb : Actual : 1,185.83 psi at 2.500 ft in Span # 1
Fb : Allowable : 1,345.50 psi
Load Comb : +D+0.750L+0.750S+H

Max fv/FvRatio = **0.586** : 1
fv : Actual : 121.30 psi at 4.550 ft in Span # 1
Fv : Allowable : 207.00 psi
Load Comb : +D+S+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.89	0.20		0.75			
Right Support	0.89	0.20		0.75			



Max Deflections

Downward L+Lr+S	0.050 in	Downward Total	0.111 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	1208 >360	Total Defl Ratio	539 >360

Wood Beam Design : E

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **4x8, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch					Wood Grade :	No.2		
Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

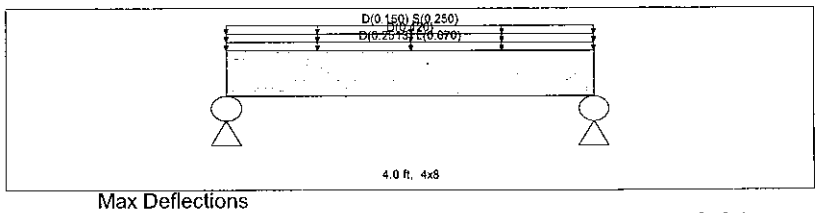
Unif Load: D = 0.0150, L = 0.040 k/ft, Trib= 16.750 ft
Unif Load: D = 0.0120 k/ft, Trib= 10.0 ft
Unif Load: D = 0.0150, S = 0.0250 k/ft, Trib= 10.0 ft

Design Summary

Max fb/Fb Ratio = **0.797** : 1
fb : Actual : 932.44 psi at 2.000 ft in Span # 1
Fb : Allowable : 1,170.00 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.548** : 1
fv : Actual : 98.59 psi at 0.000 ft in Span # 1
Fv : Allowable : 180.00 psi
Load Comb : +D+L+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	1.04	1.34		0.50			
Right Support	1.04	1.34		0.50			



Max Deflections

Downward L+Lr+S	0.022 in	Downward Total	0.039 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	2200 >360	Total Defl Ratio	1217 >360

Wood Beam Design : F

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **4x6, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch					Wood Grade :	No.2		
Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

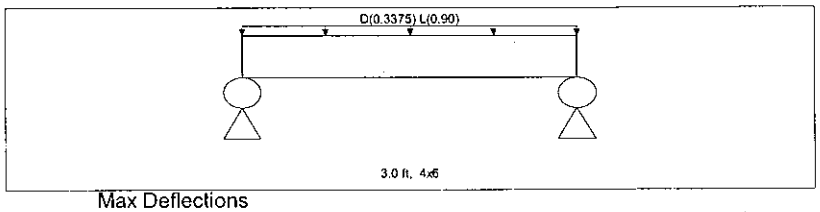
Unif Load: D = 0.0150, L = 0.040 k/ft, Trib= 22.50 ft

Design Summary

Max fb/Fb Ratio = **0.809** : 1
fb : Actual : 946.75 psi at 1.500 ft in Span # 1
Fb : Allowable : 1,170.00 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.563** : 1
fv : Actual : 101.25 psi at 2.550 ft in Span # 1
Fv : Allowable : 180.00 psi
Load Comb : +D+L+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.51	1.35					
Right Support	0.51	1.35					



Max Deflections

Downward L+Lr+S	0.021 in	Downward Total	0.029 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	1695 >360	Total Defl Ratio	1232 >360

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Licensee : MC SQUARED, INC.

Multiple Simple Beam

Lic. # : KW-06005122

Wood Beam Design : G

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **4x12, Sawn, Fully Braced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending
Wood Species : Douglas Fir - Larch — Wood Grade : No.2

Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

Unif Load: D = 0.0150, L = 0.040 k/ft, 0.0 ft to 3.750 ft, Trib= 14.50 ft
Unif Load: D = 0.0150, L = 0.040 k/ft, 3.750 to 7.50 ft, Trib= 11.750 ft

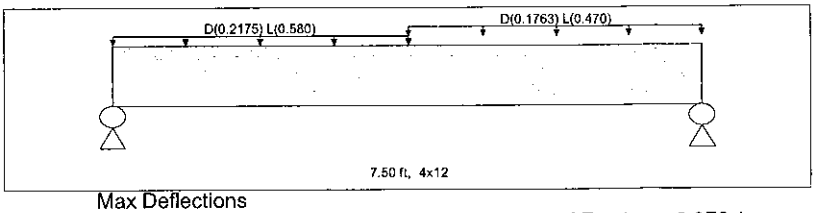
Design Summary

Max fb/Fb Ratio = **0.835** : 1
fb : Actual : 827.05 psi at 3.575 ft in Span # 1
Fb : Allowable : 990.00 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.447** : 1
fv : Actual : 80.42 psi at 0.000 ft in Span # 1
Fv : Allowable : 180.00 psi
Load Comb : +D+L+H

Max Reactions (k)

	D	L	Lr	S	W	E	H
Left Support	0.78	2.07					
Right Support	0.70	1.87					



Max Deflections

Downward L+Lr+S	0.057 in	Downward Total	0.078 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	1591 >360	Total Defl Ratio	1157 >360

Wood Beam Design : H

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **2x10, Sawn, Fully Braced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending
Wood Species : Hem Fir — Wood Grade : No.2

Fb - Tension	850.0 psi	Fc - Prll	1,300.0 psi	Fv	150.0 psi	Ebend- xx	1,300.0 ksi	Density	26.830 pcf
Fb - Compr	850.0 psi	Fc - Perp	405.0 psi	Ft	525.0 psi	Eminbend - xx	470.0 ksi		

Applied Loads

Unif Load: D = 0.010, L = 0.060 k/ft, Trib= 1.333 ft

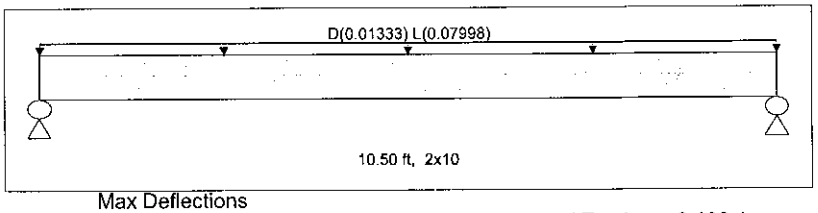
Design Summary

Max fb/Fb Ratio = **0.839** : 1
fb : Actual : 721.40 psi at 5.250 ft in Span # 1
Fb : Allowable : 860.20 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.377** : 1
fv : Actual : 45.19 psi at 9.730 ft in Span # 1
Fv : Allowable : 120.00 psi
Load Comb : +D+L+H

Max Reactions (k)

	D	L	Lr	S	W	E	H
Left Support	0.07	0.42					
Right Support	0.07	0.42					



Max Deflections

Downward L+Lr+S	0.171 in	Downward Total	0.199 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	736 >360	Total Defl Ratio	631 >360

Wood Beam Design : I - (1% OVER IS ACCEPTABLE)

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **2x10, Sawn, Fully Braced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending
Wood Species : Hem Fir — Wood Grade : No.2

Fb - Tension	850.0 psi	Fc - Prll	1,300.0 psi	Fv	150.0 psi	Ebend- xx	1,300.0 ksi	Density	26.830 pcf
Fb - Compr	850.0 psi	Fc - Perp	405.0 psi	Ft	525.0 psi	Eminbend - xx	470.0 ksi		

Applied Loads

Unif Load: D = 0.010, L = 0.060 k/ft, Trib= 1.333 ft

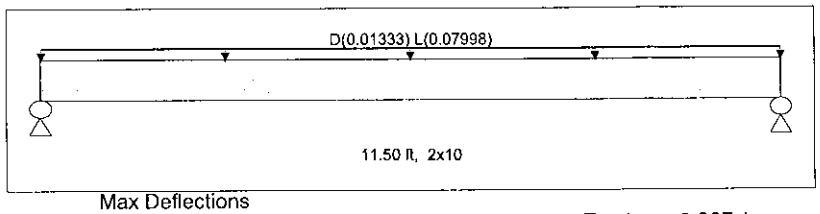
Design Summary

Max fb/Fb Ratio = **1.006** : 1 OKAY
fb : Actual : 865.35 psi at 5.750 ft in Span # 1
Fb : Allowable : 860.20 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.419** : 1
fv : Actual : 50.27 psi at 0.000 ft in Span # 1
Fv : Allowable : 120.00 psi
Load Comb : +D+L+H

Max Reactions (k)

	D	L	Lr	S	W	E	H
Left Support	0.08	0.46					
Right Support	0.08	0.46					



Max Deflections

Downward L+Lr+S	0.246 in	Downward Total	0.287 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	560 >360	Total Defl Ratio	480 >360

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ENERCALC, INC. 1983-2017, Build:6.17.3.29, Ver:6.17.3.29

Multiple Simple Beam

Lic. # : KW-06005122
Licensee : MC SQUARED, INC.

Wood Beam Design : J

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **2x10, Sawn, Fully Braced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species : Hem Fir
Wood Grade : No.2

Fb - Tension	850.0 psi	Fc - Prll	1,300.0 psi	Fv	150.0 psi	Ebend- xx	1,300.0 ksi	Density	26.830 pcf
Fb - Compr	850.0 psi	Fc - Perp	405.0 psi	Ft	525.0 psi	Eminbend - xx	470.0 ksi		

Applied Loads

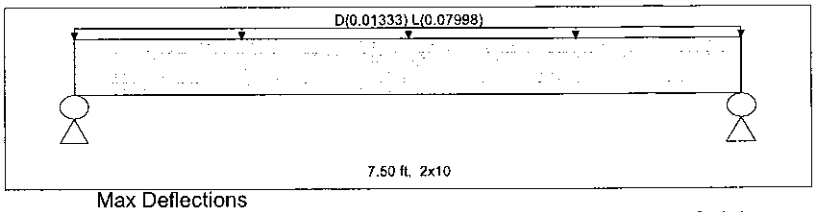
Unif Load: D = 0.010, L = 0.060 k/ft, Trib= 1.333 ft

Design Summary

Max fb/Fb Ratio = **0.428** : 1
fb : Actual : 368.06 psi at 3.750 ft in Span # 1
Fb : Allowable : 860.20 psi
Load Comb : +D+L+H

Max fv/Fv Ratio = **0.252** : 1
fv : Actual : 30.26 psi at 0.000 ft in Span # 1
Fv : Allowable : 120.00 psi
Load Comb : +D+L+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.05	0.30					
Right Support	0.05	0.30					



Max Deflections

Downward L+Lr+S	0.045 in	Downward Total	0.052 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	2022 >360	Total Defl Ratio	1733 >360

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Multiple Simple Beam

ENERCALC, INC. 1983-2017, Build:6.17.3.29, Ver:6.17.3.29

Lic. # : KW-06005122

Licensee : MC SQUARED, INC.

Description : FLOOR II

Wood Beam Design : K

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **5.5x13.5, GLB, Fully Braced**

Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species : AC/AC — Wood Grade : 20F - V12

Fb - Tension	2,000.0 psi	Fc - Prll	1,500.0 psi	Fv	265.0 psi	Ebend- xx	1,500.0 ksi	Density	28.70 pcf
Fb - Compr	1,400.0 psi	Fc - Perp	560.0 psi	Ft	925.0 psi	Eminbend - xx	790.0 ksi		

Applied Loads

Unif Load: D = 0.010, L = 0.060 k/ft, Trib= 4.0 ft

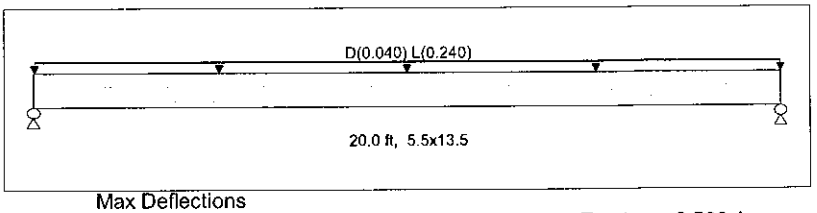
Design Summary

Max fb/Fb Ratio = **0.510** : 1
fb : Actual : 1,005.61 psi at 10.000 ft in Span # 1
Fb : Allowable : 1,972.27 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.191** : 1
fv : Actual : 50.53 psi at 18.933 ft in Span # 1
Fv : Allowable : 265.00 psi
Load Comb : +D+L+H

Max Reactions (k)

	D	L	Lr	S	W	E	H
Left Support	0.40	2.40					
Right Support	0.40	2.40					



Max Deflections

Downward L+Lr+S	0.514 in	Downward Total	0.599 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	467 >360	Total Defl Ratio	400 >360

Wood Beam Design : L

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **5.5x15, GLB, Fully Braced**

Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species : AC/AC — Wood Grade : 20F - V12

Fb - Tension	2000 psi	Fc - Prll	1500 psi	Fv	265 psi	Ebend- xx	1500 ksi	Density	28.7 pcf
Fb - Compr	1400 psi	Fc - Perp	560 psi	Ft	925 psi	Eminbend - xx	790 ksi		

Applied Loads

Unif Load: D = 0.010, L = 0.060 k/ft, Trib= 5.50 ft

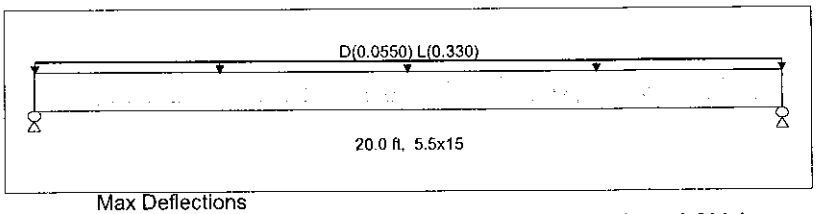
Design Summary

Max fb/Fb Ratio = **0.574** : 1
fb : Actual : 1,120.00 psi at 10.000 ft in Span # 1
Fb : Allowable : 1,951.60 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.232** : 1
fv : Actual : 61.60 psi at 18.800 ft in Span # 1
Fv : Allowable : 265.00 psi
Load Comb : +D+L+H

Max Reactions (k)

	D	L	Lr	S	W	E	H
Left Support	0.55	3.30					
Right Support	0.55	3.30					



Max Deflections

Downward L+Lr+S	0.515 in	Downward Total	0.601 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	466 >360	Total Defl Ratio	399 >360

Wood Beam Design : M

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **5.5x12, GLB, Fully Braced**

Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species : AC/AC — Wood Grade : 20F - V12

Fb - Tension	2,000.0 psi	Fc - Prll	1,500.0 psi	Fv	265.0 psi	Ebend- xx	1,500.0 ksi	Density	28.70 pcf
Fb - Compr	1,400.0 psi	Fc - Perp	560.0 psi	Ft	925.0 psi	Eminbend - xx	790.0 ksi		

Applied Loads

Unif Load: D = 0.010, L = 0.060 k/ft, Trib= 6.0 ft

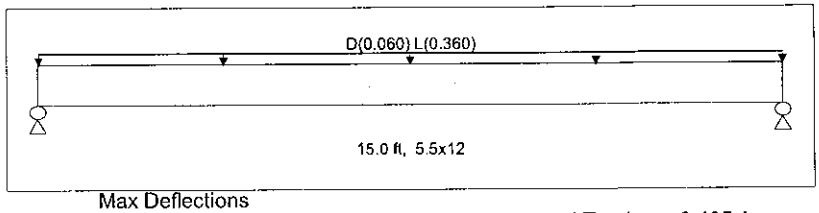
Design Summary

Max fb/Fb Ratio = **0.537** : 1
fb : Actual : 1,073.86 psi at 7.500 ft in Span # 1
Fb : Allowable : 2,000.00 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.236** : 1
fv : Actual : 62.52 psi at 14.050 ft in Span # 1
Fv : Allowable : 265.00 psi
Load Comb : +D+L+H

Max Reactions (k)

	D	L	Lr	S	W	E	H
Left Support	0.45	2.70					
Right Support	0.45	2.70					



Max Deflections

Downward L+Lr+S	0.347 in	Downward Total	0.405 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	518 >360	Total Defl Ratio	444 >360

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Multiple Simple Beam

Lic. # : KW-06005122
Licensee : MC SQUARED, INC.

Wood Beam Design : N

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **4x6, Sawn, Fully Braced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch					Wood Grade :	No.2		
Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

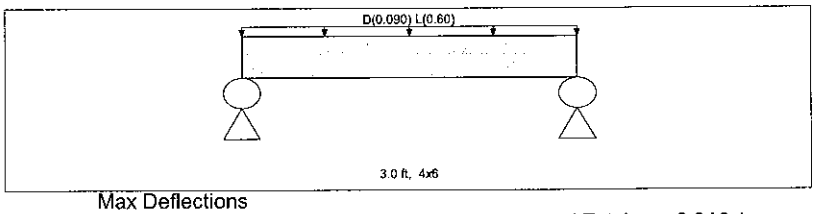
Unif Load: D = 0.0150, L = 0.10 k/ft, Trib= 6.0 ft

Design Summary

Max fb/Fb Ratio = **0.451** : 1
fb : Actual : 527.89 psi at 1.500 ft in Span # 1
Fb : Allowable : 1,170.00 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.314** : 1
fv : Actual : 56.45 psi at 2.550 ft in Span # 1
Fv : Allowable : 180.00 psi
Load Comb : +D+L+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.14	0.90					
Right Support	0.14	0.90					



Max Deflections

Downward L+Lr+S	0.014 in	Downward Total	0.016 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	2542 >360	Total Defl Ratio	2210 >360

Wood Beam Design : O

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **4x8, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Douglas Fir - Larch					Wood Grade :	No.2		
Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.20 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

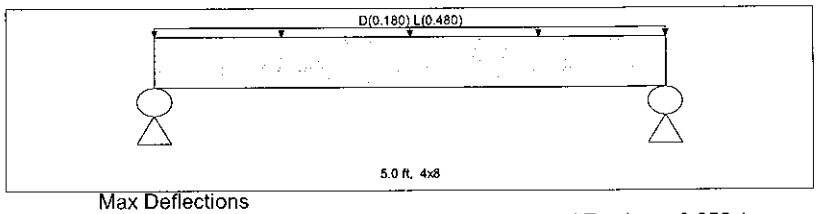
Unif Load: D = 0.0150, L = 0.040 k/ft, Trib= 12.0 ft

Design Summary

Max fb/Fb Ratio = **0.690** : 1
fb : Actual : 807.20 psi at 2.500 ft in Span # 1
Fb : Allowable : 1,170.00 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.412** : 1
fv : Actual : 74.13 psi at 4.400 ft in Span # 1
Fv : Allowable : 180.00 psi
Load Comb : +D+L+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.45	1.20					
Right Support	0.45	1.20					



Max Deflections

Downward L+Lr+S	0.038 in	Downward Total	0.052 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	1572 >360	Total Defl Ratio	1143 >360

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Multiple Simple Beam

Description :

Wood Beam Design : Walkway Joists

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **2x10, Sawn, Fully Braced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Hem Fir					Wood Grade :	No.2		
Fb - Tension	850.0 psi	Fc - Prll	1,300.0 psi	Fv	150.0 psi	Ebend- xx	1,300.0 ksi	Density	26.830 pcf
Fb - Compr	850.0 psi	Fc - Perp	405.0 psi	Ft	525.0 psi	Eminbend - xx	470.0 ksi		

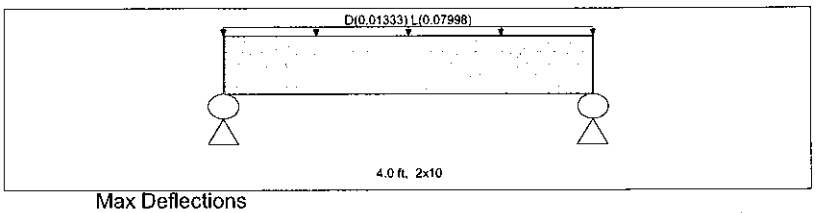
Applied Loads

Unif Load: D = 0.010, L = 0.060 k/ft, Trib= 1.333 ft

Design Summary

Max fb/Fb Ratio = **0.122** : 1
fb : Actual : 104.69 psi at 2.000 ft in Span # 1
Fb : Allowable : 860.20 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.104** : 1
fv : Actual : 12.51 psi at 0.000 ft in Span # 1
Fv : Allowable : 120.00 psi
Load Comb : +D+L+H



Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.03	0.16					
Right Support	0.03	0.16					

Max Deflections

Downward L+Lr+S	0.004 in	Downward Total	0.004 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	13329 >360	Total Defl Ratio	11425 >360

Wood Beam Design : Walkway Beam - P

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **6x10, Sawn, Fully Braced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Hem Fir					Wood Grade :	No.1		
Fb - Tension	1,050.0 psi	Fc - Prll	750.0 psi	Fv	140.0 psi	Ebend- xx	1,300.0 ksi	Density	26.830 pcf
Fb - Compr	1,050.0 psi	Fc - Perp	405.0 psi	Ft	525.0 psi	Eminbend - xx	470.0 ksi		

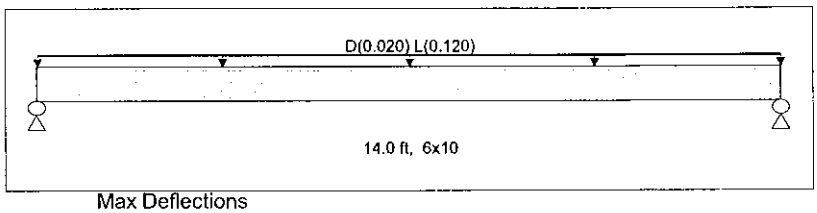
Applied Loads

Unif Load: D = 0.010, L = 0.060 k/ft, Trib= 2.0 ft

Design Summary

Max fb/Fb Ratio = **0.592** : 1
fb : Actual : 497.53 psi at 7.000 ft in Span # 1
Fb : Allowable : 840.00 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.224** : 1
fv : Actual : 25.13 psi at 13.253 ft in Span # 1
Fv : Allowable : 112.00 psi
Load Comb : +D+L+H



Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.14	0.84					
Right Support	0.14	0.84					

Max Deflections

Downward L+Lr+S	0.204 in	Downward Total	0.238 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	823 >360	Total Defl Ratio	705 >360

Wood Beam Design : Walkway Beam - Q

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10

BEAM Size : **4x10, Sawn, Fully Braced**
Using Allowable Stress Design with IBC 2015 Load Combinations, Major Axis Bending

Wood Species :	Hem Fir					Wood Grade :	No.2		
Fb - Tension	850.0 psi	Fc - Prll	1,300.0 psi	Fv	150.0 psi	Ebend- xx	1,300.0 ksi	Density	26.830 pcf
Fb - Compr	850.0 psi	Fc - Perp	405.0 psi	Ft	525.0 psi	Eminbend - xx	470.0 ksi		

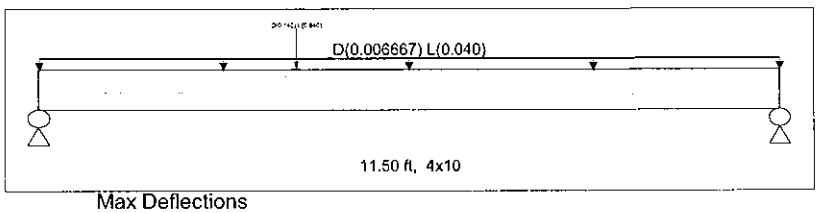
Applied Loads

Unif Load: D = 0.010, L = 0.060 k/ft, Trib= 0.6667 ft
Point: D = 0.140, L = 0.840 k @ 4.0 ft

Design Summary

Max fb/Fb Ratio = **0.958** : 1
fb : Actual : 781.40 psi at 4.025 ft in Span # 1
Fb : Allowable : 816.00 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.337** : 1
fv : Actual : 40.39 psi at 0.000 ft in Span # 1
Fv : Allowable : 120.00 psi
Load Comb : +D+L+H



Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.13	0.78					
Right Support	0.09	0.52					

Max Deflections

Downward L+Lr+S	0.188 in	Downward Total	0.220 in
Upward L+Lr+S	0.000 in	Upward Total	0.000 in
Live Load Defl Ratio	732 >360	Total Defl Ratio	627 >360

ls

C&C Wind	
A (ft^2)	W (PSF)
10	15.81
20	14.94
50	13.77

F_B = 1.6*900 = 1440 psi

Opening (ft)	Height (ft)	TA (ft^2)	Wind load (PSF)	Design Wind (plf)	Axial TW (ft)	Dead Load (#)	Snow Load (#)	M (ft-#)	Smin (in^3)	**Min. Stud Size**	**Approx. F_b (psi)**	**Bending Capacity**
8	10	40.0	14.94	60	6	90	300	747	6.23	**2x6**	**1185**	**82%**
5	10	25.0	14.94	37	2	30	100	467	3.89	**2x6**	**741**	**51%**
12	10	60.0	13.77	83	5.5	82.5	275	1033	8.61	**(2)2x6**	**819**	**57%**
5	10	25.0	14.94	37	2	30	100	467	3.89	**2x6**	**741**	**51%**

ıds/ Columns: *LOAD VIA ROOF

405 psi

Loads via Enercalc)

Vertical Load (#)	Min. Area (in^2)	**Min. Stud Size**	
5670	14.0	**(2)2x6**	
3010	7.4	**2x6**	
2310	5.7	**2x6**	
1602.5	4.0	**2x6**	
2080	5.1	**2x6**	
2660	6.6	**2x6**	
5300	13.1	**(2)2x6**	
5722.5	14.1	**(2)2x6**	
3725	9.2	**(2)2x6**	
3592.5	8.9	**(2)2x6**	<- USE 6x6
4240	10.5	**(2)2x6**	<- USE 8x8
3500	8.6	**(2)2x6**	<- USE 8x8

Beam Crushing:

$F_{c\perp}$= 625 psi

ID	Vertical Load (#)	Brg Area (in^2)	**$F_{c\perp}$**
A	5670	16.50	**343.6**
B	3010	8.25	**364.8**
C	2310	8.25	**280.0**
D	1602.5	8.25	**194.2**
F	2080	8.25	**252.1**
G	2660	8.25	**322.4**
H	5300	16.50	**321.2**
I	5722.5	16.50	**346.8**
J	3725	16.50	**225.8**
K	3592.5	30.25	**118.8**
L	4240	56.25	**75.4**
M	3500	56.25	**62.2**

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Wood Column

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ENERCALC, INC. 1983-2017, Build:6.17.3.29, Ver:6.17.3.29

Lic. # : KW-06005122 — **Licensee : MC SQUARED, INC.**

Description : POST @ BEAM L

Code References

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
Load Combinations Used : IBC 2015

General Information

Analysis Method :	Allowable Stress Design		
End Fixities	Top Free, Bottom Fixed		
Overall Column Height	11.0 ft		
(Used for non-slender calculations)			
Wood Species	Hem Fir		
Wood Grade	No.1		
Fb +	975.0 psi	Fv	140.0 psi
Fb -	975.0 psi	Ft	650.0 psi
Fc - Prll	850.0 psi	Density	26.830 pcf
Fc - Perp	405.0 psi		

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

Wood Section Name	**8x8**		
Wood Grading/Manuf.	Graded Lumber		
Wood Member Type	Sawn		
Exact Width	**7.50** in	Allow Stress Modification Factors	
Exact Depth	**7.50** in	Cf or Cv for Bending	1.0
Area	56.250 in^2	Cf or Cv for Compression	1.0
Ix	263.672 in^4	Cf or Cv for Tension	1.0
Iy	263.672 in^4	Cm : Wet Use Factor	1.0
		Ct : Temperature Factor	1.0
		Cfu : Flat Use Factor	1.0
		Kf : Built-up columns	1.0 *NDS 15.3.2*
		Use Cr : Repetitive ?	No

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for X-X Axis buckling = 11.0 ft, K = 2.1
Y-Y (depth) axis : Unbraced Length for X-X Axis buckling = 11.0 ft, K = 2.1

Applied Loads

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

Column self weight included : 115.285 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 11.0 ft, Xecc = 1.20 in, D = 0.940, L = 3.30, S = 0.660 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio = **0.2979 : 1**
Load Combination +D+L+H
Governing NDS Forumla Comp + Myy, NDS Eq. 3.9-4
Location of max.above base 0.0 ft
At maximum location values are . . .
Applied Axial 4.355 k
Applied Mx 0.0 k-ft
Applied My -0.4240 k-ft
Fc : Allowable 259.919 psi

PASS Maximum Shear Stress Ratio = **0.0 : 1**
Load Combination +0.60D+E+0.60H
Location of max.above base 11.0 ft
Applied Design Shear 0.0 psi
Allowable Shear 224.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.0 k	Bottom along Y-Y	0.0 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .

Along Y-Y 0.0 in at 0.0 ft above base
for load combination : n/a
Along X-X 0.1285 in at 11.0 ft above base
for load combination : +D+L+H

Other Factors used to calculate allowable stresses . . .

	Bending	Compression	Tension

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
+D+H	0.900	0.336	0.07304	PASS	0.0 ft	0.0	PASS	11.0 ft
+D+L+H	1.000	0.306	0.2979	PASS	0.0 ft	0.0	PASS	11.0 ft
+D+Lr+H	1.250	0.250	0.07075	PASS	0.0 ft	0.0	PASS	11.0 ft
+D+S+H	1.150	0.269	0.1158	PASS	0.0 ft	0.0	PASS	11.0 ft
+D+0.750Lr+0.750L+H	1.250	0.250	0.2367	PASS	0.0 ft	0.0	PASS	11.0 ft
+D+0.750L+0.750S+H	1.150	0.269	0.2717	PASS	0.0 ft	0.0	PASS	11.0 ft
+D+W+H	1.600	0.198	0.06961	PASS	0.0 ft	0.0	PASS	11.0 ft
+D+E+H	1.600	0.198	0.06961	PASS	0.0 ft	0.0	PASS	11.0 ft
+D+0.750Lr+0.750L+0.750W+H	1.600	0.198	0.2329	PASS	0.0 ft	0.0	PASS	11.0 ft
+D+0.750L+0.750S+0.750W+H	1.600	0.198	0.2655	PASS	0.0 ft	0.0	PASS	11.0 ft
+D+0.750L+0.750S+0.750E+H	1.600	0.198	0.2655	PASS	0.0 ft	0.0	PASS	11.0 ft
+0.60D+W+0.60H	1.600	0.198	0.04177	PASS	0.0 ft	0.0	PASS	11.0 ft

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Wood Column

Lic. # : KW-06005122 — **Licensee : MC SQUARED, INC.**

Description : POST @ BEAM L

Load Combination Results

Load Combination	C_D	C_P	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
+0.60D+E+0.60H	1.600	0.198	0.04177	PASS	0.0 ft	0.0	PASS	11.0 ft

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction @ Base	X-X Axis Reaction @ Top	k	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Axial Reaction @ Base	My - End Moments @ Base	My - End Moments @ Top	k-ft	Mx - End Moments @ Base	Mx - End Moments @ Top
+D+H						1.055	0.094				
+D+L+H						4.355	0.424				
+D+Lr+H						1.055	0.094				
+D+S+H						1.715	0.160				
+D+0.750Lr+0.750L+H						3.530	0.342				
+D+0.750L+0.750S+H						4.025	0.391				
+D+0.60W+H						1.055	0.094				
+D+0.70E+H						1.055	0.094				
+D+0.750Lr+0.750L+0.450W+H						3.530	0.342				
+D+0.750L+0.750S+0.450W+H						4.025	0.391				
+D+0.750L+0.750S+0.5250E+H						4.025	0.391				
+0.60D+0.60W+0.60H						0.633	0.056				
+0.60D+0.70E+0.60H						0.633	0.056				
D Only						1.055	0.094				
Lr Only											
L Only						3.300	0.330				
S Only						0.660	0.066				
W Only											
E Only											
H Only											

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
+D+H	0.0285 in	11.000 ft	0.000 in	0.000 ft
+D+L+H	0.1284 in	11.000 ft	0.000 in	0.000 ft
+D+Lr+H	0.0285 in	11.000 ft	0.000 in	0.000 ft
+D+S+H	0.0485 in	11.000 ft	0.000 in	0.000 ft
+D+0.750Lr+0.750L+H	0.1035 in	11.000 ft	0.000 in	0.000 ft
+D+0.750L+0.750S+H	0.1185 in	11.000 ft	0.000 in	0.000 ft
+D+0.60W+H	0.0285 in	11.000 ft	0.000 in	0.000 ft
+D+0.70E+H	0.0285 in	11.000 ft	0.000 in	0.000 ft
+D+0.750Lr+0.750L+0.450W+H	0.1035 in	11.000 ft	0.000 in	0.000 ft
+D+0.750L+0.750S+0.450W+H	0.1185 in	11.000 ft	0.000 in	0.000 ft
+D+0.750L+0.750S+0.5250E+H	0.1185 in	11.000 ft	0.000 in	0.000 ft
+0.60D+0.60W+0.60H	0.0171 in	11.000 ft	0.000 in	0.000 ft
+0.60D+0.70E+0.60H	0.0171 in	11.000 ft	0.000 in	0.000 ft
D Only	0.0285 in	11.000 ft	0.000 in	0.000 ft
Lr Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
L Only	0.1000 in	11.000 ft	0.000 in	0.000 ft
S Only	0.0200 in	11.000 ft	0.000 in	0.000 ft
W Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
E Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
H Only	0.0000 in	0.000 ft	0.000 in	0.000 ft

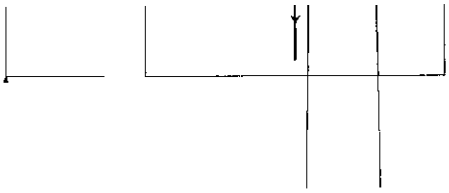
Printed: 26 MAY 2020, 1:48PM
File = m:\ENGINE~1\2-ENER~1.0\201126~1.EC6
ENERCALC, INC. 1983-2017, Build:6.17.3.29, Ver:6.17.3.29

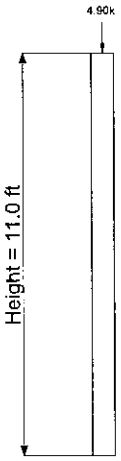
Wood Column

Lic. # : KW-06005122 — **Licensee : MC SQUARED, INC.**

Description : POST @ BEAM L

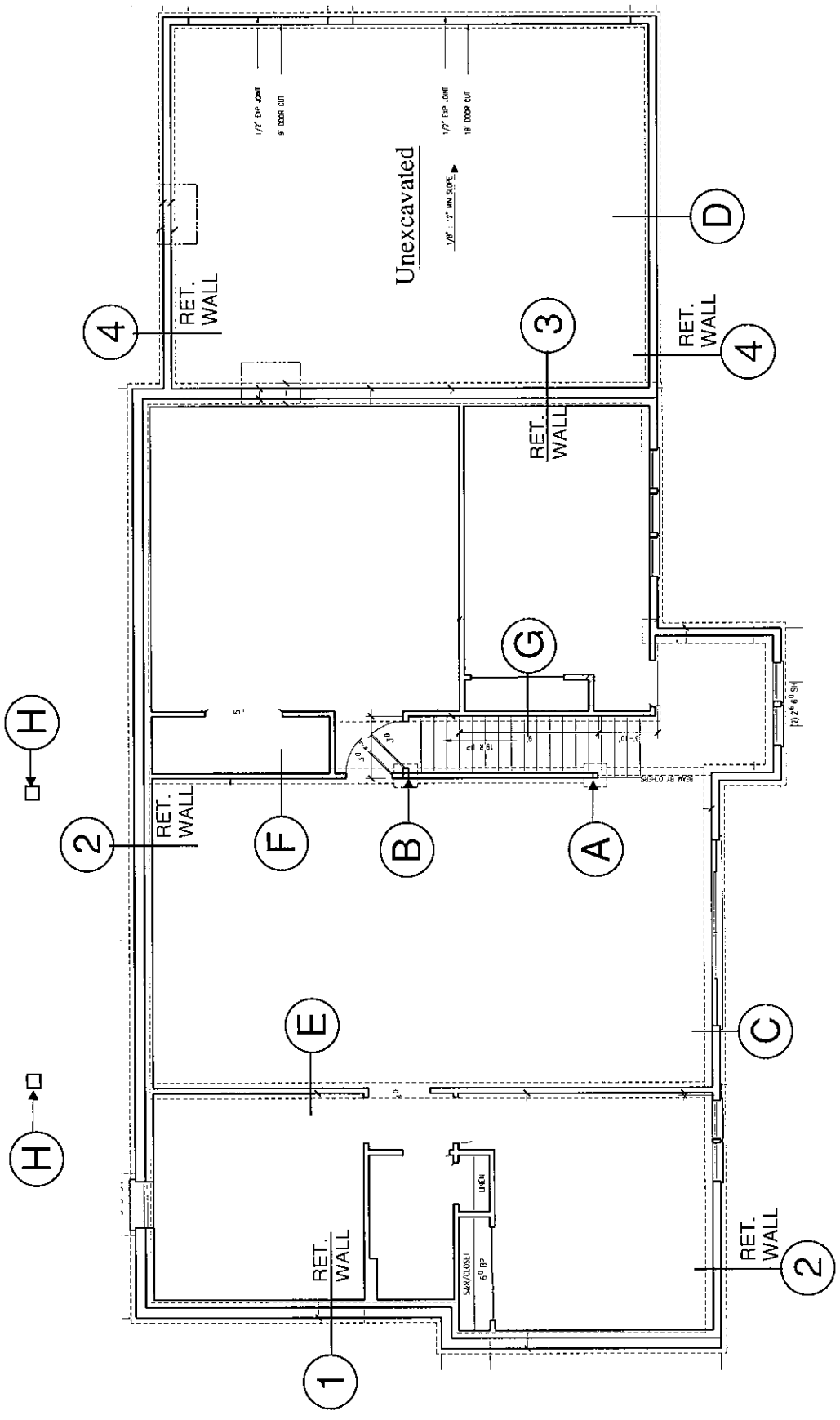
Sketches





Loads are total entered value. Arrows do not reflect absolute direction.

FOUNDATION


Unexcavated
RET. WALL
RET. WALL
RET. WALL
RET. WALL
RET. WALL
RET. WALL
A
B
C
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E
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G
H
H
1
2
2
3
4
4
LINEN
SAW CLOSET

MC SQUARED, INC.
OLYMPIA, WASHINGTON 98506
(360) 754-9339
FAX (360) 352-2044

Job:	Altman Middle Lot		2020-0198
Date:	5/21/2020	By:	JAG
Sheet:		Page	of

PSF = 3000 psf

POST FOOTING: **A**

LOAD = 5723 #

VIA : G,P*,Q*

MIN AREA (ft^2) = 1.91

FTG REQ'D: 1.4 ft sq Use => 18" square

POST FOOTING: **B**

LOAD = 5300 #

VIA : F,P*,O*

MIN AREA (ft^2) = 1.77

FTG REQ'D: 1.3 ft sq Use => 18" square

STRIP FOOTING: 16" WIDTH **C & D** => SUPPORT ON PIN PILES

STRIP FOOTING: **E**

TW1 = 10 ft VIA ROOF
TW2 = 18.0 ft VIA FLOOR

DL1 = 150 plf
SL1 = 250 plf
DL 2= 270 plf
LL2 = 720 plf
WALL = 240 plf
SUM = 1388 plf

16" FTG CHECK, σ = 1041 psf ∴ GOOD

MC SQUARED, INC.
OLYMPIA, WASHINGTON 98506
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FAX (360) 352-2044

Job:	Altman Middle Lot		2020-0198
Date:	5/21/2020	By:	JAG
Sheet:		Page	of

STRIP FOOTING: **F**

TW1 = 10 ft VIA ROOF
TW2 = 22.3 ft VIA FLOOR

DL1 = 150 plf
SL1 = 250 plf
DL 2= 334 plf
LL2 = 890 plf
WALL = 240 plf
SUM = 1579 plf

16" FTG CHECK, σ = 1184 psf ∴ GOOD

STRIP FOOTING: **G**

TW1 = 0 ft VIA ROOF
TW2 = 12.0 ft VIA FLOOR

DL1 = 0 plf
SL1 = 0 plf
DL 2= 180 plf
LL2 = 480 plf
WALL = 240 plf
SUM = 900 plf

16" FTG CHECK, σ = 675 psf ∴ GOOD

POST FOOTING: **H**

LOAD = 3593 #

VIA : BEAM K

MIN AREA (ft^2) = 1.20

FTG REQ'D: 1.1 ft sq Use => 18" square

MC SQUARED, INC.
OLYMPIA, WASHINGTON 98506
(360) 754-9339
FAX (360) 352-2044

Job:	Altman Middle Lot		2020-0198
Date:	5/21/2020	By:	JAG
Sheet:		Page	of

RETAINING WALLS:

WALL SECTION: **1**

TW1 = 2 ft VIA ROOF
TW2 = 8.0 ft VIA FLOOR
WALL HT ABOVE = 10.0 ft

DL1 = 30 plf
SL1 = 50 plf
DL 2= 120 plf
LL2 = 320 plf
WALL = 120 plf

DL = 270 plf
0.75(L+S) = 278 plf
SL = 50 plf
LL = 320 plf

SEISMIC = 6H

H = 11.33'
(1:2 BACKSLOPE)

CHECK CASES: -> CONCSTRUCTION
-> FULL LOADING
-> SEISMIC LOADING

WALL SECTION: **2**

TW1 = 17.5 ft VIA ROOF
TW2 = 2.0 ft VIA FLOOR
WALL HT ABOVE = 10.0 ft

DL1 = 263 plf
SL1 = 438 plf
DL 2= 30 plf
LL2 = 80 plf
WALL = 120 plf

DL = 413 plf
0.75(L+S) = 388 plf
SL = 438 plf
LL = 80 plf
INCLUDE 50 PSF LL SURCHARGE
SEISMIC = 6H

H_A = 11.33'
H_B = 6.25'

CHECK CASES: -> CONCSTRUCTION
-> FULL LOADING
-> SEISMIC LOADING

MC SQUARED, INC.
OLYMPIA, WASHINGTON 98506
(360) 754-9339
FAX (360) 352-2044

Job:	Altman Middle Lot	2020-0198
Date:	5/21/2020	By: JAG
Sheet:		Page of

WALL SECTION: **3**

TW1 = 2.0 ft VIA ROOF
TW2 = 12.0 ft VIA FLOOR
WALL HT ABOVE = 10.0 ft

DL1 = 30 plf
SL1 = 50 plf
DL 2= 180 plf
LL2 = 480 plf
WALL = 120 plf

H = 11.33'

DL = 330 plf
0.75(L+S) = 398 plf
SL = 50 plf
LL = 480 plf
INCLUDE 50 PSF LL SURCHARGE
SEISMIC = 6H

CHECK CASES: -> CONCSTRUCTION
-> FULL LOADING
-> SEISMIC LOADING

WALL SECTION: **4**

TW1 = 17.0 ft VIA ROOF
TW2 = 0.0 ft VIA FLOOR
WALL HT ABOVE = 10.0 ft

DL1 = 255 plf
SL1 = 425 plf
DL 2=
LL2 =
WALL = 120 plf

H_A = 11.33'
H_B = 9.33'
H_C = 4'

DL = 375 plf
0.75(L+S) =
SL = 425 plf
LL =
INCLUDE 50 PSF LL SURCHARGE
SEISMIC = 6H

CHECK CASES: -> CONCSTRUCTION
-> FULL LOADING
-> SEISMIC LOADING

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

Project Name/Number : 2020-0198
Title **Wall 1 - Const.**
Dsgnr: **JAG**
Description....

Date: 14 MAY 2020

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

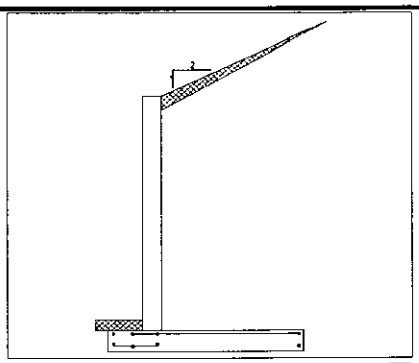
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	11.33 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	2.00
Height of Soil over Toe	=	6.00 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	=	400.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	2.85	OK
Sliding	=	1.53	OK
Total Bearing Load	=	12,216 lbs	
...resultant ecc.	=	0.00 in	
Soil Pressure @ Toe	=	1,437 psf	OK
Soil Pressure @ Heel	=	1,437 psf	OK
Allowable	=	3,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,012 psf	
ACI Factored @ Heel	=	2,012 psf	
Footing Shear @ Toe	=	11.5 psi	OK
Footing Shear @ Heel	=	1.1 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	4,157.5 lbs	
less 100% Passive Force	= -	250.0 lbs	
less 100% Friction Force	= -	6,108.1 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	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, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	10.00
Rebar Size	=	# 6
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.952**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	3,594.3
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	13,574.6
Moment.....Allowable	=	14,240.8
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	39.3
Shear.....Allowable	psi =	82.2
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	7.63
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	125.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	3,000.0
Fy	psi =	60,000.0

Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.4129 in2/ft		
(4/3) * As :	0.5505 in2/ft	Min Stem T&S Reinf Area 2.719 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.4129 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.44 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.2395 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Data

Toe Width	=	1.50 ft
Heel Width	=	7.00
Total Footing Width	=	8.50
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	2,012	2,012 psf
Mu' : Upward	=	2,264	38,258 ft-#
Mu' : Downward	=	284	40,072 ft-#
Mu: Design	=	1,980	1,814 ft-#
Actual 1-Way Shear	=	11.45	1.10 psi
Allow 1-Way Shear	=	40.00	40.00 psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 2.20 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

Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	21,360.3	Soil Over HL (ab. water tbl)	1,250.0	3.42	45,414.4
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	45,414.4
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	= 1,140.8	6.44	7,352.0
Surcharge over Heel	=				Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	0.75	
	=				Surcharge Over Toe	=		
					Stem Weight(s)	= 1,416.3	1.92	2,714.5
					Earth @ Stem Transitions	=		
Total	=	4,157.5	O.T.M. =	21,360.3	Footing Weight	= 1,275.0	4.25	5,418.8
					Key Weight	=		
					Vert. Component	=		
					Total =	12,216.3 lbs	R.M.=	60,899.7

Resisting/Overturning Ratio = **2.85**
Vertical Loads used for Soil Pressure = 12,216.3 lbs

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

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.000	in

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

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

Project Name/Number : 2020-0198
Title Wall 1 - Loaded
Dsgnr: JAG
Description....

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

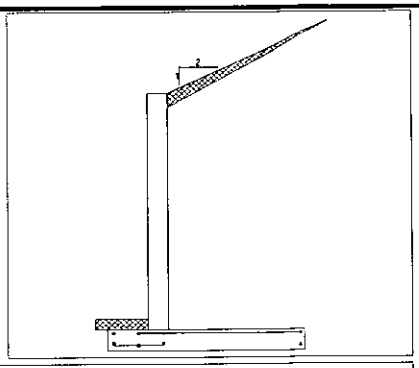
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	11.33 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	2.00
Height of Soil over Toe	=	6.00 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	=	400.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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

Axial Load Applied to Stem

Axial Dead Load	=	270.0 lbs
Axial Live Load	=	320.0 lbs
Axial Load Eccentricity	=	0.0 in

Design Summary

Wall Stability Ratios

Overturning	=	2.90	OK
Sliding	=	1.57	OK
Total Bearing Load	=	12,376 lbs	
...resultant ecc.	=	0.00 in	
Soil Pressure @ Toe	=	1,456 psf	OK
Soil Pressure @ Heel	=	1,456 psf	OK
Allowable	=	3,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,038 psf	
ACI Factored @ Heel	=	2,038 psf	
Footing Shear @ Toe	=	18.0 psi	OK
Footing Shear @ Heel	=	0.7 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	4,090.3 lbs	
less 100% Passive Force	= -	250.0 lbs	
less 100% Friction Force	= -	6,187.9 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	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, E	1.000

Stem Construction

Bottom

			Stem OK
Design Height Above Ftg	ft =		0.00
Wall Material Above "Ht"	=		Concrete
Design Method	=		LRFD
Thickness	=		10.00
Rebar Size	=		# 6
Rebar Spacing	=		12.00
Rebar Placed at	=		Edge
Design Data			
fb/FB + fa/Fa	=		0.952
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =		3,594.3
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =		13,574.6
Moment.....Allowable	=		14,240.8
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =		39.3
Shear.....Allowable	psi =		82.2
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =		7.63
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =		125.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=		Medium Weight
Masonry Design Method	=		ASD
Concrete Data			
f'c	psi =		3,000.0
Fy	psi =		60,000.0

Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.4129 in2/ft	
(4/3) * As :	0.5505 in2/ft	Min Stem T&S Reinf Area 2.719 in2
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.4129 in2/ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.44 in2/ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.2395 in2/ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	6.75
Total Footing Width	=	8.50
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	2,038	2,038 psf
Mu' : Upward	=	3,121	35,678 ft-#
Mu' : Downward	=	386	36,679 ft-#
Mu: Design	=	2,735	1,000 ft-#
Actual 1-Way Shear	=	18.00	0.68 psi
Allow 1-Way Shear	=	75.00	40.00 psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 2.20 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

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

Project Name/Number : 2020-0198
Title Wall 1 - Loaded
Dsgnr: JAG
Description....

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	20,844.8	Soil Over HL (ab. water tbl)	1,250.0	3.42	44,578.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	44,578.8
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	= 1,050.2	6.53	6,855.5
Surcharge over Heel	=				Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 590.0	2.17	585.0
Added Lateral Load	=				* Axial Live Load on Stem	= 320.0	2.17	693.3
Load @ Stem Above Soil	=				Soil Over Toe	=	0.88	
	=				Surcharge Over Toe	=		
					Stem Weight(s)	= 1,416.3	2.17	3,068.5
					Earth @ Stem Transitions	=		
					Footing Weight	= 1,275.0	4.25	5,418.8
					Key Weight	=		
					Vert. Component	=		
Total	= 4,090.3	**O.T.M.**	= 20,844.8		**Total** =	12,375.8 lbs	**R.M.=**	60,506.6

Resisting/Overturning Ratio = **2.90**
Vertical Loads used for Soil Pressure = 12,375.8 lbs

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

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.000	in

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

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

Project Name/Number : 2020-0198
Title **Wall 1 - Seismic**
Dsgnr: **JAG**
Description....

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

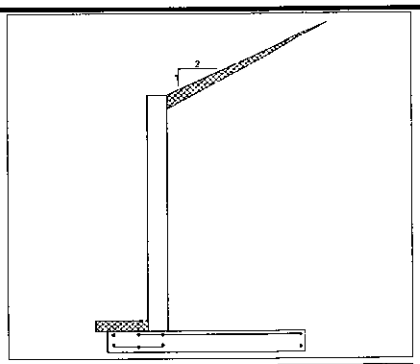
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	11.33 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	2.00
Height of Soil over Toe	=	6.00 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	=	400.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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

Axial Load Applied to Stem

Axial Dead Load	=	270.0 lbs
Axial Live Load	=	320.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform
Multiplier Used = 6.000
(Multiplier used on soil density)

Uniform Seismic Force = 73.980
Total Seismic Force = 912.173

Design Summary

Wall Stability Ratios

Overturning	=	2.44 OK
Sliding	=	1.36 Ratio < 1.5!
Total Bearing Load	=	12,376 lbs
...resultant ecc.	=	0.00 in
Soil Pressure @ Toe	=	1,456 psf OK
Soil Pressure @ Heel	=	1,456 psf OK
Allowable	=	3,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,038 psf
ACI Factored @ Heel	=	2,038 psf
Footing Shear @ Toe	=	18.0 psi OK
Footing Shear @ Heel	=	0.7 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	4,728.9 lbs
less 100% Passive Force	= -	250.0 lbs
less 100% Friction Force	= -	6,187.9 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	655.4 lbs NG

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, E	1.000

Stem Construction

Bottom

			Stem OK
Design Height Above Ftg	ft =		0.00
Wall Material Above "Ht"	=		Concrete
Design Method	=		LRFD
Thickness	=		10.00
Rebar Size	=		# 7
Rebar Spacing	=		12.00
Rebar Placed at	=		Edge
Design Data			
fb/FB + fa/Fa	=		**0.972**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =		4,432.5
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =		18,322.9
Moment.....Allowable	=		18,825.8
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =		48.8
Shear.....Allowable	psi =		82.2
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =		7.56
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =		125.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=		Medium Weight
Masonry Design Method	=		ASD
Concrete Data			
f'c	psi =		3,000.0
Fy	psi =		60,000.0

Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.5621 in2/ft	
(4/3) * As :	0.7495 in2/ft	Min Stem T&S Reinf Area 2.719 in2
200bd/fy : 200(12)(7.5625)/60000 :	0.3025 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.5621 in2/ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.6 in2/ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.2294 in2/ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	6.75
Total Footing Width	=	8.50
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	2,038	2,038 psf
Mu' : Upward	=	3,121	35,678 ft-#
Mu' : Downward	=	386	36,679 ft-#
Mu: Design	=	2,735	1,000 ft-#
Actual 1-Way Shear	=	18.00	0.68 psi
Allow 1-Way Shear	=	75.00	40.00 psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 2.20 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

Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	20,844.8	Soil Over HL (ab. water tbl)	1,250.0	3.42	44,578.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	44,578.8
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	= 1,050.2	6.53	6,855.5
Surcharge over Heel	=				Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 590.0	2.17	585.0
Added Lateral Load	=				* Axial Live Load on Stem	= 320.0	2.17	693.3
Load @ Stem Above Soil	=				Soil Over Toe	=	0.88	
Seismic Earth Load	=	638.5	6.17	3,936.5	Surcharge Over Toe	=		
	=				Stem Weight(s)	= 1,416.3	2.17	3,068.5
					Earth @ Stem Transitions	=		
					Footing Weight	= 1,275.0	4.25	5,418.8
					Key Weight	=		
					Vert. Component	=		
Total	=	4,728.9	**O.T.M.** =	24,781.3	**Total =**	12,375.8 lbs	**R.M.=**	60,506.6

Resisting/Overturning Ratio = **2.44**
Vertical Loads used for Soil Pressure = 12,375.8 lbs

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

If seismic is included, the OTM and sliding ratios 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.

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)	0.000	in

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

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

Project Name/Number : 2020-0198
Title **Wall 2A - Const.**
Dsgnr: **JAG**
Description....

Date: 14 MAY 2020

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

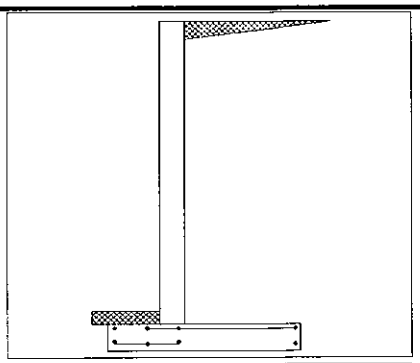
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	11.33 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	400.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	2.60 OK
Sliding	=	1.48 Ratio < 1.5!
Total Bearing Load	=	7,912 lbs
...resultant ecc.	=	0.00 in
Soil Pressure @ Toe	=	1,217 psf OK
Soil Pressure @ Heel	=	1,217 psf OK
Allowable	=	3,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,704 psf
ACI Factored @ Heel	=	1,704 psf
Footing Shear @ Toe	=	12.4 psi OK
Footing Shear @ Heel	=	6.1 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	2,840.3 lbs
less 100% Passive Force	= -	250.0 lbs
less 100% Friction Force	= -	3,956.1 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	54.4 lbs NG

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, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	10.00
Rebar Size	=	# 7
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.800**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	3,858.7
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	15,072.2
Moment.....Allowable	=	18,825.8
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	42.5
Shear.....Allowable	psi =	82.2
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	7.56
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	125.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	3,000.0
Fy	psi =	60,000.0

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.4624 in2/ft	
(4/3) * As :	0.6165 in2/ft	Min Stem T&S Reinf Area 2.719 in2
200bd/fy : 200(12)(7.5625)/60000 :	0.3025 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.4624 in2/ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.6 in2/ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.2294 in2/ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	4.75
Total Footing Width	=	6.50
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,704	1,704 psf
Mu' : Upward	=	2,609	13,071 ft-#
Mu' : Downward	=	386	14,508 ft-#
Mu: Design	=	2,224	1,437 ft-#
Actual 1-Way Shear	=	12.40	6.12 psi
Allow 1-Way Shear	=	40.00	40.00 psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 1.68 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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	10,934.7	Soil Over HL (ab. water tbl)	1,250.0	3.42	24,184.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	24,184.8
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=	179.8	6.17	1,108.5	Surcharge Over Heel =	195.8	4.54	889.4
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =			
Added Lateral Load	=				* Axial Live Load on Stem =			
Load @ Stem Above Soil	=				Soil Over Toe =		0.88	
	=				Surcharge Over Toe =			
					Stem Weight(s) =	1,416.3	2.17	3,068.5
					Earth @ Stem Transitions =			
					Footing Weight =	975.0	3.25	3,168.8
					Key Weight =			
					Vert. Component =			
Total	=	2,840.3	**O.T.M.** =	12,043.2	**Total =**	7,912.2 lbs	**R.M.=**	31,311.5

Resisting/Overturning Ratio = **2.60**
Vertical Loads used for Soil Pressure = 7,912.2 lbs

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

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.000	in

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

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

Project Name/Number : 2020-0198
Title **Wall 2A - Loaded**
Dsgnr: **JAG**
Description....

Date: 14 MAY 2020

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

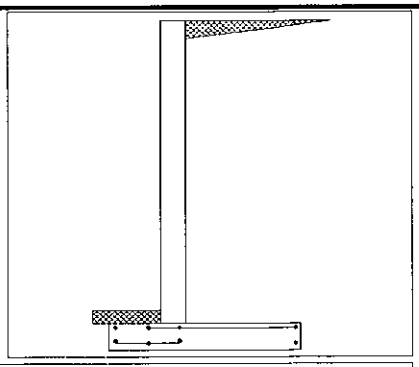
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	11.33 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	400.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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

Axial Load Applied to Stem

Axial Dead Load	=	413.0 lbs
Axial Live Load	=	438.0 lbs
Axial Load Eccentricity	=	0.0 in

Design Summary

Wall Stability Ratios

Overturning	=	2.67	OK
Sliding	=	1.63	OK
Total Bearing Load	=	8,763 lbs	
...resultant ecc.	=	0.00 in	
Soil Pressure @ Toe	=	1,348 psf	OK
Soil Pressure @ Heel	=	1,348 psf	OK
Allowable	=	3,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,887 psf	
ACI Factored @ Heel	=	1,887 psf	
Footing Shear @ Toe	=	16.5 psi	OK
Footing Shear @ Heel	=	0.1 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,840.3 lbs	
less 100% Passive Force	= -	250.0 lbs	
less 100% Friction Force	= -	4,381.6 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	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, E	1.000

Stem Construction

Bottom

			Stem OK
Design Height Above Ftg	ft =		0.00
Wall Material Above "Ht"	=		Concrete
Design Method	=		LRFD
Thickness	=		10.00
Rebar Size	=		# 6
Rebar Spacing	=		11.25
Rebar Placed at	=		Edge
Design Data			
fb/FB + fa/Fa	=		0.995
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =		3,858.7
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =		15,072.2
Moment.....Allowable	=		15,129.3
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =		42.2
Shear.....Allowable	psi =		82.2
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =		7.63
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =		125.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =		3,000.0
Fy	psi =		60,000.0

DWGS SHOW 12"

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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	Horizontal Reinforcing	
As (based on applied moment) :	0.4584 in2/ft		
(4/3) * As :	0.6112 in2/ft	Min Stem T&S Reinf Area 2.719 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.4584 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.4693 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.2395 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	4.75
Total Footing Width	=	6.50
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,887	1,887 psf
Mu' : Upward	=	2,890	14,477 ft-#
Mu' : Downward	=	386	14,508 ft-#
Mu: Design	=	2,504	31 ft-#
Actual 1-Way Shear	=	16.46	0.13 psi
Allow 1-Way Shear	=	75.00	40.00 psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 1.68 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

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Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	10,934.7	Soil Over HL (ab. water tbl)	1,250.0	3.42	24,184.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	24,184.8
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	179.8	6.17	1,108.5	Surcharge Over Heel	= 195.8	4.54	889.4
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 851.0	2.17	894.8
Added Lateral Load	=				* Axial Live Load on Stem	= 438.0	2.17	949.0
Load @ Stem Above Soil	=				Soil Over Toe	=	0.88	
	=				Surcharge Over Toe	=		
					Stem Weight(s)	= 1,416.3	2.17	3,068.5
					Earth @ Stem Transitions	=		
					Footing Weight	= 975.0	3.25	3,168.8
					Key Weight	=		
					Vert. Component	=		
Total	=	2,840.3	**O.T.M.** =	12,043.2	**Total =**	8,763.2 lbs	**R.M.=**	32,206.4

Resisting/Overturning Ratio = **2.67**
Vertical Loads used for Soil Pressure = 8,763.2 lbs

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

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.000	in

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

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Cantilevered Retaining Wall

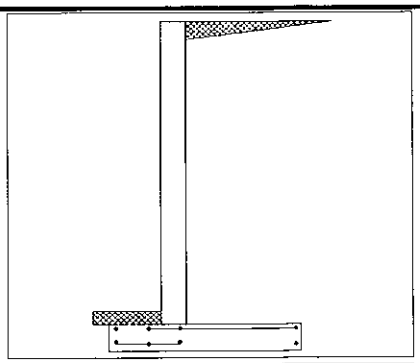
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	11.33 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	400.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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

Axial Load Applied to Stem

Axial Dead Load	=	413.0 lbs
Axial Live Load	=	438.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	6.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	73.980
Total Seismic Force	=	912.173

Design Summary

Wall Stability Ratios

Overturning	=	2.02 OK
Sliding	=	1.33 Ratio < 1.5!
Total Bearing Load	=	8,763 lbs
...resultant ecc.	=	0.00 in
Soil Pressure @ Toe	=	1,348 psf OK
Soil Pressure @ Heel	=	1,348 psf OK
Allowable	=	3,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,887 psf
ACI Factored @ Heel	=	1,887 psf
Footing Shear @ Toe	=	16.5 psi OK
Footing Shear @ Heel	=	0.1 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	3,478.8 lbs
less 100% Passive Force	= -	250.0 lbs
less 100% Friction Force	= -	4,381.6 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	586.7 lbs NG

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, E	1.000

Stem Construction

	Bottom
	As < Min %
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	10.00
Rebar Size =	# 6
Rebar Spacing =	12.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	No Good
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	4,696.9
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	19,820.6
Moment.....Allowable =	15,129.3
Shear.....Actual	
Service Level psi =	
Strength Level psi =	51.3
Shear.....Allowable psi =	82.2
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	7.63
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	125.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	3,000.0
Fy psi =	60,000.0

Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.6029 in2/ft	
(4/3) * As :	0.8038 in2/ft	Min Stem T&S Reinf Area 2.719 in2
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.6029 in2/ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.4693 in2/ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.2395 in2/ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	4.75
Total Footing Width	=	6.50
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,887	1,887 psf
Mu' : Upward	=	2,890	14,477 ft-#
Mu' : Downward	=	386	14,508 ft-#
Mu: Design	=	2,504	31 ft-#
Actual 1-Way Shear	=	16.46	0.13 psi
Allow 1-Way Shear	=	75.00	40.00 psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 1.68 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

Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	10,934.7	Soil Over HL (ab. water tbl)	1,250.0	3.42	24,184.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	24,184.8
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	179.8	6.17	1,108.5	Surcharge Over Heel	= 195.8	4.54	889.4
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 851.0	2.17	894.8
Added Lateral Load	=				* Axial Live Load on Stem	= 438.0	2.17	949.0
Load @ Stem Above Soil	=				Soil Over Toe	=	0.88	
Seismic Earth Load	=	638.5	6.17	3,936.5	Surcharge Over Toe	=		
	=				Stem Weight(s)	= 1,416.3	2.17	3,068.5
					Earth @ Stem Transitions	=		
Total	=	3,478.8	**O.T.M.** =	15,979.7	Footing Weight	= 975.0	3.25	3,168.8
					Key Weight	=		
					Vert. Component	=		
					Total =	8,763.2 lbs	**R.M.=**	32,206.4

Resisting/Overturning Ratio = **2.02**
Vertical Loads used for Soil Pressure = 8,763.2 lbs

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

If seismic is included, the OTM and sliding ratios 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.

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)	0.000	in

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

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Cantilevered Retaining Wall

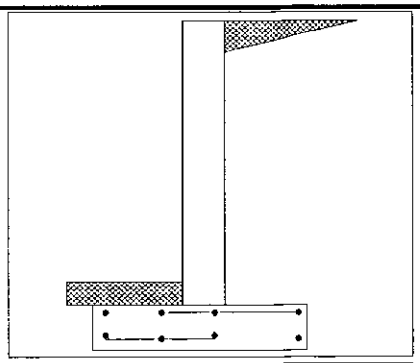
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	6.25 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	400.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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

Axial Load Applied to Stem

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

Design Summary

Wall Stability Ratios

Overturning	=	2.92 OK
Sliding	=	1.59 OK
Total Bearing Load	=	2,752 lbs
...resultant ecc.	=	0.00 in
Soil Pressure @ Toe	=	648 psf OK
Soil Pressure @ Heel	=	648 psf OK
Allowable	=	3,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	907 psf
ACI Factored @ Heel	=	907 psf
Footing Shear @ Toe	=	5.5 psi OK
Footing Shear @ Heel	=	3.5 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	1,025.6 lbs
less 100% Passive Force	= -	250.0 lbs
less 100% Friction Force	= -	1,376.0 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	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, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	10.00
Rebar Size	=	# 6
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	0.191
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,239.6
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	2,734.4
Moment.....Allowable	=	14,240.8
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	13.5
Shear.....Allowable	psi =	82.2
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	7.63
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	125.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	3,000.0
Fy	psi =	60,000.0

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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	Horizontal Reinforcing	
As (based on applied moment) :	0.0832 in2/ft		
(4/3) * As :	0.1109 in2/ft	Min Stem T&S Reinf Area 1.500 in2	
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.216 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.44 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.2395 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	2.50
Total Footing Width	=	4.25
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	907	907 psf
Mu' : Upward	=	1,388	1,259 ft-#
Mu' : Downward	=	386	1,611 ft-#
Mu: Design	=	1,002	352 ft-#
Actual 1-Way Shear	=	5.47	3.52 psi
Allow 1-Way Shear	=	40.00	40.00 psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 1.10 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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	2,223.0	Soil Over HL (ab. water tbl)	1,250.0	3.42	4,270.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	4,270.8
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	105.7	3.63	383.3	Surcharge Over Heel	= 83.3	3.42	284.7
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	0.88	
	=				Surcharge Over Toe	=		
					Stem Weight(s)	= 781.3	2.17	1,692.7
					Earth @ Stem Transitions	=		
					Footing Weight	= 637.5	2.13	1,354.7
					Key Weight	=		
					Vert. Component	=		
Total	=	1,025.6	**O.T.M.** =	2,606.2	**Total** =	2,752.1 lbs	**R.M.=**	7,603.0

Resisting/Overturning Ratio = **2.92**
Vertical Loads used for Soil Pressure = 2,752.1 lbs

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

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.000	in

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

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

Project Name/Number : 2020-0198
Title Wall 2B - Loaded
Dsgnr: JAG
Description....

Date: 14 MAY 2020

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

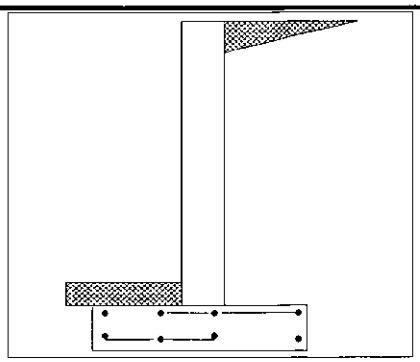
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	6.25 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	413.0 lbs
Axial Live Load	=	438.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

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

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

Overturning	=	3.26 OK
Sliding	=	1.91 OK
Total Bearing Load	=	3,603 lbs
...resultant ecc.	=	0.00 in
Soil Pressure @ Toe	=	848 psf OK
Soil Pressure @ Heel	=	848 psf OK
Allowable	=	3,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,187 psf
ACI Factored @ Heel	=	1,187 psf
Footing Shear @ Toe	=	7.9 psi OK
Footing Shear @ Heel	=	0.4 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	1,025.6 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	1,801.5 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	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, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	10.00
Rebar Size	=	# 6
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.191**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,239.6
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	2,734.4
Moment.....Allowable	=	14,240.8
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	13.5
Shear.....Allowable	psi =	82.2
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	7.63
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	125.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	3,000.0
Fy	psi =	60,000.0

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0832 in2/ft	
(4/3) * As :	0.1109 in2/ft	Min Stem T&S Reinf Area 1.500 in2
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.216 in2/ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.44 in2/ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.2395 in2/ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	2.50
Total Footing Width	=	4.25
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,187	1,187 psf
Mu' : Upward	=	1,817	1,648 ft-#
Mu' : Downward	=	386	1,611 ft-#
Mu: Design	=	1,432	-37 ft-#
Actual 1-Way Shear	=	7.91	0.37 psi
Allow 1-Way Shear	=	40.00	40.00 psi

Toe Reinforcing = # 4 @ 9.00 in
Heel Reinforcing = # 4 @ 9.00 in
Key Reinforcing = None Spec'd
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 1.10 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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	2,223.0	Soil Over HL (ab. water tbl)	1,250.0	3.42	4,270.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	4,270.8
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	105.7	3.63	383.3	Surcharge Over Heel	= 83.3	3.42	284.7
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 851.0	2.17	894.8
Added Lateral Load	=				* Axial Live Load on Stem	= 438.0	2.17	949.0
Load @ Stem Above Soil	=				Soil Over Toe	=	0.88	
	=				Surcharge Over Toe	=		
					Stem Weight(s)	= 781.3	2.17	1,692.7
					Earth @ Stem Transitions	=		
Total	=	1,025.6	O.T.M. =	2,606.2	Footing Weight	= 637.5	2.13	1,354.7
					Key Weight	=		
					Vert. Component	=		
					Total =	3,603.1 lbs	R.M.=	8,497.8

Resisting/Overturning Ratio = **3.26**
Vertical Loads used for Soil Pressure = 3,603.1 lbs

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

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.000	in

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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

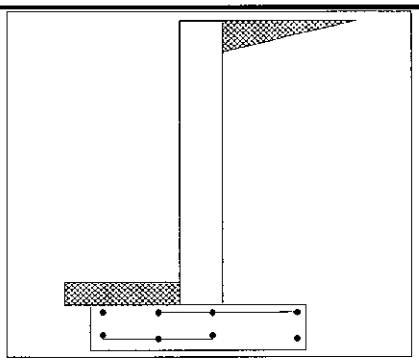
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	6.25 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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

Axial Load Applied to Stem

Axial Dead Load	=	413.0 lbs
Axial Live Load	=	438.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	6.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	43.500
Total Seismic Force	=	315.375

Design Summary

Wall Stability Ratios

Overturning	=	2.49 OK
Sliding	=	1.57 OK
Total Bearing Load	=	3,603 lbs
...resultant ecc.	=	0.00 in
Soil Pressure @ Toe	=	848 psf OK
Soil Pressure @ Heel	=	848 psf OK
Allowable	=	3,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,187 psf
ACI Factored @ Heel	=	1,187 psf
Footing Shear @ Toe	=	7.9 psi OK
Footing Shear @ Heel	=	0.4 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	1,246.3 lbs
less 100% Passive Force	= -	156.3 lbs
less 100% Friction Force	= -	1,801.5 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	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, E	1.000

Stem Construction

Bottom

			Stem OK
Design Height Above Ftg	ft =		0.00
Wall Material Above "Ht"	=		Concrete
Design Method	=		LRFD
Thickness	=		10.00
Rebar Size	=		# 6
Rebar Spacing	=		12.00
Rebar Placed at	=		Edge
Design Data			
fb/FB + fa/Fa	=		**0.251**
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =		1,511.5
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =		3,584.0
Moment.....Allowable	=		14,240.8
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =		16.5
Shear.....Allowable	psi =		82.2
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =		7.63
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =		125.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =		3,000.0
Fy	psi =		60,000.0

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.109 in2/ft	
(4/3) * As :	0.1453 in2/ft	Min Stem T&S Reinf Area 1.500 in2
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.216 in2/ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.44 in2/ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.2395 in2/ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	2.50
Total Footing Width	=	4.25
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,187	1,187 psf
Mu' : Upward	=	1,817	1,648 ft-#
Mu' : Downward	=	386	1,611 ft-#
Mu: Design	=	1,432	-37 ft-#
Actual 1-Way Shear	=	7.91	0.37 psi
Allow 1-Way Shear	=	40.00	40.00 psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 1.10 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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	2,223.0	Soil Over HL (ab. water tbl)	1,250.0	3.42	4,270.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	4,270.8
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	105.7	3.63	383.3	Surcharge Over Heel	= 83.3	3.42	284.7
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 851.0	2.17	894.8
Added Lateral Load	=				* Axial Live Load on Stem	= 438.0	2.17	949.0
Load @ Stem Above Soil	=				Soil Over Toe	=	0.88	
Seismic Earth Load	=	220.8	3.63	800.3	Surcharge Over Toe	=		
	=				Stem Weight(s)	= 781.3	2.17	1,692.7
Total	=	1,246.3	**O.T.M.** =	3,406.5	Earth @ Stem Transitions	=		
					Footing Weight	= 637.5	2.13	1,354.7
					Key Weight	=		
					Vert. Component	=		
					Total =	3,603.1 lbs	**R.M.**=	8,497.8

Resisting/Overturning Ratio = **2.49**
Vertical Loads used for Soil Pressure = 3,603.1 lbs

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

If seismic is included, the OTM and sliding ratios 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.

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)	0.000	in

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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

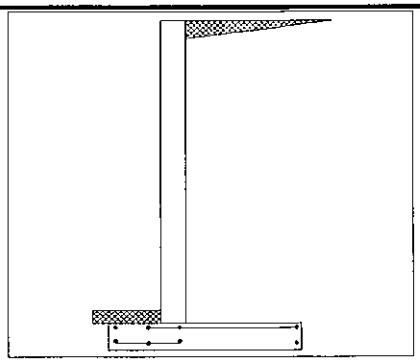
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	11.33 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	400.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Axial Load Applied to Stem

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

Lateral Load Applied to Stem

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

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

Overturning	=	2.60 OK
Sliding	=	1.48 Ratio < 1.5!
Total Bearing Load	=	7,912 lbs
...resultant ecc.	=	0.00 in
Soil Pressure @ Toe	=	1,217 psf OK
Soil Pressure @ Heel	=	1,217 psf OK
Allowable	=	3,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,704 psf
ACI Factored @ Heel	=	1,704 psf
Footing Shear @ Toe	=	12.4 psi OK
Footing Shear @ Heel	=	6.1 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	2,840.3 lbs
less 100% Passive Force	= -	250.0 lbs
less 100% Friction Force	= -	3,956.1 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	54.4 lbs NG

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, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	10.00
Rebar Size	=	# 7
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	0.800
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	3,858.7
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	15,072.2
Moment.....Allowable	=	18,825.8
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	42.5
Shear.....Allowable	psi =	82.2
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	7.56
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	125.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	3,000.0
Fy	psi =	60,000.0

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.4624 in2/ft	
(4/3) * As :	0.6165 in2/ft	Min Stem T&S Reinf Area 2.719 in2
200bd/fy : 200(12)(7.5625)/60000 :	0.3025 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.4624 in2/ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.6 in2/ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.2294 in2/ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	4.75
Total Footing Width	=	6.50
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,704	1,704 psf
Mu' : Upward	=	2,609	13,071 ft-#
Mu' : Downward	=	386	14,508 ft-#
Mu: Design	=	2,224	1,437 ft-#
Actual 1-Way Shear	=	12.40	6.12 psi
Allow 1-Way Shear	=	40.00	40.00 psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 1.68 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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	10,934.7	Soil Over HL (ab. water tbl)	1,250.0	3.42	24,184.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	24,184.8
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	179.8	6.17	1,108.5	Surcharge Over Heel	= 195.8	4.54	889.4
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=	0.88	
	=				Surcharge Over Toe	=		
					Stem Weight(s)	= 1,416.3	2.17	3,068.5
					Earth @ Stem Transitions	=		
					Footing Weight	= 975.0	3.25	3,168.8
					Key Weight	=		
					Vert. Component	=		
Total	=	2,840.3	**O.T.M.** =	12,043.2	**Total** =	7,912.2 lbs	**R.M.**=	31,311.5

Resisting/Overturning Ratio = **2.60**
Vertical Loads used for Soil Pressure = 7,912.2 lbs

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

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.000	in

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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

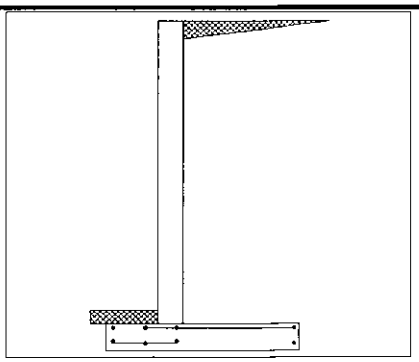
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	11.33 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	400.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	330.0 lbs
Axial Live Load	=	480.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

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

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

Overturning	=	2.66 OK
Sliding	=	1.62 OK
Total Bearing Load	=	8,722 lbs
...resultant ecc.	=	0.00 in
Soil Pressure @ Toe	=	1,342 psf OK
Soil Pressure @ Heel	=	1,342 psf OK
Allowable	=	3,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,879 psf
ACI Factored @ Heel	=	1,879 psf
Footing Shear @ Toe	=	13.9 psi OK
Footing Shear @ Heel	=	0.4 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	2,840.3 lbs
less 100% Passive Force	= -	250.0 lbs
less 100% Friction Force	= -	4,361.1 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	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, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	10.00
Rebar Size	=	# 7
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	0.800
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	3,858.7
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	15,072.2
Moment.....Allowable	=	18,825.8
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	42.5
Shear.....Allowable	psi =	82.2
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	7.56
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	125.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	3,000.0
Fy	psi =	60,000.0

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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	Horizontal Reinforcing	
As (based on applied moment) :	0.4624 in2/ft		
(4/3) * As :	0.6165 in2/ft	Min Stem T&S Reinf Area 2.719 in2	
200bd/fy : 200(12)(7.5625)/60000 :	0.3025 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.4624 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.6 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.2294 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	4.75
Total Footing Width	=	6.50
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,879	1,879 psf
Mu' : Upward	=	2,877	14,409 ft-#
Mu' : Downward	=	386	14,508 ft-#
Mu: Design	=	2,491	99 ft-#
Actual 1-Way Shear	=	13.91	0.42 psi
Allow 1-Way Shear	=	40.00	40.00 psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 1.68 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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

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Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	10,934.7	Soil Over HL (ab. water tbl)	1,250.0	3.42	24,184.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	24,184.8
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	179.8	6.17	1,108.5	Surcharge Over Heel	= 195.8	4.54	889.4
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 810.0	2.17	715.0
Added Lateral Load	=				* Axial Live Load on Stem	= 480.0	2.17	1,040.0
Load @ Stem Above Soil	=				Soil Over Toe	=	0.88	
	=				Surcharge Over Toe	=		
					Stem Weight(s)	= 1,416.3	2.17	3,068.5
					Earth @ Stem Transitions	=		
					Footing Weight	= 975.0	3.25	3,168.8
					Key Weight	=		
					Vert. Component	=		
Total	= 2,840.3	O.T.M.	= 12,043.2		Total =	8,722.2 lbs	R.M.=	32,026.5

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

Resisting/Overturning Ratio = **2.66**
Vertical Loads used for Soil Pressure = 8,722.2 lbs

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.000	in

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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

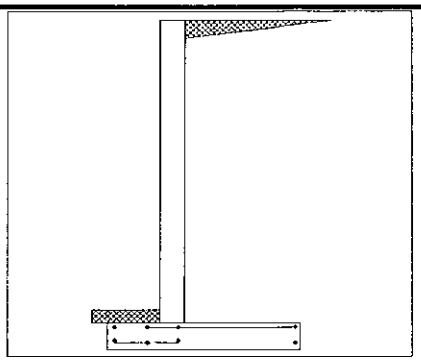
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	11.33 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	400.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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

Axial Load Applied to Stem

Axial Dead Load	=	330.0 lbs
Axial Live Load	=	480.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform
Multiplier Used = 6.000
(Multiplier used on soil density)

Uniform Seismic Force = 73.980
Total Seismic Force = 912.173

Design Summary

Wall Stability Ratios

Overturning	=	2.00 OK
Sliding	=	1.33 Ratio < 1.5!
Total Bearing Load	=	8,722 lbs
...resultant ecc.	=	0.00 in
Soil Pressure @ Toe	=	1,342 psf OK
Soil Pressure @ Heel	=	1,342 psf OK
Allowable	=	3,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,879 psf
ACI Factored @ Heel	=	1,879 psf
Footing Shear @ Toe	=	13.9 psi OK
Footing Shear @ Heel	=	0.4 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	3,478.8 lbs
less 100% Passive Force	= -	250.0 lbs
less 100% Friction Force	= -	4,361.1 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	607.2 lbs NG

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, E	1.000

Stem Construction

		Bottom
		As < Min %
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	10.00
Rebar Size	=	# 7
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	No Good
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	4,696.9
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	19,820.6
Moment.....Allowable	=	18,825.8
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	51.8
Shear.....Allowable	psi =	82.2
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	7.56
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	125.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	3,000.0
Fy	psi =	60,000.0

Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.6081 in2/ft		
(4/3) * As :	0.8107 in2/ft	Min Stem T&S Reinf Area 2.719 in2	
200bd/fy : 200(12)(7.5625)/60000 :	0.3025 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.6081 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.6 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.2294 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	4.75
Total Footing Width	=	6.50
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,879	1,879 psf
Mu' : Upward	=	2,877	14,409 ft-#
Mu' : Downward	=	386	14,508 ft-#
Mu: Design	=	2,491	99 ft-#
Actual 1-Way Shear	=	13.91	0.42 psi
Allow 1-Way Shear	=	40.00	40.00 psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 1.68 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

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Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	10,934.7	Soil Over HL (ab. water tbl)	1,250.0	3.42	24,184.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	24,184.8
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	179.8	6.17	1,108.5	Surcharge Over Heel	= 195.8	4.54	889.4
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 810.0	2.17	715.0
Added Lateral Load	=				* Axial Live Load on Stem	= 480.0	2.17	1,040.0
Load @ Stem Above Soil	=				Soil Over Toe	=	0.88	
Seismic Earth Load	=	638.5	6.17	3,936.5	Surcharge Over Toe	=		
	=				Stem Weight(s)	= 1,416.3	2.17	3,068.5
Total	=	3,478.8	**O.T.M.** =	15,979.7	Earth @ Stem Transitions	=		
					Footing Weight	= 975.0	3.25	3,168.8
					Key Weight	=		
					Vert. Component	=		
					Total =	8,722.2 lbs	**R.M.=**	32,026.5

Resisting/Overturning Ratio = **2.00**
Vertical Loads used for Soil Pressure = 8,722.2 lbs

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

If seismic is included, the OTM and sliding ratios 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.

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)	0.000	in

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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

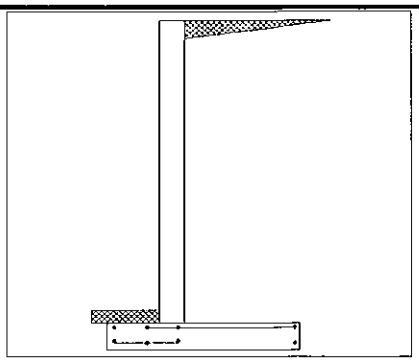
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	11.33 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	400.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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

Axial Load Applied to Stem

Axial Dead Load	=	255.0 lbs
Axial Live Load	=	425.0 lbs
Axial Load Eccentricity	=	0.0 in

Design Summary

Wall Stability Ratios

Overturning	=	2.65	OK
Sliding	=	1.60	OK
Total Bearing Load	=	8,592 lbs	
...resultant ecc.	=	0.00 in	
Soil Pressure @ Toe	=	1,322 psf	OK
Soil Pressure @ Heel	=	1,322 psf	OK
Allowable	=	3,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,851 psf	
ACI Factored @ Heel	=	1,851 psf	
Footing Shear @ Toe	=	13.7 psi	OK
Footing Shear @ Heel	=	1.3 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	2,840.3 lbs	
less 100% Passive Force	= -	250.0 lbs	
less 100% Friction Force	= -	4,296.1 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	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, E	1.000

Stem Construction

	Bottom
	Stem OK
Design Height Above Ftg ft =	0.00
Wall Material Above "Ht" =	Concrete
Design Method =	LRFD
Thickness =	10.00
Rebar Size =	# 7
Rebar Spacing =	12.00
Rebar Placed at =	Edge
Design Data	
fb/FB + fa/Fa =	0.800
Total Force @ Section	
Service Level lbs =	
Strength Level lbs =	3,858.7
Moment....Actual	
Service Level ft-# =	
Strength Level ft-# =	15,072.2
Moment.....Allowable =	18,825.8
Shear.....Actual	
Service Level psi =	
Strength Level psi =	42.5
Shear.....Allowable psi =	82.2
Anet (Masonry) in2 =	
Rebar Depth 'd' in =	7.56
Masonry Data	
f'm psi =	
Fs psi =	
Solid Grouting =	
Modular Ratio 'n' =	
Wall Weight psf =	125.0
Short Term Factor =	
Equiv. Solid Thick. =	
Masonry Block Type =	Medium Weight
Masonry Design Method =	ASD
Concrete Data	
f'c psi =	3,000.0
Fy psi =	60,000.0

Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.4624 in2/ft		
(4/3) * As :	0.6165 in2/ft	Min Stem T&S Reinf Area 2.719 in2	
200bd/fy : 200(12)(7.5625)/60000 :	0.3025 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.4624 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.6 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.2294 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	4.75
Total Footing Width	=	6.50
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	1,851	1,851	psf
Mu' : Upward	=	2,834	14,195	ft-#
Mu' : Downward	=	386	14,508	ft-#
Mu: Design	=	2,448	314	ft-#
Actual 1-Way Shear	=	13.67	1.33	psi
Allow 1-Way Shear	=	40.00	40.00	psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 1.68 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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	10,934.7	Soil Over HL (ab. water tbl)	1,250.0	3.42	24,184.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	24,184.8
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Hee'	=		
Surcharge over Heel	=	179.8	6.17	1,108.5	Surcharge Over Heel	= 195.8	4.54	889.4
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 680.0	2.17	552.5
Added Lateral Load	=				* Axial Live Load on Stem	= 425.0	2.17	920.8
Load @ Stem Above Soil	=				Soil Over Toe	=	0.88	
	=				Surcharge Over Toe	=		
					Stem Weight(s)	= 1,416.3	2.17	3,068.5
					Earth @ Stem Transitions	=		
					Footing Weight	= 975.0	3.25	3,168.8
					Key Weight	=		
					Vert. Component	=		
Total	=	2,840.3	**O.T.M.** =	12,043.2	**Total** =	8,592.2 lbs	**R.M.=**	31,864.0

Resisting/Overturning Ratio = **2.65**
Vertical Loads used for Soil Pressure = 8,592.2 lbs

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

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.000	in

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

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

Project Name/Number : 2020-0198
Title Wall 4A - Seismic
Dsgnr: JAG
Description....

Date: 14 MAY 2020

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

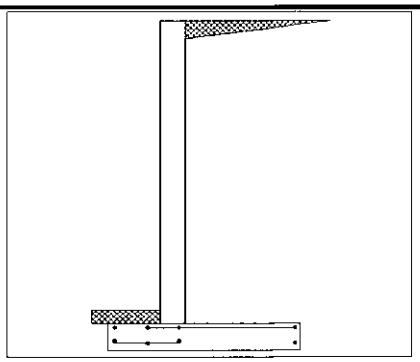
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	11.33 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	400.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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

Axial Load Applied to Stem

Axial Dead Load	=	255.0 lbs
Axial Live Load	=	425.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform
Multiplier Used = 6.000
(Multiplier used on soil density)

Uniform Seismic Force = 73.980
Total Seismic Force = 912.173

Design Summary

Wall Stability Ratios

Overturning	=	1.99 OK
Sliding	=	1.31 Ratio < 1.5!
Total Bearing Load	=	8,592 lbs
...resultant ecc.	=	0.00 in
Soil Pressure @ Toe	=	1,322 psf OK
Soil Pressure @ Heel	=	1,322 psf OK
Allowable	=	3,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,851 psf
ACI Factored @ Heel	=	1,851 psf
Footing Shear @ Toe	=	13.7 psi OK
Footing Shear @ Heel	=	1.3 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	3,478.8 lbs
less 100% Passive Force	= -	250.0 lbs
less 100% Friction Force	= -	4,296.1 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	672.2 lbs NG

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, E	1.000

Stem Construction

		Bottom
		As < Min %
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	10.00
Rebar Size	=	# 7
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	No Good
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	4,696.9
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	19,820.6
Moment.....Allowable	=	18,825.8
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	51.8
Shear.....Allowable	psi =	82.2
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	7.56
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	125.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	3,000.0
Fy	psi =	60,000.0

Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.6081 in2/ft	
(4/3) * As :	0.8107 in2/ft	Min Stem T&S Reinf Area 2.719 in2
200bd/fy : 200(12)(7.5625)/60000 :	0.3025 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.6081 in2/ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.6 in2/ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.2294 in2/ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	4.75
Total Footing Width	=	6.50
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,851	1,851 psf
Mu' : Upward	=	2,834	14,195 ft-#
Mu' : Downward	=	386	14,508 ft-#
Mu: Design	=	2,448	314 ft-#
Actual 1-Way Shear	=	13.67	1.33 psi
Allow 1-Way Shear	=	40.00	40.00 psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 1.68 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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	10,934.7	Soil Over HL (ab. water tbl)	1,250.0	3.42	24,184.8
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	24,184.8
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Hee'	=		
Surcharge over Heel	=	179.8	6.17	1,108.5	Surcharge Over Heel	= 195.8	4.54	889.4
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 680.0	2.17	552.5
Added Lateral Load	=				* Axial Live Load on Stem	= 425.0	2.17	920.8
Load @ Stem Above Soil	=				Soil Over Toe	=	0.88	
Seismic Earth Load	=	638.5	6.17	3,936.5	Surcharge Over Toe	=		
	=				Stem Weight(s)	= 1,416.3	2.17	3,068.5
					Earth @ Stem Transitions	=		
Total	=	3,478.8	**O.T.M.** =	15,979.7	Footing Weight	= 975.0	3.25	3,168.8
					Key Weight	=		
					Vert. Component	=		
					Total =	8,592.2 lbs	**R.M.=**	31,864.0

Resisting/Overturning Ratio = **1.99**
Vertical Loads used for Soil Pressure = 8,592.2 lbs

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

If seismic is included, the OTM and sliding ratios 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.

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)	0.000	in

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

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

Project Name/Number : 2020-0198
Title Wall 4B - Loaded
Dsgnr: JAG
Description....

Date: 14 MAY 2020

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

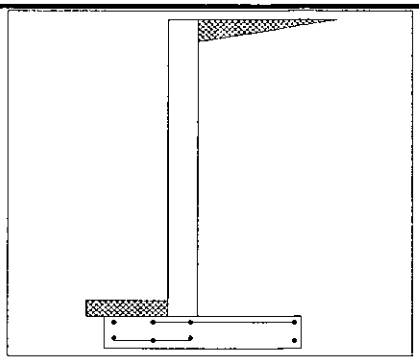
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	9.25 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	400.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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

Axial Load Applied to Stem

Axial Dead Load	=	255.0 lbs
Axial Live Load	=	425.0 lbs
Axial Load Eccentricity	=	0.0 in

Design Summary

Wall Stability Ratios

Overturning	=	2.70 OK
Sliding	=	1.65 OK
Total Bearing Load	=	6,045 lbs
...resultant ecc.	=	0.00 in
Soil Pressure @ Toe	=	1,099 psf OK
Soil Pressure @ Heel	=	1,099 psf OK
Allowable	=	3,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,539 psf
ACI Factored @ Heel	=	1,539 psf
Footing Shear @ Toe	=	11.0 psi OK
Footing Shear @ Heel	=	1.3 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	1,988.1 lbs
less 100% Passive Force	= -	250.0 lbs
less 100% Friction Force	= -	3,022.3 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	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, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	10.00
Rebar Size	=	# 6
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	0.553
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	2,611.6
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	8,385.1
Moment.....Allowable	=	15,129.3
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	28.5
Shear.....Allowable	psi =	82.2
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	7.63
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	125.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	3,000.0
Fy	psi =	60,000.0

Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.255 in2/ft	
(4/3) * As :	0.34 in2/ft	Min Stem T&S Reinf Area 2.220 in2
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.305 in2/ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.4693 in2/ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.2395 in2/ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	3.75
Total Footing Width	=	5.50
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,539	1,539 psf
Mu' : Upward	=	2,356	6,544 ft-#
Mu' : Downward	=	386	6,772 ft-#
Mu: Design	=	1,970	227 ft-#
Actual 1-Way Shear	=	10.96	1.30 psi
Allow 1-Way Shear	=	40.00	40.00 psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 1.43 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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	6,281.9	Soil Over HL (ab. water tbl)	1,250.0	3.42	13,084.9
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	13,084.9
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Hee'	=		
Surcharge over Heel	=	149.5	5.13	766.1	Surcharge Over Heel	= 145.8	4.04	589.4
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 680.0	2.17	552.5
Added Lateral Load	=				* Axial Live Load on Stem	= 425.0	2.17	920.8
Load @ Stem Above Soil	=				Soil Over Toe	=	0.88	
	=				Surcharge Over Toe	=		
					Stem Weight(s)	= 1,156.3	2.17	2,505.2
					Earth @ Stem Transitions	=		
					Footing Weight	= 825.0	2.75	2,268.8
					Key Weight	=		
					Vert. Component	=		
Total	=	1,988.1	**O.T.M.** =	7,047.9	**Total =**	6,044.6 lbs	**R.M.=**	19,000.8

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

Resisting/Overturning Ratio = **2.70**
Vertical Loads used for Soil Pressure = 6,044.6 lbs

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.000	in

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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

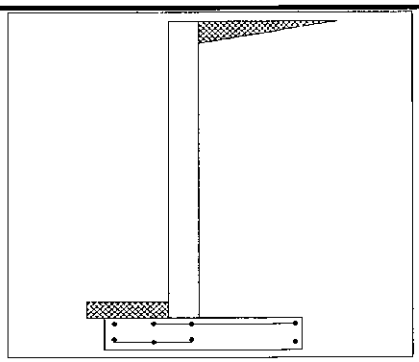
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	9.25 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	400.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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

Axial Load Applied to Stem

Axial Dead Load	=	255.0 lbs
Axial Live Load	=	425.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	6.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	61.500
Total Seismic Force	=	630.375

Design Summary

Wall Stability Ratios

Overturning	=	2.04 OK
Sliding	=	1.35 Ratio < 1.5!
Total Bearing Load	=	6,045 lbs
...resultant ecc.	=	0.00 in
Soil Pressure @ Toe	=	1,099 psf OK
Soil Pressure @ Heel	=	1,099 psf OK
Allowable	=	3,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,539 psf
ACI Factored @ Heel	=	1,539 psf
Footing Shear @ Toe	=	11.0 psi OK
Footing Shear @ Heel	=	1.3 psi OK
Allowable	=	75.0 psi

Sliding Calcs

Lateral Sliding Force	=	2,429.3 lbs
less 100% Passive Force	= -	250.0 lbs
less 100% Friction Force	= -	3,022.3 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 Stability	=	371.7 lbs NG

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, E	1.000

Stem Construction

Bottom

			Stem OK
Design Height Above Ftg	ft =		0.00
Wall Material Above "Ht"	=		Concrete
Design Method	=		LRFD
Thickness	=		10.00
Rebar Size	=		# 7
Rebar Spacing	=		12.00
Rebar Placed at	=		Edge
Design Data			
fb/FB + fa/Fa	=		0.584
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =		3,180.5
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =		11,016.2
Moment.....Allowable	=		18,825.8
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =		35.0
Shear.....Allowable	psi =		82.2
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =		7.56
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =		125.0
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=		Medium Weight
Masonry Design Method	=		ASD
Concrete Data			
f'c	psi =		3,000.0
Fy	psi =		60,000.0

Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.338 in2/ft		
(4/3) * As :	0.4506 in2/ft	Min Stem T&S Reinf Area 2.220 in2	
200bd/fy : 200(12)(7.5625)/60000 :	0.3025 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft	
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.338 in2/ft	#4@ 10.00 in	#4@ 20.00 in
Provided Area :	0.6 in2/ft	#5@ 15.50 in	#5@ 31.00 in
Maximum Area :	1.2294 in2/ft	#6@ 22.00 in	#6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	3.75
Total Footing Width	=	5.50
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,539	1,539 psf
Mu' : Upward	=	2,356	6,544 ft-#
Mu' : Downward	=	386	6,772 ft-#
Mu: Design	=	1,970	227 ft-#
Actual 1-Way Shear	=	10.96	1.30 psi
Allow 1-Way Shear	=	40.00	40.00 psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 1.43 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

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Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	6,281.9	Soil Over HL (ab. water tbl)	1,250.0	3.42	13,084.9
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	13,084.9
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel =			
Surcharge over Heel	=	149.5	5.13	766.1	Surcharge Over Heel =	145.8	4.04	589.4
Surcharge Over Toe	=				Adjacent Footing Load =			
Adjacent Footing Load	=				Axial Dead Load on Stem =	680.0	2.17	552.5
Added Lateral Load	=				* Axial Live Load on Stem =	425.0	2.17	920.8
Load @ Stem Above Soil	=				Soil Over Toe =		0.88	
Seismic Earth Load	=	441.3	5.13	2,261.5	Surcharge Over Toe =			
	=				Stem Weight(s) =	1,156.3	2.17	2,505.2
					Earth @ Stem Transitions =			
					Footing Weight =	825.0	2.75	2,268.8
					Key Weight =			
					Vert. Component =			
Total	=	2,429.3	**O.T.M.** =	9,309.4	**Total =**	6,044.6 lbs	**R.M.=**	19,000.8

Resisting/Overturning Ratio = **2.04**
Vertical Loads used for Soil Pressure = 6,044.6 lbs

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

If seismic is included, the OTM and sliding ratios 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.

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)	0.000	in

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

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

Project Name/Number : 2020-0198
Title Wall 4C - Loaded
Dsgnr: JAG
Description....

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

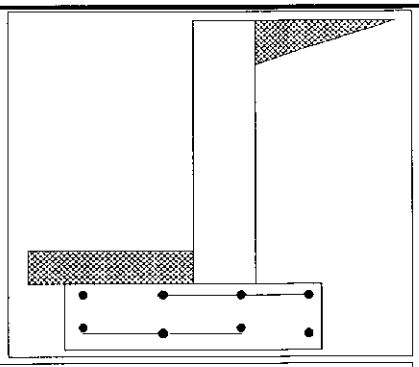
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	400.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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

Axial Load Applied to Stem

Axial Dead Load	=	255.0 lbs
Axial Live Load	=	425.0 lbs
Axial Load Eccentricity	=	0.0 in

Design Summary

Wall Stability Ratios

Overturning	=	4.42	OK
Sliding	=	2.64	OK
Total Bearing Load	=	2,191 lbs	
...resultant ecc.	=	0.00 in	
Soil Pressure @ Toe	=	626 psf	OK
Soil Pressure @ Heel	=	626 psf	OK
Allowable	=	3,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	876 psf	
ACI Factored @ Heel	=	876 psf	
Footing Shear @ Toe	=	5.2 psi	OK
Footing Shear @ Heel	=	0.3 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	510.4 lbs	
less 100% Passive Force	= -	250.0 lbs	
less 100% Friction Force	= -	1,095.4 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	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, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	10.00
Rebar Size	=	# 6
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	0.054
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	541.3
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	784.0
Moment.....Allowable	=	14,240.8
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	5.9
Shear.....Allowable	psi =	82.2
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	7.63
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	125.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	3,000.0
Fy	psi =	60,000.0

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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	Horizontal Reinforcing
As (based on applied moment) :	0.0238 in2/ft	
(4/3) * As :	0.0318 in2/ft	Min Stem T&S Reinf Area 0.960 in2
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.216 in2/ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.44 in2/ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.2395 in2/ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	1.75
Total Footing Width	=	3.50
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	876	876 psf
Mu' : Upward	=	1,342	368 ft-#
Mu' : Downward	=	386	351 ft-#
Mu: Design	=	956	-17 ft-#
Actual 1-Way Shear	=	5.21	0.31 psi
Allow 1-Way Shear	=	40.00	40.00 psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 0.91 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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

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

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	729.2	Soil Over HL (ab. water tbl)	1,250.0	3.42	1,338.3
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	1,338.3
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	72.9	2.50	182.3	Surcharge Over Heel	= 45.8	3.04	139.4
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 680.0	2.17	552.5
Added Lateral Load	=				* Axial Live Load on Stem	= 425.0	2.17	920.8
Load @ Stem Above Soil	=				Soil Over Toe	=	0.88	
	=				Surcharge Over Toe	=		
					Stem Weight(s)	= 500.0	2.17	1,083.3
					Earth @ Stem Transitions	=		
					Footing Weight	= 525.0	1.75	918.8
					Key Weight	=		
					Vert. Component	=		
Total	=	510.4	O.T.M. =	911.5	Total =	2,190.8 lbs	R.M.=	4,032.3

Resisting/Overturning Ratio = **4.42**
Vertical Loads used for Soil Pressure = 2,190.8 lbs

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

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

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

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.000	in

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

This Wall in File: M:\PROJECTS\Altman, Benjamin\2020-0198 Altman Middle Lot\Documents\calcs\2020-019

Cantilevered Retaining Wall

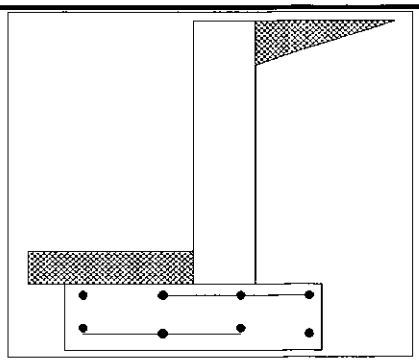
Code: IBC 2015,ACI 318-14,ACI 530-13

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 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	=	400.0 psf/ft
Soil Density, Heel	=	120.00 pcf
Soil Density, Toe	=	0.00 pcf
Footing||Soil Friction	=	0.500
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	50.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

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

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

Axial Load Applied to Stem

Axial Dead Load	=	255.0 lbs
Axial Live Load	=	425.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	6.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	30.000
Total Seismic Force	=	150.000

Design Summary

Wall Stability Ratios

Overturning	=	3.43	OK
Sliding	=	2.19	OK
Total Bearing Load	=	2,191 lbs	
...resultant ecc.	=	0.00 in	
Soil Pressure @ Toe	=	626 psf	OK
Soil Pressure @ Heel	=	626 psf	OK
Allowable	=	3,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	876 psf	
ACI Factored @ Heel	=	876 psf	
Footing Shear @ Toe	=	5.2 psi	OK
Footing Shear @ Heel	=	0.3 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	615.4 lbs	
less 100% Passive Force	= -	250.0 lbs	
less 100% Friction Force	= -	1,095.4 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	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, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	10.00
Rebar Size	=	# 6
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	0.071
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	661.3
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	1,024.0
Moment.....Allowable	=	14,240.8
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	7.2
Shear.....Allowable	psi =	82.2
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	7.63
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	125.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	3,000.0
Fy	psi =	60,000.0

Cantilevered Retaining Wall

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

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0311 in2/ft	
(4/3) * As :	0.0415 in2/ft	Min Stem T&S Reinf Area 0.960 in2
200bd/fy : 200(12)(7.625)/60000 :	0.305 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft
0.0018bh : 0.0018(12)(10) :	0.216 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.216 in2/ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.44 in2/ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.2395 in2/ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	1.75 ft
Heel Width	=	1.75
Total Footing Width	=	3.50
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 = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	876	876 psf
Mu' : Upward	=	1,342	368 ft-#
Mu' : Downward	=	386	351 ft-#
Mu: Design	=	956	-17 ft-#
Actual 1-Way Shear	=	5.21	0.31 psi
Allow 1-Way Shear	=	40.00	40.00 psi

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

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

Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.34 in, #6@ 20.36 in, #7@ 27.77 in, #8@ 36.56 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 0.91 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

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		919.8	2.42	729.2	Soil Over HL (ab. water tbl)	1,250.0	3.42	1,338.3
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		3.42	1,338.3
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=	72.9	2.50	182.3	Surcharge Over Heel	= 45.8	3.04	139.4
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	= 680.0	2.17	552.5
Added Lateral Load	=				* Axial Live Load on Stem	= 425.0	2.17	920.8
Load @ Stem Above Soil	=				Soil Over Toe	=	0.88	
Seismic Earth Load	=	105.0	2.50	262.5	Surcharge Over Toe	=		
	=				Stem Weight(s)	= 500.0	2.17	1,083.3
					Earth @ Stem Transitions	=		
Total	=	615.4	O.T.M. =	1,174.0	Footing Weight	= 525.0	1.75	918.8
					Key Weight	=		
					Vert. Component	=		
					Total =	2,190.8 lbs	R.M.=	4,032.3

Resisting/Overturning Ratio = **3.43**
Vertical Loads used for Soil Pressure = 2,190.8 lbs

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

If seismic is included, the OTM and sliding ratios 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.

Tilt

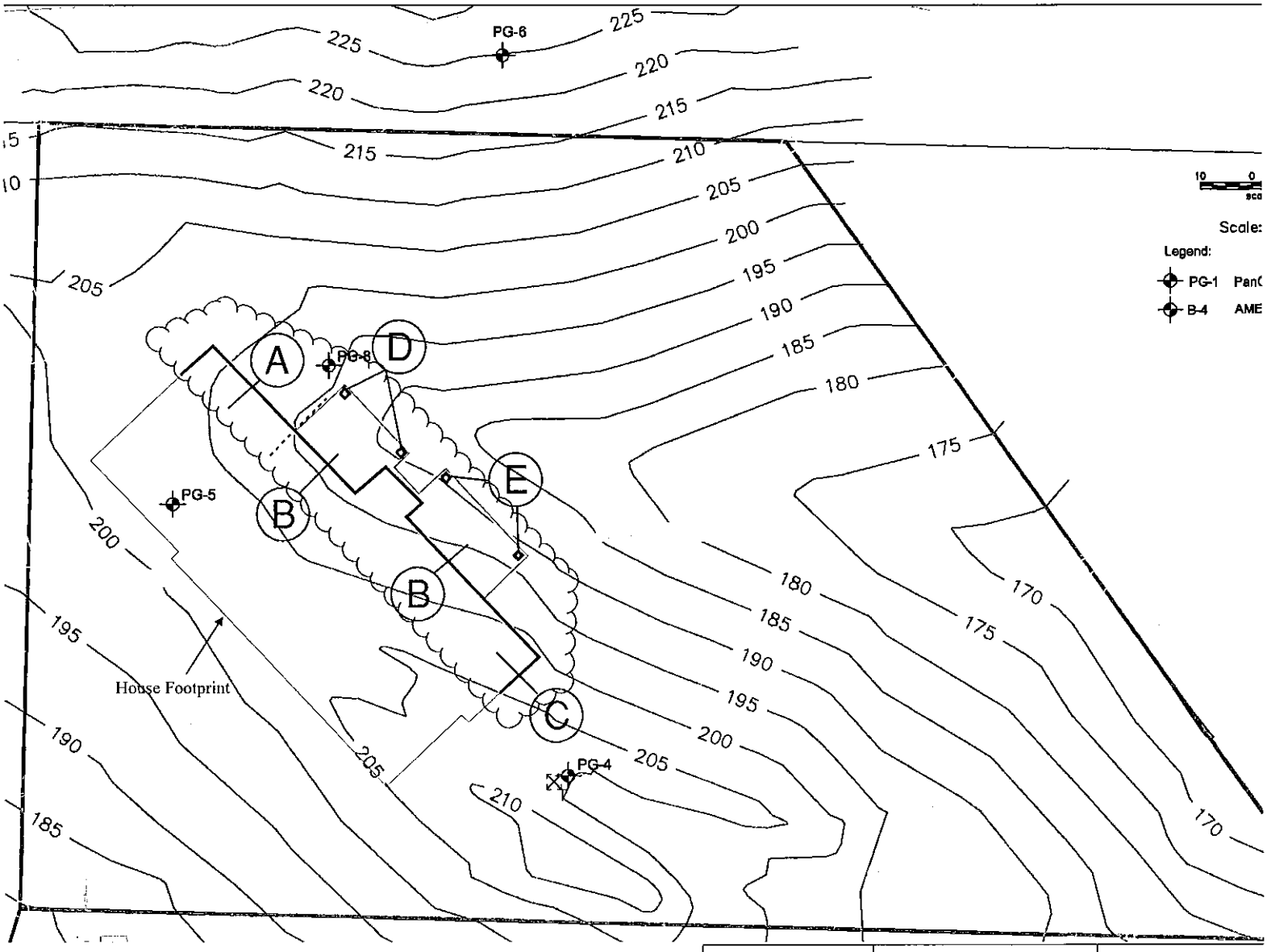
Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.000	in

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

PIN PILE LAYC



MC SQUARED, INC.
OLYMPIA, WASHINGTON 98506
(360) 754-9339
FAX (360) 352-2044

Job:	Altman Middle Lot		2020-0198
Date:	5/21/2020	By:	JAG
Sheet:	Roof Framing	Page	of

LOCATION: **A** (4" Φ pin-piles, **16k**)

TW1 = 17.0 ft
DL = 255 plf
SL = 425 plf

TW2 = 0.0 ft
DL = 0 plf
LL = 0 plf

RET WALL= 11.0 ft
SOIL BEARING LOAD = 1372 plf

SUM = 2052 plf *Pile Spacing =* **4.9 ft**
Use **3.2 ft** (For 1.5 F.S.)

LOCATION: **B** (4" Φ pin-piles, **16k**)

TW1 = 20.0 ft
DL = 300 plf
SL = 500 plf

TW2 = 6.0 ft
DL = 60 plf
LL = 360 plf

WALL HT = 10.0 ft
DL = 120 plf

SUM = 1125 plf *Pile Spacing =* **8.9 ft**

→ Use 6' spacing for concrete strength
See Enercalc

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ENERCALC, INC. 1983-2017, Build:6.17.3.29, Ver:6.17.3.29

Concrete Beam

Lic. # : KW-06005122
Licensee : MC SQUARED, INC.

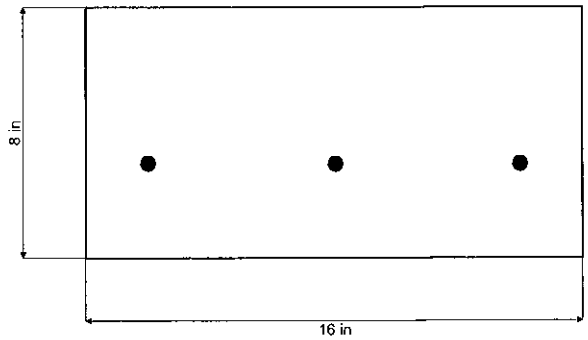
Description : 6' Pin Pile Spacing @ 16" footing

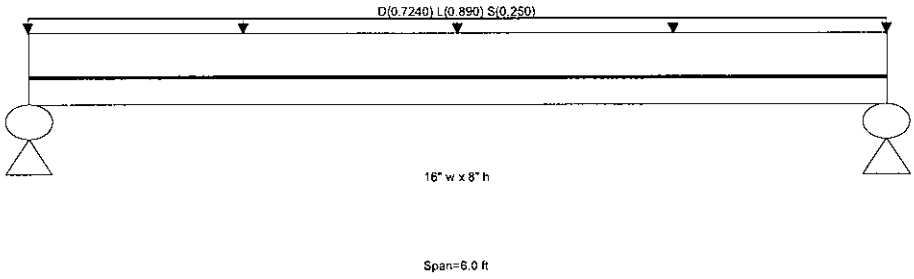
CODE REFERENCES

Calculations per ACI 318-14, IBC 2015, ASCE 7-10
Load Combination Set : IBC 2015

Material Properties

f'c	= 3.0 ksi	ϕ Phi Values	Flexure :	0.90	
fr = f'c $^{1/2}$ * 7.50	= 410.792 psi		Shear :	0.750	
ψ Density	= 145.0 pcf	β_1	=	0.850	
λ LtWt Factor	= 1.0				
Elastic Modulus	= 3,122.0 ksi	Fy - Stirrups		40.0 ksi	
fy - Main Rebar	= 60.0 ksi	E - Stirrups	=	29,000.0 ksi	
E - Main Rebar	= 29,000.0 ksi	Stirrup Bar Size #		3	
		Number of Resisting Legs Per Stirrup	=	2	





Cross Section & Reinforcing Details

Rectangular Section, Width = 16.0 in, Height = 8.0 in
Span #1 Reinforcing....
3-#4 at 3.0 in from Bottom, from 0.0 to 6.0 ft in this span

Applied Loads

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

Loads on all spans...
D = 0.7240, L = 0.890, S = 0.250
Uniform Load on ALL spans : D = 0.7240, L = 0.890, S = 0.250 k/ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	= 0.884 : 1	Maximum Deflection			
Section used for this span	Typical Section	Max Downward Transient Deflection	0.012 in	Ratio =	5914 >=36
Mu : Applied	10.880 k-ft	Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Mn * Phi : Allowable	12.309 k-ft	Max Downward Total Deflection	0.035 in	Ratio =	2075 >=36
Location of maximum on span	2.995 ft	Max Upward Total Deflection	0.000 in	Ratio =	999 <360
Span # where maximum occurs	Span # 1				

Vertical Reactions

Support notation : Far left is #1

Load Combination	Support 1	Support 2
Overall MAXimum	4.842	4.842
Overall MINimum	0.750	0.750
+D+H	2.172	2.172
+D+L+H	4.842	4.842
+D+Lr+H	2.172	2.172
+D+S+H	2.922	2.922
+D+0.750Lr+0.750L+H	4.175	4.175
+D+0.750L+0.750S+H	4.737	4.737
+D+0.60W+H	2.172	2.172
+D+0.70E+H	2.172	2.172
+D+0.750Lr+0.750L+0.450W+H	4.175	4.175
+D+0.750L+0.750S+0.450W+H	4.737	4.737
+D+0.750L+0.750S+0.5250E+H	4.737	4.737

Concrete Beam

Lic. # : KW-06005122 — **Licensee : MC SQUARED, INC.**

Description : 6' Pin Pile Spacing @ 16" footing

Vertical Reactions

Support notation : Far left is #1

Load Combination	Support 1	Support 2
+0.60D+0.60W+0.60H	1.303	1.303
+0.60D+0.70E+0.60H	1.303	1.303
D Only	2.172	2.172
Lr Only		
L Only	2.670	2.670
S Only	0.750	0.750
W Only		
E Only		
H Only		

Shear Stirrup Requirements

Entire Beam Span Length : PhiVc/2 < Vu <= PhiVc, Req'd Vs = Ht<=10", Not Reqd, use stirrups spaced at 0.000 in

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Location (ft) in Span	Bending Stress Results (k-ft) Mu : Max	Phi*Mnx	Stress Ratio
MAXimum BENDING Envelope					
Span # 1	1	6.000	10.88	12.31	0.88
+1.40D+1.60H					
Span # 1	1	6.000	4.56	12.31	0.37
+1.20D+0.50Lr+1.60L+1.60H					
Span # 1	1	6.000	10.32	12.31	0.84
+1.20D+1.60L+0.50S+1.60H					
Span # 1	1	6.000	10.88	12.31	0.88
+1.20D+1.60Lr+0.50L+1.60H					
Span # 1	1	6.000	5.91	12.31	0.48
+1.20D+1.60Lr+0.50W+1.60H					
Span # 1	1	6.000	3.91	12.31	0.32
+1.20D+0.50L+1.60S+1.60H					
Span # 1	1	6.000	7.71	12.31	0.63
+1.20D+1.60S+0.50W+1.60H					
Span # 1	1	6.000	5.71	12.31	0.46
+1.20D+0.50Lr+0.50L+W+1.60H					
Span # 1	1	6.000	5.91	12.31	0.48
+1.20D+0.50L+0.50S+W+1.60H					
Span # 1	1	6.000	6.47	12.31	0.53
+1.20D+0.50L+0.70S+E+1.60H					
Span # 1	1	6.000	6.70	12.31	0.54
+0.90D+W+0.90H					
Span # 1	1	6.000	2.93	12.31	0.24
+0.90D+E+0.90H					
Span # 1	1	6.000	2.93	12.31	0.24

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	1	0.0347	3.000		0.0000	0.000

MC SQUARED, INC.
OLYMPIA, WASHINGTON 98506
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Job:	Altman Middle Lot		2020-0198
Date:	5/21/2020	By:	JAG
Sheet:	Roof Framing	Page	of

LOCATION: **C** (4" Φ pin-piles, **16k**)

TW1 = 2.0 ft
DL = 30 plf
SL = 50 plf

TW2 = 8.0 ft
DL = 120 plf
LL = 320 plf

WALL HT = 11.0 ft
DL = 132 plf

RET WALL = 11.0 ft
SOIL BEARING LOAD = 1506 plf

SUM = 2108 plf *Pile Spacing =* **4.7 ft**
Use **3.2 ft** (For 1.5 F.S.)

LOCATION: **D,E** (4" Φ pin-piles, **16k**)

PL_D = 3500 # (VIA M)

PL_E = 4240 # (VIA L)

(1) PILE GOOD @ EACH

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Concrete Beam

Lic. # : KW-06005122
Licensee : MC SQUARED, INC.

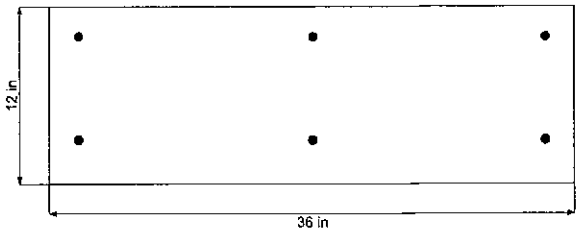
Description : 3' Spacing @ A, C, D, E

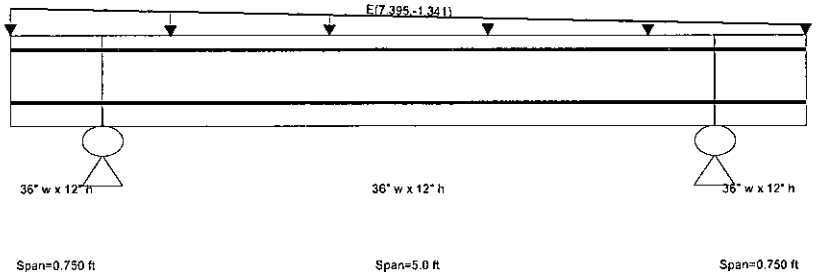
CODE REFERENCES

Calculations per ACI 318-14, IBC 2015, ASCE 7-10
Load Combination Set : IBC 2015

Material Properties

f'c	= 3.0 ksi	ϕ Phi Values	Flexure :	0.90	
fr = f'c^1/2 * 7.50	= 410.792 psi		Shear :	0.750	
ψ Density	= 145.0 pcf	β 1	=	0.850	
λ LtWt Factor	= 1.0				
Elastic Modulus	= 3,122.0 ksi	Fy - Stirrups		40.0 ksi	
fy - Main Rebar	= 60.0 ksi	E - Stirrups	=	29,000.0 ksi	
E - Main Rebar	= 29,000.0 ksi	Stirrup Bar Size #		3	
		Number of Resisting Legs Per Stirrup =		2	





Cross Section & Reinforcing Details

Rectangular Section, Width = 36.0 in, Height = 12.0 in

Span #1 Reinforcing....
3-#5 at 3.0 in from Bottom, from 0.0 to 0.750 ft in this span
3-#5 at 2.0 in from Top, from 0.0 to 0.750 ft in this span

Span #2 Reinforcing....
3-#5 at 3.0 in from Bottom, from 0.0 to 5.0 ft in this span
3-#5 at 2.0 in from Top, from 0.0 to 5.0 ft in this span

Span #3 Reinforcing....
3-#5 at 3.0 in from Bottom, from 0.0 to 0.750 ft in this span
3-#5 at 2.0 in from Top, from 0.0 to 0.750 ft in this span

Applied Loads

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

Loads on all spans...
Varying Uniform Load : E(S,E) = 7.395->-1.341 k/ft, Extent = 0.0 -->> 6.50 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.217** : 1	Maximum Deflection			
Section used for this span	**Typical Section**	Max Downward Transient Deflection	0.002 in	Ratio =	25624 >=36
Mu : Applied	8.750 k-ft	Max Upward Transient Deflection	-0.001 in	Ratio =	16670 >=36
Mn * Phi : Allowable	40.245 k-ft	Max Downward Total Deflection	0.000 in	Ratio =	999 <360
Location of maximum on span	2.200 ft	Max Upward Total Deflection	0.000 in	Ratio =	999 <360
Span # where maximum occurs	Span # 2				

Vertical Reactions

Support notation : Far left is #1

Load Combination	Support 1	Support 2	Support 3	Support 4
Overall MAXimum		15.989	3.686	
Overall MINimum		8.394	1.935	
+D+H				
+D+L+H				
+D+Lr+H				
+D+S+H				
+D+0.750Lr+0.750L+H				
+D+0.750L+0.750S+H				
+D+0.60W+H				
+D+0.70E+H		11.193	2.580	

Concrete Beam

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Lic. # : KW-06005122
Licensee : MC SQUARED, INC.

Description : 3' Spacing @ Wall 1

Vertical Reactions

Support notation : Far left is #1

Load Combination	Support 1	Support 2	Support 3	Support 4
+D+0.750Lr+0.750L+0.450W+H				
+D+0.750L+0.750S+0.450W+H				
+D+0.750L+0.750S+0.5250E+H		8.394	1.935	
+0.60D+0.60W+0.60H				
+0.60D+0.70E+0.60H		11.193	2.580	
D Only				
Lr Only				
L Only				
S Only				
W Only				
E Only		15.989	3.686	
H Only				

Shear Stirrup Requirements

Entire Beam Span Length : Vu < PhiVc/2, Req'd Vs = Not Reqd 9.6.3.1, use stirrups spaced at 0.000 in

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Location (ft) in Span	Bending Stress Results (k-ft) Mu : Max	Phi*Mnx	Stress Ratio
MAXimum BENDING Envelope					
Span # 1	1	0.750	-1.96	49.32	0.04
Span # 2	2	5.000	8.75	40.24	0.22
Span # 3	3	0.750	0.28	40.24	0.01
+1.40D+1.60H					
Span # 1	1	0.750	0.28	40.24	0.01
Span # 2	2	5.000	0.28	40.24	0.01
Span # 3	3	0.750	0.28	40.24	0.01
+1.20D+0.50Lr+1.60L+1.60H					
Span # 1	1	0.750	0.28	40.24	0.01
Span # 2	2	5.000	0.28	40.24	0.01
Span # 3	3	0.750	0.28	40.24	0.01
+1.20D+1.60L+0.50S+1.60H					
Span # 1	1	0.750	0.28	40.24	0.01
Span # 2	2	5.000	0.28	40.24	0.01
Span # 3	3	0.750	0.28	40.24	0.01
+1.20D+1.60Lr+0.50L+1.60H					
Span # 1	1	0.750	0.28	40.24	0.01
Span # 2	2	5.000	0.28	40.24	0.01
Span # 3	3	0.750	0.28	40.24	0.01
+1.20D+1.60Lr+0.50W+1.60H					
Span # 1	1	0.750	0.28	40.24	0.01
Span # 2	2	5.000	0.28	40.24	0.01
Span # 3	3	0.750	0.28	40.24	0.01
+1.20D+0.50L+1.60S+1.60H					
Span # 1	1	0.750	0.28	40.24	0.01
Span # 2	2	5.000	0.28	40.24	0.01
Span # 3	3	0.750	0.28	40.24	0.01
+1.20D+1.60S+0.50W+1.60H					
Span # 1	1	0.750	0.28	40.24	0.01
Span # 2	2	5.000	0.28	40.24	0.01
Span # 3	3	0.750	0.28	40.24	0.01
+1.20D+0.50Lr+0.50L+W+1.60H					
Span # 1	1	0.750	0.28	40.24	0.01
Span # 2	2	5.000	0.28	40.24	0.01
Span # 3	3	0.750	0.28	40.24	0.01
+1.20D+0.50L+0.50S+W+1.60H					
Span # 1	1	0.750	0.28	40.24	0.01
Span # 2	2	5.000	0.28	40.24	0.01
Span # 3	3	0.750	0.28	40.24	0.01
+1.20D+0.50L+0.70S+E+1.60H					
Span # 1	1	0.750	-1.96	49.32	0.04
Span # 2	2	5.000	8.75	40.24	0.22
Span # 3	3	0.750	0.28	40.24	0.01
+0.90D+W+0.90H					
Span # 1	1	0.750	0.28	40.24	0.01
Span # 2	2	5.000	0.28	40.24	0.01
Span # 3	3	0.750	0.28	40.24	0.01

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Concrete Beam

Lic. # : KW-06005122
Licensee : MC SQUARED, INC.

Description : 3' Spacing @ Wall 1

Load Combination / Segment Length	Span #	Location (ft) in Span	Bending Stress Results (k-ft) Mu : Max	Phi*Mnx	Stress Ratio
+0.90D+E+0.90H					
Span # 1	1	0.750	-1.96	49.32	0.04
Span # 2	2	5.000	8.75	40.24	0.22
Span # 3	3	0.750	0.28	40.24	0.01

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
E Only	1	0.0001	0.850	E Only	-0.0011	0.000
E Only	2	0.0023	2.500	E Only	-0.0000	5.015
	3	0.0000	2.500	E Only	-0.0011	0.750

PORTAL FRAME

H = 10'
LENGTH = 20" x 3 WALLS

Z* = 875 PLF (ALLOWABLE)

Z = 2177#/(3*1.667') = 435 PLF MAX

875 > 435, GOOD

USE MST37 STRAPS @ HEADERS
& STHD10 STRAPS @ FNDN

TABLE 1

RECOMMENDED ALLOWABLE DESIGN VALUES FOR A SINGLE LEG OF AN APA PORTAL FRAME USED ON A RIGID-BASE FOUNDATION FOR WIND OR SEISMIC LOADING[a,b,c,d]

Minimum Portal Width (in.)	Maximum Portal Height (ft)	Allowable Design (ASD) Values per Frame Segment		Load Factor
		Shear[e,f] (lbf)	Deflection (in.)	
16	8	850	0.33	3.09
	10	625	0.44	2.97
24	8	1,675	0.38	2.88
	10	1,125	0.51	3.42

a. Design values are based on the use of Douglas-fir or Southern pine framing. For other species of framing, multiply the above shear design value by the specific gravity adjustment factor = [1 – (0.5 – SG)], where SG = specific gravity of the actual framing. This adjustment shall not be greater than 1.0.

b. For construction as shown in Figure 1.

c. Values are for a single portal-frame segment (one vertical leg and a portion of the header). For multiple portal-frame segments, the allowable shear design values are permitted to be multiplied by the number of frame segments.

d. Interpolation of design values for heights between 8 and 10 feet, and for portal widths between 16 and 24 inches, is permitted.

e. The allowable shear design value is permitted to be multiplied by a factor of 1.4 for wind design.

f. If story drift is not a design consideration, the tabulated design shear values are permitted to be multiplied by a factor of 1.15. This factor is permitted to be used cumulatively with the wind-design adjustment factor in Footnote (e) above.

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