BYKONEN
CARTER
QUINN

STRUCTURAL
ENGINEERING

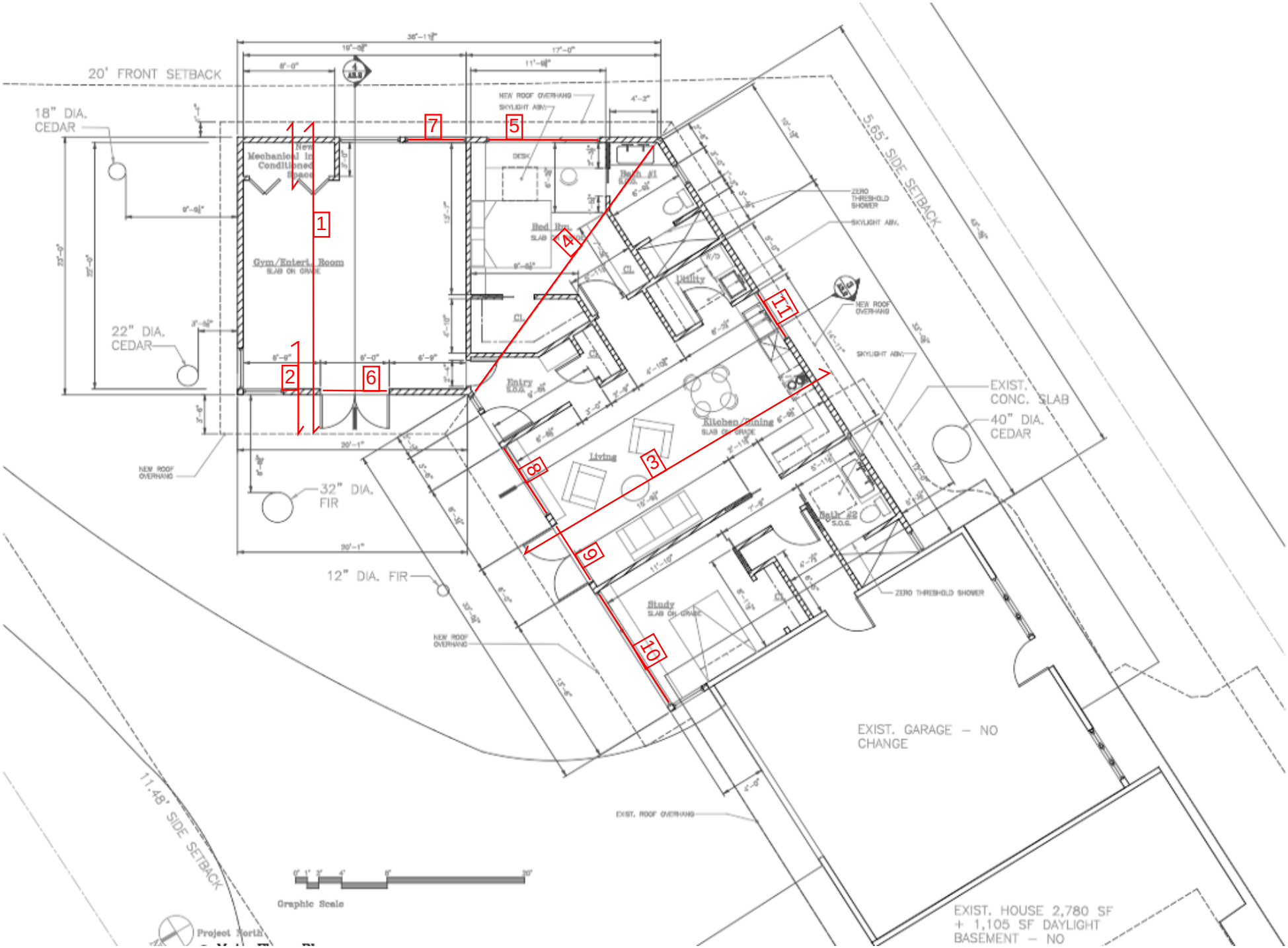
STRUCTURAL CALCULATIONS

Studio Ectypos
4212 W Mercer Way
Mercer Island, WA 98040

Morgan-Hornsby Addition
6405 W Mercer Way
Mercer Island, WA 98040

10/1/2022

2033 Sixth Avenue #995 Seattle, WA 98121 206-264-7784 www.BCQ-SE.com


20' FRONT SETBACK
18" DIA. CEDAR
22" DIA. CEDAR
32" DIA. FIR
12" DIA. FIR
40" DIA. CEDAR
5.65' SIDE SETBACK
11.48' SIDE SETBACK
EXIST. CONC. SLAB
EXIST. GARAGE – NO CHANGE
EXIST. HOUSE 2,780 SF + 1,105 SF DAYLIGHT BASEMENT – NO
EXIST. ROOF OVERHANG
NEW ROOF OVERHANG
SKYLIGHT ABV.
ZERO THRESHOLD SHOWER
Gym/Entert. Room
SLAB ON GRADE
Entry
Living
Kitchen/Dining
Utility
Study
Graphic Scale
Project North
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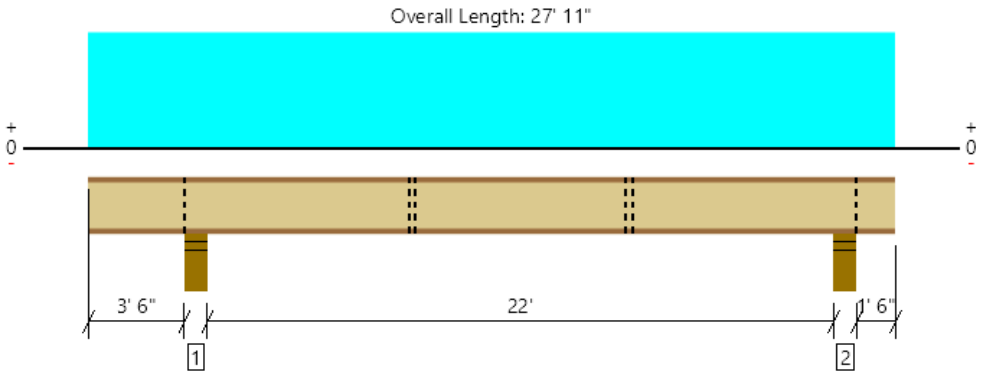
11

Roof, J1

1 piece(s) 16" TJI® 110 @ 16" OC



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	913 @ 3' 8 3/4"	2703 (5.25")	Passed (34%)	1.15	1.0 D + 1.0 S (Adj Spans)
Shear (lbs)	650 @ 3' 11 1/2"	2467	Passed (26%)	1.15	1.0 D + 1.0 S (Adj Spans)
Moment (Ft-lbs)	3601 @ 15' 1 5/8"	4922	Passed (73%)	1.15	1.0 D + 1.0 S (Alt Spans)
Live Load Defl. (in)	0.370 @ 15'	1.123	Passed (L/728)	--	1.0 D + 1.0 S (Alt Spans)
Total Load Defl. (in)	0.655 @ 15' 1/4"	1.497	Passed (L/411)	--	1.0 D + 1.0 S (Alt Spans)

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

- Deflection criteria: LL (L/240) and TL (L/180).
- Overhang deflection criteria: LL (2L/240) and TL (2L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Permanent bracing at third points in the back span or a direct applied ceiling over the entire back span length is required at the left span of the member. See literature detail (PB1) For clarification.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Stud wall - HF	5.50"	5.50"	3.50"	405	508	913	Blocking
2 - Stud wall - HF	5.50"	5.50"	3.50"	339	429	768	Blocking

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

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	3' 6" o/c	
Bottom Edge (Lu)	7' 4" o/c	

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

Vertical Load	Location	Spacing	Dead (0.90)	Snow (1.15)	Comments
1 - Uniform (PSF)	0 to 27' 11"	16"	20.0	25.0	Roof Load

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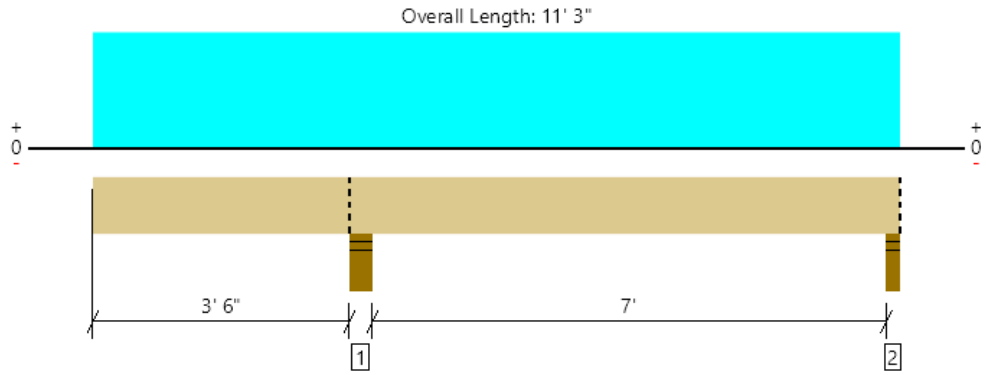
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Drew Carpenter Bykonen Carter Quinn (360) 633-5541 dc@bcq-se.com	

Weyerhaeuser

Roof, J2

1 piece(s) 2 x 8 HF No.2 @ 16" OC



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	500 @ 3' 8 3/4"	3341 (5.50")	Passed (15%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	226 @ 4' 6 3/4"	1251	Passed (18%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	-417 @ 3' 8 3/4"	1477	Passed (28%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.053 @ 0	0.373	Passed (2L/999+)	--	1.0 D + 1.0 S (Alt Spans)
Total Load Defl. (in)	0.073 @ 0	0.497	Passed (2L/999+)	--	1.0 D + 1.0 S (Alt Spans)

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

- Deflection criteria: LL (L/240) and TL (L/180).
- Overhang deflection criteria: LL (2L/240) and TL (2L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A 15% increase in the moment capacity has been added to account for repetitive member usage.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Stud wall - HF	5.50"	5.50"	1.50"	222	278	500	Blocking
2 - Stud wall - HF	3.50"	3.50"	1.50"	78	113	191	Blocking

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

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

•Maximum allowable bracing intervals based on applied load.

Vertical Load	Location (Side)	Spacing	Dead (0.90)	Snow (1.15)	Comments
1 - Uniform (PSF)	0 to 11' 3"	16"	20.0	25.0	Roof Load

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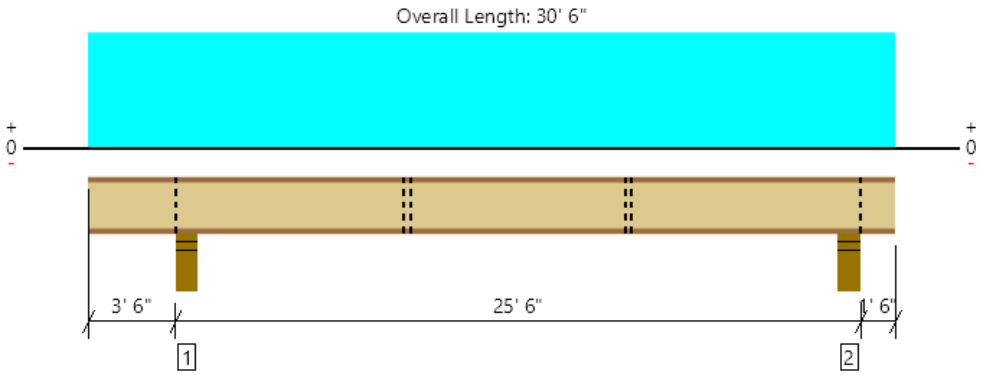
ForteWEB Software Operator	Job Notes
Drew Carpenter Bykonen Carter Quinn (360) 633-5541 dc@bcq-se.com	

Weyerhaeuser

Roof, J3

1 piece(s) 16" TJI® 110 @ 16" OC



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	989 @ 3' 8 3/4"	2703 (5.25")	Passed (37%)	1.15	1.0 D + 1.0 S (Adj Spans)
Shear (lbs)	723 @ 3' 11 1/2"	2467	Passed (29%)	1.15	1.0 D + 1.0 S (Adj Spans)
Moment (Ft-lbs)	4521 @ 16' 4 7/8"	4922	Passed (92%)	1.15	1.0 D + 1.0 S (Alt Spans)
Live Load Defl. (in)	0.568 @ 16' 3 7/16"	1.252	Passed (L/529)	--	1.0 D + 1.0 S (Alt Spans)
Total Load Defl. (in)	1.009 @ 16' 3 11/16"	1.669	Passed (L/298)	--	1.0 D + 1.0 S (Alt Spans)

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

- Deflection criteria: LL (L/240) and TL (L/180).
- Overhang deflection criteria: LL (2L/240) and TL (2L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Upward deflection on left cantilever exceeds 0.4".
- Permanent bracing at third points in the back span or a direct applied ceiling over the entire back span length is required at the left span of the member. See literature detail (PB1) For clarification.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Stud wall - HF	5.50"	5.50"	3.50"	439	550	989	Blocking
2 - Stud wall - HF	5.50"	5.50"	3.50"	374	472	847	Blocking

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

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	3' o/c	
Bottom Edge (Lu)	7' 4" o/c	

•TJI joists are only analyzed using Maximum Allowable bracing solutions.

•Maximum allowable bracing intervals based on applied load.

Vertical Load	Location	Spacing	Dead (0.90)	Snow (1.15)	Comments
1 - Uniform (PSF)	0 to 30' 6"	16"	20.0	25.0	Roof Load

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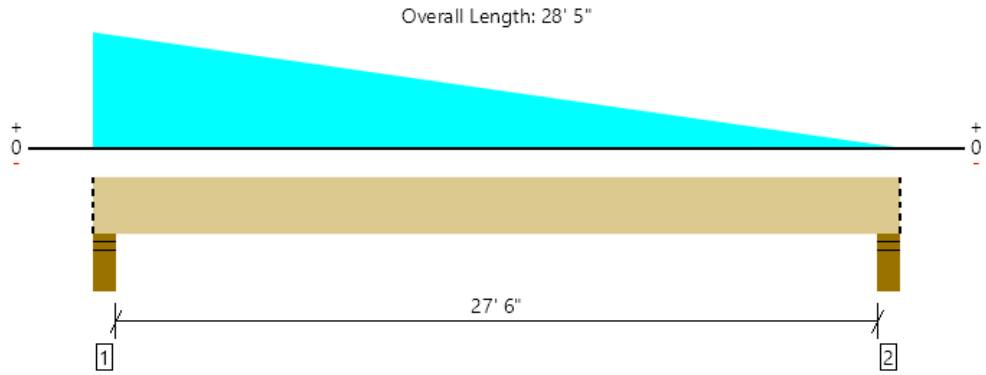
Roof, B4

1 piece(s) 7" x 16" 2.2E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	10679 @ 4"	15593 (5.50")	Passed (68%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	8762 @ 1' 9 1/2"	24901	Passed (35%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	56025 @ 12' 2 5/8"	80396	Passed (70%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.782 @ 13' 8 5/16"	1.388	Passed (L/426)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	1.499 @ 13' 8 11/16"	1.850	Passed (L/222)	--	1.0 D + 1.0 S (All Spans)

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

- Deflection criteria: LL (L/240) and TL (L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Member should be side-loaded from both sides of the member or braced to prevent rotation.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Stud wall - HF	5.50"	5.50"	3.77"	5022	5656	10679	Blocking
2 - Stud wall - HF	5.50"	5.50"	1.94"	2720	2779	5499	Blocking

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

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	28' 5" o/c	
Bottom Edge (Lu)	28' 5" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 28' 5"	N/A	35.0	--	
1 - Tapered (PSF)	0 to 28' 5" (Front)	23' 9" to 0	20.0	25.0	Roof Load

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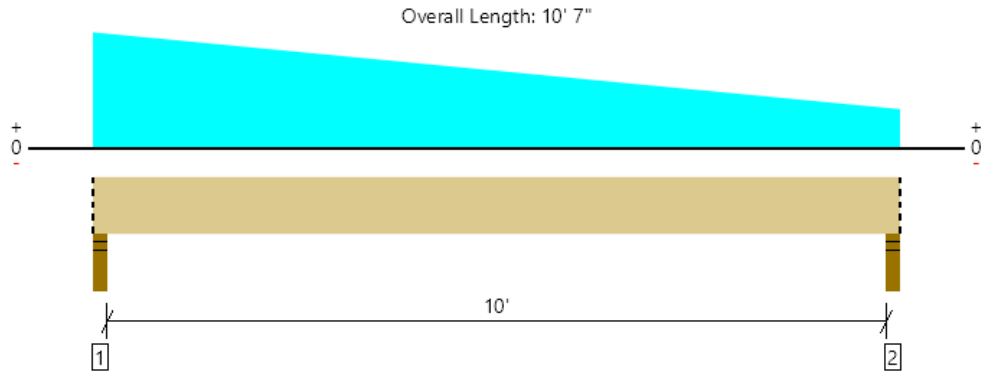
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Roof, B5

2 piece(s) 2 x 12 HF No.2



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1998 @ 2"	4253 (3.50")	Passed (47%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	1430 @ 1' 2 3/4"	3881	Passed (37%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	4275 @ 4' 10 3/4"	5155	Passed (83%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.094 @ 5' 2 5/16"	0.512	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.174 @ 5' 2 3/8"	0.683	Passed (L/708)	--	1.0 D + 1.0 S (All Spans)

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

- Deflection criteria: LL (L/240) and TL (L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Stud wall - HF	3.50"	3.50"	1.64"	913	1085	1998	Blocking
2 - Stud wall - HF	3.50"	3.50"	1.50"	659	767	1425	Blocking

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

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	7' 4" o/c	
Bottom Edge (Lu)	10' 7" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 10' 7"	N/A	8.6	--	
1 - Tapered (PSF)	0 to 10' 7" (Front)	10' 6" to 3' 6"	20.0	25.0	Roof Load

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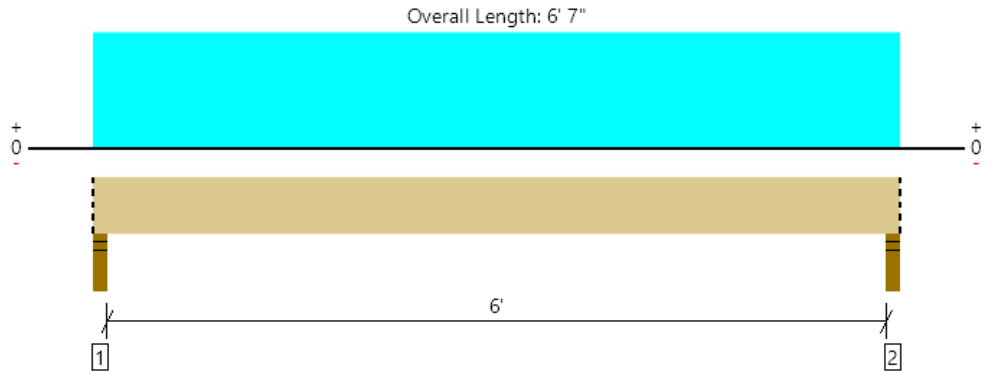
Roof, B6

2 piece(s) 2 x 10 HF No.2



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2171 @ 2"	4253 (3.50")	Passed (51%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	1470 @ 1' 3/4"	3191	Passed (46%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	3220 @ 3' 3 1/2"	3833	Passed (84%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.048 @ 3' 3 1/2"	0.313	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.088 @ 3' 3 1/2"	0.417	Passed (L/852)	--	1.0 D + 1.0 S (All Spans)

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

- Deflection criteria: LL (L/240) and TL (L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Stud wall - HF	3.50"	3.50"	1.79"	978	1193	2171	Blocking
2 - Stud wall - HF	3.50"	3.50"	1.79"	978	1193	2171	Blocking

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

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

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 6' 7"	N/A	7.0	--	
1 - Uniform (PSF)	0 to 6' 7" (Front)	14' 6"	20.0	25.0	Roof Load

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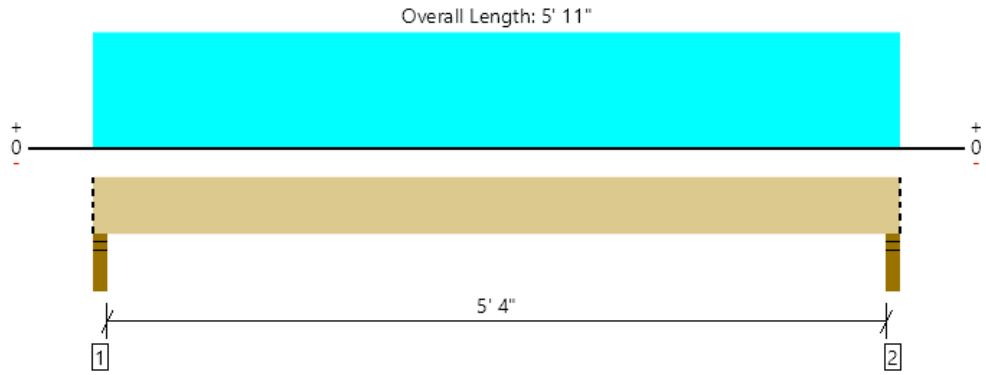
Roof, B7

2 piece(s) 2 x 8 HF No.2



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1680 @ 2"	4253 (3.50")	Passed (40%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	1172 @ 10 3/4"	2501	Passed (47%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	2213 @ 2' 11 1/2"	2569	Passed (86%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.055 @ 2' 11 1/2"	0.279	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.100 @ 2' 11 1/2"	0.372	Passed (L/668)	--	1.0 D + 1.0 S (All Spans)

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

- Deflection criteria: LL (L/240) and TL (L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Stud wall - HF	3.50"	3.50"	1.50"	756	924	1680	Blocking
2 - Stud wall - HF	3.50"	3.50"	1.50"	756	924	1680	Blocking

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

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	5' 11" o/c	
Bottom Edge (Lu)	5' 11" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 5' 11"	N/A	5.5	--	
1 - Uniform (PSF)	0 to 5' 11" (Front)	12' 6"	20.0	25.0	Roof Load

Weyerhaeuser Notes

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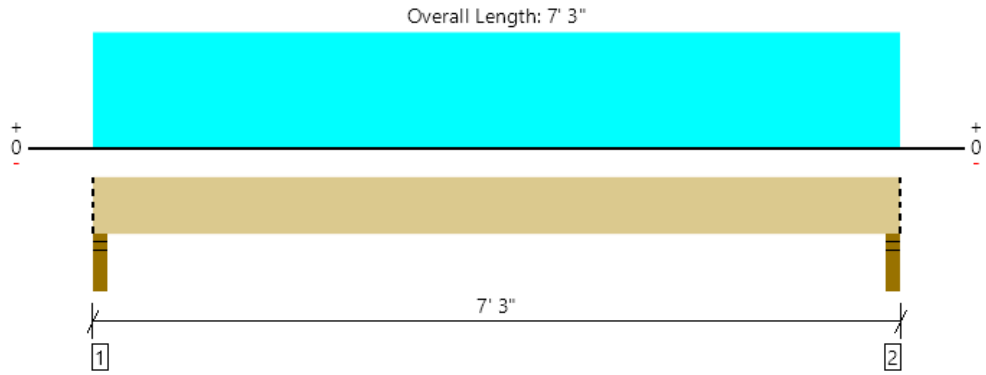
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Roof, B8

2 piece(s) 1 3/4" x 7 1/4" 2.0E Microllam® LVL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2678 @ 2"	4961 (3.50")	Passed (54%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	2016 @ 10 3/4"	5544	Passed (36%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	4417 @ 3' 7 1/2"	8182	Passed (54%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.105 @ 3' 7 1/2"	0.346	Passed (L/789)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.191 @ 3' 7 1/2"	0.461	Passed (L/434)	--	1.0 D + 1.0 S (All Spans)

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

- Deflection criteria: LL (L/240) and TL (L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Stud wall - HF	3.50"	3.50"	1.89"	1205	1473	2678	Blocking
2 - Stud wall - HF	3.50"	3.50"	1.89"	1205	1473	2678	Blocking

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

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	7' 3" o/c	
Bottom Edge (Lu)	7' 3" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 7' 3"	N/A	7.4	--	
1 - Uniform (PSF)	0 to 7' 3" (Front)	16' 3"	20.0	25.0	Roof Load

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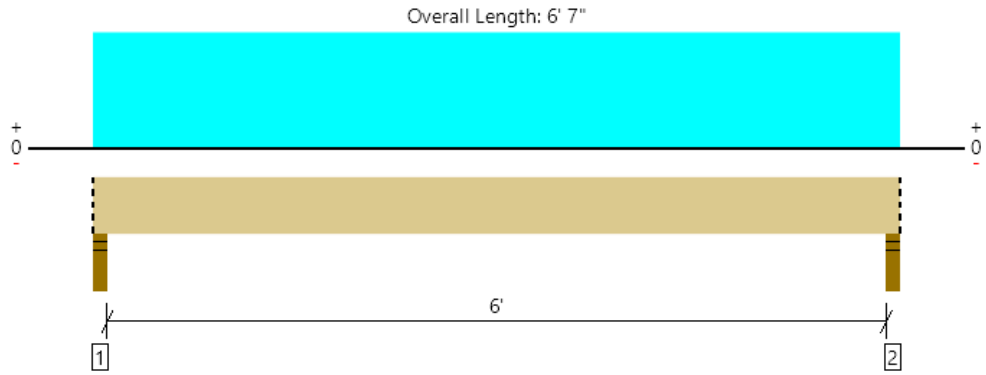
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Roof, B9

2 piece(s) 1 3/4" x 7 1/4" 2.0E Microllam® LVL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2431 @ 2"	4961 (3.50")	Passed (49%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	1770 @ 10 3/4"	5544	Passed (32%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	3607 @ 3' 3 1/2"	8182	Passed (44%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.072 @ 3' 3 1/2"	0.313	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.130 @ 3' 3 1/2"	0.417	Passed (L/575)	--	1.0 D + 1.0 S (All Spans)

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

- Deflection criteria: LL (L/240) and TL (L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Stud wall - HF	3.50"	3.50"	1.72"	1094	1337	2431	Blocking
2 - Stud wall - HF	3.50"	3.50"	1.72"	1094	1337	2431	Blocking

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

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

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 6' 7"	N/A	7.4	--	
1 - Uniform (PSF)	0 to 6' 7" (Front)	16' 3"	20.0	25.0	Roof Load

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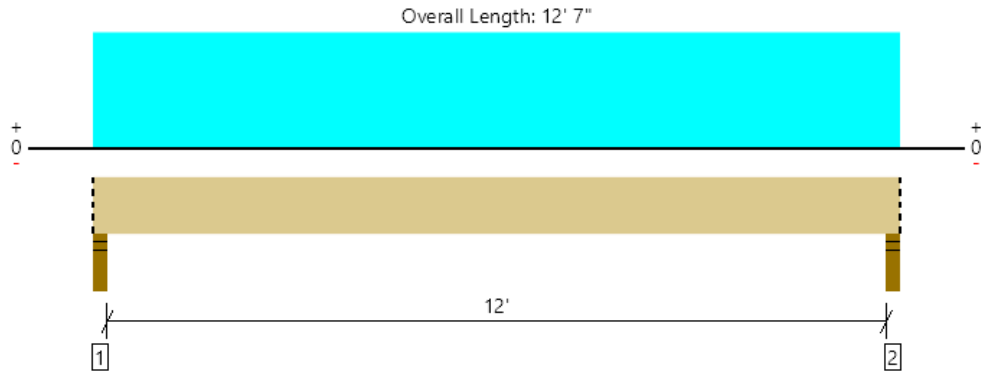
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Drew Carpenter Bykonen Carter Quinn (360) 633-5541 dc@bcq-se.com	

Weyerhaeuser

Roof, B10

3 piece(s) 1 3/4" x 9 1/4" 2.0E Microllam® LVL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	4690 @ 2"	7442 (3.50")	Passed (63%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	3898 @ 1' 3/4"	10611	Passed (37%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	13982 @ 6' 3 1/2"	19327	Passed (72%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.315 @ 6' 3 1/2"	0.613	Passed (L/466)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.579 @ 6' 3 1/2"	0.817	Passed (L/254)	--	1.0 D + 1.0 S (All Spans)

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

- Deflection criteria: LL (L/240) and TL (L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Stud wall - HF	3.50"	3.50"	2.21"	2134	2556	4690	Blocking
2 - Stud wall - HF	3.50"	3.50"	2.21"	2134	2556	4690	Blocking

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

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	12' 7" o/c	
Bottom Edge (Lu)	12' 7" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 12' 7"	N/A	14.2	--	
1 - Uniform (PSF)	0 to 12' 7" (Front)	16' 3"	20.0	25.0	Roof Load

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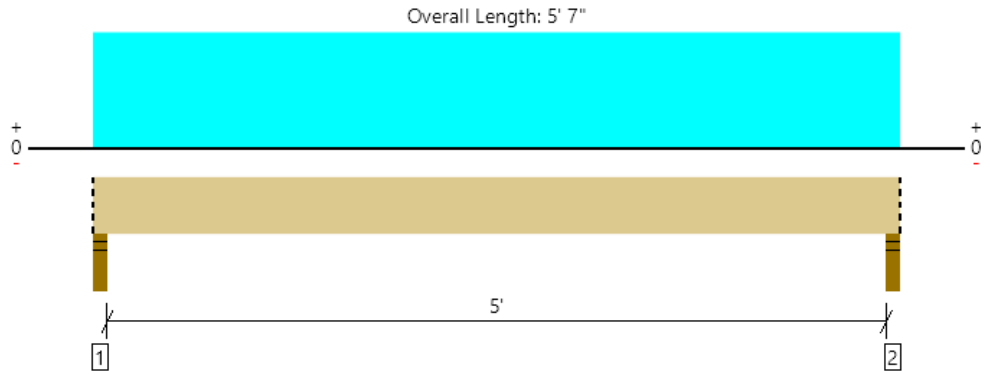
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Drew Carpenter Bykonen Carter Quinn (360) 633-5541 dc@bcq-se.com	

Weyerhaeuser

Roof, B11

2 piece(s) 2 x 8 HF No.2



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1806 @ 2"	4253 (3.50")	Passed (42%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	1226 @ 10 3/4"	2501	Passed (49%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	2228 @ 2' 9 1/2"	2569	Passed (87%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.049 @ 2' 9 1/2"	0.262	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.089 @ 2' 9 1/2"	0.350	Passed (L/706)	--	1.0 D + 1.0 S (All Spans)

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

- Deflection criteria: LL (L/240) and TL (L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Stud wall - HF	3.50"	3.50"	1.50"	811	995	1806	Blocking
2 - Stud wall - HF	3.50"	3.50"	1.50"	811	995	1806	Blocking

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

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	5' 7" o/c	
Bottom Edge (Lu)	5' 7" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 5' 7"	N/A	5.5	--	
1 - Uniform (PSF)	0 to 5' 7" (Front)	14' 3"	20.0	25.0	Roof Load

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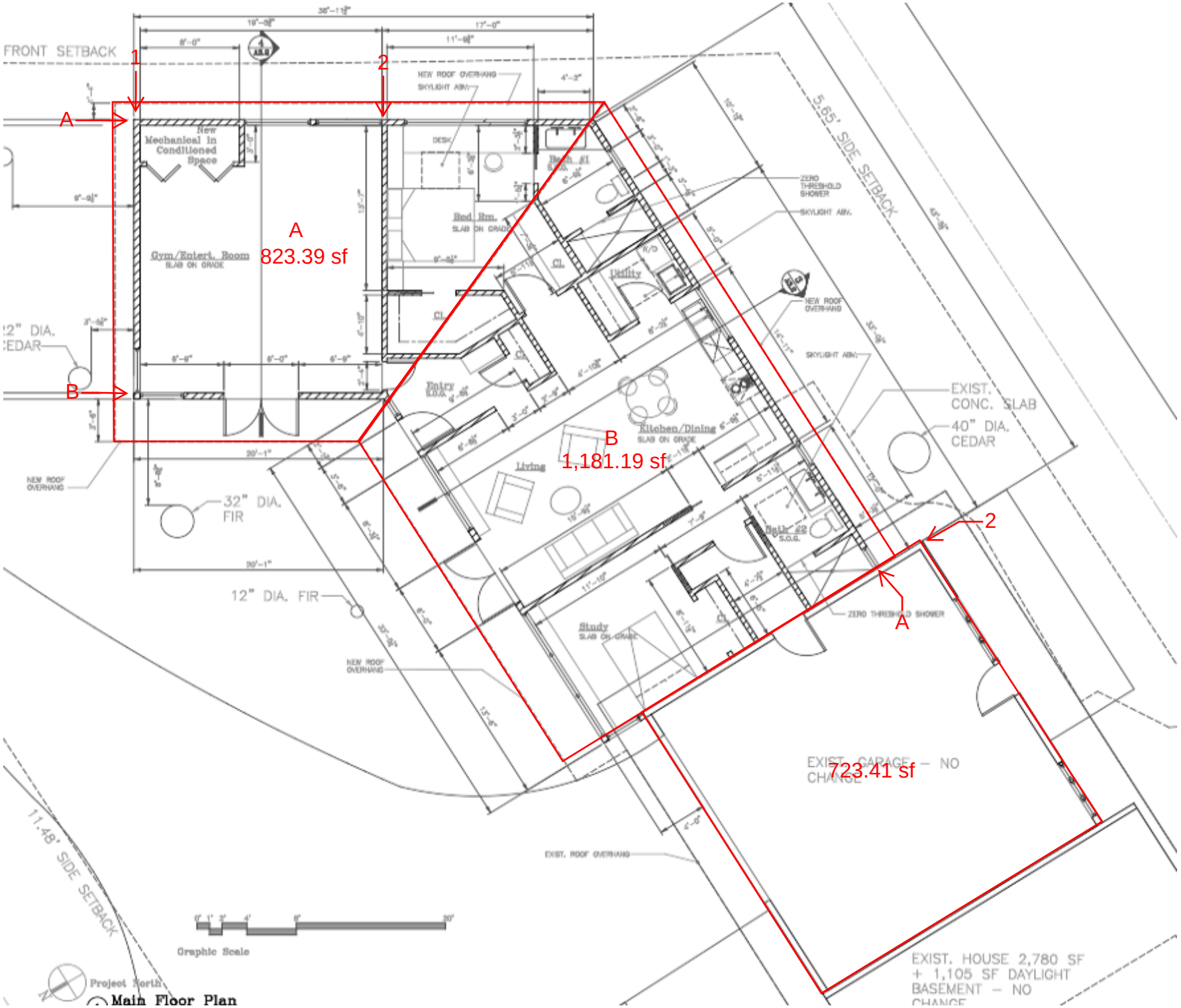
ForteWEB Software Operator	Job Notes
Drew Carpenter Bykonen Carter Quinn (360) 633-5541 dc@bcq-se.com	

Weyerhaeuser


FRONT SETBACK
1
2
A
B
A
823.39 sf
B
1,181.19 sf
723.41 sf
New Mechanical in Conditioned Space
Gym/Entert. Room
SLAB ON GRADE
Bed Rm.
SLAB ON GRADE
Utility
Entry
Living
Kitchen/Dining
SLAB ON GRADE
Study
SLAB ON GRADE
Bath #2
NEW ROOF OVERHANG
SKYLIGHT ABV.
ZERO THRESHOLD SHOWER
5.65' SIDE SETBACK
EXIST. CONC. SLAB
40" DIA. CEDAR
32" DIA. FIR
12" DIA. FIR
EXIST. GARAGE – NO CHANGE
EXIST. ROOF OVERHANG
11.48' SIDE SETBACK
EXIST. HOUSE 2,780 SF + 1,105 SF DAYLIGHT BASEMENT – NO CHANGE
Graphic Scale
Project North
Main Floor Plan

Seismic

Project:

Seismic Design Parameters		
Site Class	D	
Risk Category	II	*Table 1.5-1*
Importance Factor	1	*Table 1.5-2*
Ss	1.468	*From USGS*
S1	0.509	
Fa	1.200	*Table 11.4-1*
Fv	1.800	*Table 11.4-2*
Sms	1.762	*Eq. 11.4-1*
Sm1	0.916	*Eq. 11.4-2*
Sds	1.174	*Eq. 11.4-3*
Sd1	0.611	*Eq. 11.4-4*
R	6.5	*Table 12.2-1*
C_s	0.181	*Eq. 12.8-2*
k	1	*12.8.3*
Seismic Design Category	D	*Table 11.6-1*

Seismic Weight

Areas (ft^2)	
Roof	823

Loads	
DL-Floor (psf)	15
DL-Solar (psf)	5
Wall Weight (psf)	15
(-) Half Wall Weight (psf)	-7.5

Seismic Base Shear		
$V_{ultimate}$ (k)	4.1	*Eq. 12.8-1*
$V_{allowable}$ (k)	2.9	

Level	Weight (k)	Height (ft)	$w_x f_x^k$	C_{vx}	F_x (ult.)	F_x (allow.)
Roof	22.6325	12	271.6	1.00	4.1	2.9
TOTAL	22.6	-	271.6	1	4.1	2.9

All references are from ASCE 7-16: Minimum Design Loads and Associated Criteria for Buildings and Other Structures

Wind

Project:

Wind Load Parameters - Envelope Method		
Exposure	C	*Sec. 26.7*
Risk Category	II	*Table 1.5-1*
Mean Roof Height (ft)	12	
Roof Slope X/12	2	
Roof Angle (deg)	9.46	
a (ft)	3	*Figure 28.3-1 Note "a"*
K_d	0.85	*Table 26.6-1*
K_{zt}	1.6	
V (mph)	97	
K_z	0.85	*Table 26.10-1*
q_h (psf)	27.84	*Eq. 26.10-1*
Minimum Wind Pressure on Walls (psf)	16	*Sec. 28.3.4*
Minimum Wind Pressure on Roof (psf)	8	

Building Geometry

Level	Length Along Ridge (Parallel) (ft)	Length Perpendicular to Ridge (ft)	Roof trib (ft)	Wall trib (ft)
Roof	28	40	6	0
	long	short		

Wind

Perpendicular to Ridge

Roof	
Roof Area (sf)	132
Roof Area (corners, sf)	36
Wall Area (sf)	0
Wall Area (corners, sf)	0
Roof Wind Shear (k)	3.58

Parallel to Ridge

Roof	
Roof Area (sf)	204
Roof Area (corners, sf)	36
Wall Area (sf)	0
Wall Area (corners, sf)	0
Roof Wind Shear (k)	4.96

Check Minimum Pressure

Level	Calculated Perpendicular Pressure (psf)	Calculated Parallel Pressure (psf)	Minimum Ultimate Perpendicular Shear (k)	Minimum Parallel Ultimate Shear (k)
Roof	21.30	20.67	1.34	1.92

Summary Table

Level	Perpendicular Wind Shear (ultimate, k)	Parallel Wind Shear (ultimate, k)	Perpendicular Wind Shear (allowable, k)	Parallel Wind Shear (allowable, k)
Roof	3.58	4.96	**2.15**	**2.98**
Base Shear	3.58	4.96	**2.15**	**2.98**

All references are from ASCE 7-16: Minimum Design Loads and Associated Criteria for Buildings and Other Structures

WL-MASTER (1)

Level	Total Wall Line Lengths (ft)	Seismic Forces (k)	Wind Forces (k)	Story Heights (ft)
Roof	18.75	0.841	0.8642	12

Max H/W Ratio [2] 3.5

ROOF

Select strap or holdown

Length (ft)	H/W Ratio	Increase [1]	Force in Wall Elements		Dead Loads		Seismic Overturning (k)	Wind Overturning (k)	Shear Wall	Holdown	Notes
			Seismic Shear (plf)	Wind Shear (plf)	Wall (lb)	Floor (lb)					
18.75	0.64	1.00	45	46	3375	188	-0.53	-0.52	SW1	No Holdown Required	

Holdown Line

[1] Increase per 4.3.4.2 ANSI/AWC SDPWS-2015

[2] Per Table 4.3.4 ANSI/AWC SDPWS-2015

WL-MASTER (2)

Level	Total Wall Line Lengths (ft)	Seismic Forces (k)	Wind Forces (k)	Story Heights (ft)
Roof	19.75	2.059	2.1158	12

Max H/W Ratio [2] 3.5

ROOF

Select strap or holdown

Length (ft)	H/W Ratio	Increase [1]	Force in Wall Elements		Dead Loads		Seismic Overturning (k)	Wind Overturning (k)	Shear Wall	Holdown	Notes
			Seismic Shear (plf)	Wind Shear (plf)	Wall (lb)	Floor (lb)					
19.75	0.61	1.00	104	107	3555	198	0.13	0.16	SW1	No Holdown Required	

Holdown Line

[1] Increase per 4.3.4.2 ANSI/AWC SDPWS-2015

[2] Per Table 4.3.4 ANSI/AWC SDPWS-2015

WL-MASTER (A)

Level	Total Wall Line Lengths (ft)	Seismic Forces (k)	Wind Forces (k)	Story Heights (ft)
Roof	13.75	1.334	0.989	9

Max H/W Ratio [2] 3.5

ROOF

Select strap or holdown

Length (ft)	H/W Ratio	Increase [1]	Force in Wall Elements		Dead Loads		Seismic Overturning (k)	Wind Overturning (k)	Shear Wall	Holdown	Notes
			Seismic Shear (plf)	Wind Shear (plf)	Wall (lb)	Floor (lb)					
8.75	1.03	1.00	97	72	1181	88	0.49	0.27	SW1	No Holdown Required	
5	1.80	1.00	97	72	675	50	0.66	0.43	SW1	No Holdown Required	

Holdown Line

[1] Increase per 4.3.4.2 ANSI/AWC SDPWS-2015

[2] Per Table 4.3.4 ANSI/AWC SDPWS-2015

WL-MASTER (B)

Level	Total Wall Line Lengths (ft)	Seismic Forces (k)	Wind Forces (k)	Story Heights (ft)
Roof	6.75	1.566	1.161	12

Max H/W Ratio [2] 3.5

ROOF

Select strap or holdown

Length (ft)	H/W Ratio	Increase [1]	Force in Wall Elements		Dead Loads		Seismic Overturning (k)	Wind Overturning (k)	Shear Wall	Holdown	Notes
			Seismic Shear (plf)	Wind Shear (plf)	Wall (lb)	Floor (lb)					
6.75	1.78	1.00	232	172	1215	68	2.40	1.68	SW1	HDU4	

Holdown Line

[1] Increase per 4.3.4.2 ANSI/AWC SDPWS-2015

[2] Per Table 4.3.4 ANSI/AWC SDPWS-2015

Seismic

Project:

Seismic Design Parameters		
Site Class	D	
Risk Category	II	*Table 1.5-1*
Importance Factor	1	*Table 1.5-2*
Ss	1.468	*From USGS*
S1	0.509	
Fa	1.200	*Table 11.4-1*
Fv	1.800	*Table 11.4-2*
Sms	1.762	*Eq. 11.4-1*
Sm1	0.916	*Eq. 11.4-2*
Sds	1.174	*Eq. 11.4-3*
Sd1	0.611	*Eq. 11.4-4*
R	6.5	*Table 12.2-1*
C_s	0.181	*Eq. 12.8-2*
k	1	*12.8.3*
Seismic Design Category	D	*Table 11.6-1*

Seismic Weight

Areas (ft^2)	
Roof	1182

Loads	
DL-Floor (psf)	15
DL-Solar (psf)	5
Wall Weight (psf)	15
(-) Half Wall Weight (psf)	-7.5

Seismic Base Shear		
$V_{ultimate}$ (k)	5.9	*Eq. 12.8-1*
$V_{allowable}$ (k)	4.1	

Level	Weight (k)	Height (ft)	$w_x f_x^k$	C_{vx}	F_x (ult.)	F_x (allow.)
Roof	32.505	12	390.1	1.00	5.9	4.1
TOTAL	32.5	-	390.1	1	5.9	4.1

All references are from ASCE 7-16: Minimum Design Loads and Associated Criteria for Buildings and Other Structures

Wind

Project:

Wind Load Parameters - Envelope Method		
Exposure	C	*Sec. 26.7*
Risk Category	II	*Table 1.5-1*
Mean Roof Height (ft)	12	
Roof Slope X/12	2	
Roof Angle (deg)	9.46	
a (ft)	3.2	*Figure 28.3-1 Note "a"*
K_d	0.85	*Table 26.6-1*
K_{zt}	1.6	
V (mph)	97	
K_z	0.85	*Table 26.10-1*
q_h (psf)	27.84	*Eq. 26.10-1*
Minimum Wind Pressure on Walls (psf)	16	*Sec. 28.3.4*
Minimum Wind Pressure on Roof (psf)	8	

Building Geometry

Level	Length Along Ridge (Parallel) (ft)	Length Perpendicular to Ridge (ft)	Roof trib (ft)	Wall trib (ft)
Roof	44	32	6	0
	long	short		

Wind

Perpendicular to Ridge

Roof	
Roof Area (sf)	225.6
Roof Area (corners, sf)	38.4
Wall Area (sf)	0
Wall Area (corners, sf)	0
Roof Wind Shear (k)	5.45

Parallel to Ridge

Roof	
Roof Area (sf)	153.6
Roof Area (corners, sf)	38.4
Wall Area (sf)	0
Wall Area (corners, sf)	0
Roof Wind Shear (k)	4.06

Check Minimum Pressure

Level	Calculated Perpendicular Pressure (psf)	Calculated Parallel Pressure (psf)	Minimum Ultimate Perpendicular Shear (k)	Minimum Parallel Ultimate Shear (k)
Roof	20.63	21.16	2.11	1.54

Summary Table

Level	Perpendicular Wind Shear (ultimate, k)	Parallel Wind Shear (ultimate, k)	Perpendicular Wind Shear (allowable, k)	Parallel Wind Shear (allowable, k)
Roof	5.45	4.06	**3.27**	**2.44**
Base Shear	5.45	4.06	**3.27**	**2.44**

All references are from ASCE 7-16: Minimum Design Loads and Associated Criteria for Buildings and Other Structures

WL-MASTER (2)

Level	Total Wall Line Lengths (ft)	Seismic Forces (k)	Wind Forces (k)	Story Heights (ft)
Roof	24	5.35	3.27	12

Max H/W Ratio [2] 3.5

ROOF

Select strap or holdown

Length (ft)	H/W Ratio	Increase [1]	Force in Wall Elements		Dead Loads		Seismic Overturning (k)	Wind Overturning (k)	Shear Wall	Holdown	Notes
			Seismic Shear (plf)	Wind Shear (plf)	Wall (lb)	Floor (lb)					
12.75	0.94	1.00	223	136	2295	128	1.95	0.91	SW1	HDU2	
11.25	1.07	1.00	223	136	2025	113	2.03	0.99	SW1	HDU2	

Holdown Line

[1] Increase per 4.3.4.2 ANSI/AWC SDPWS-2015

[2] Per Table 4.3.4 ANSI/AWC SDPWS-2015

WL-MASTER (A) (2)

Level	Total Wall Line Lengths (ft)	Seismic Forces (k)	Wind Forces (k)	Story Heights (ft)
Roof	29.5	4.1	2.44	9

Max H/W Ratio [2] 3.5

ROOF

Select strap or holdown

Length (ft)	H/W Ratio	Increase [1]	Force in Wall Elements		Dead Loads		Seismic Overturning (k)	Wind Overturning (k)	Shear Wall	Holdown	Notes
			Seismic Shear (plf)	Wind Shear (plf)	Wall (lb)	Floor (lb)					
11.25	0.80	1.00	139	83	1519	113	0.76	0.26	SW1	No Holdown Required	
10.25	0.88	1.00	139	83	1384	103	0.80	0.30	SW1	No Holdown Required	
8	1.13	1.00	139	83	1080	80	0.90	0.40	SW1	No Holdown Required	

Holdown Line

[1] Increase per 4.3.4.2 ANSI/AWC SDPWS-2015

[2] Per Table 4.3.4 ANSI/AWC SDPWS-2015

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 3 ft wall

Code Reference

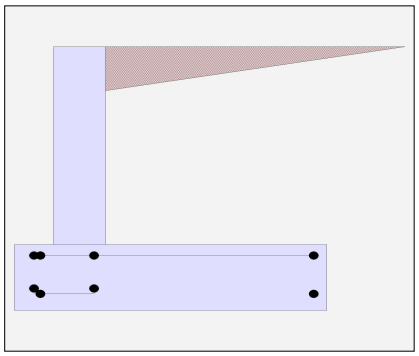
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

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

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	60.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
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		

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 (Strength 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		Spread Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 3 ft wall

Design Summary

Wall Stability Ratios

Overturning	=	6.04	OK
Sliding	=	1.53	OK
Global Stability	=	1.70	

Total Bearing Load	=	1,835 lbs	
...resultant ecc.	=	2.91 in	
Eccentricity within middle third			
Soil Pressure @ Toe	=	625 psf	OK
Soil Pressure @ Heel	=	292 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	876 psf	
ACI Factored @ Heel	=	409 psf	
Footing Shear @ Toe	=	0.4 psi	OK
Footing Shear @ Heel	=	0.0 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	480.0 lbs	
less 100% Passive Force	-	0.0 lbs	
less 100% Friction Force	-	734.0 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	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

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

Design Data

fb/FB + fa/Fa	=	**0.079**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	432.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	432.0
Moment.....Allowable	=	5,412.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	5.8
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.25

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 3 ft wall

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0162 in2/ft		
(4/3) * As :	0.0216 in2/ft	Min Stem T&S Reinf Area 0.576 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	0.50 ft
Heel Width	=	3.50
Total Footing Width	=	4.00
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	409	psf
Mu' : Upward	=	107	2,083	ft-#
Mu' : Downward	=	23	2,312	ft-#
Mu: Design	=	85 OK	229	ft-# OK
phiMn	=	10,013	11,209	ft-#
Actual 1-Way Shear	=	0.37	0.05	psi
Allow 1-Way Shear	=	75.00	75.00	psi

Toe Reinforcing = # 5 @ 14.00 in
Heel Reinforcing = # 5 @ 14.00 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@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Heel: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Key: No key defined

Min footing T&S reinf Area 1.04 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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 3 ft wall

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	480.0	1.33	640.0			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
				Soil Over HL (ab. water tbl)	935.0	2.58	2,415.4
				Soil Over HL (bel. water tbl)		2.58	2,415.4
				Watre Table			
				Sloped Soil Over Heel =			
				Surcharge Over Heel =			
				Adjacent Footing Load =			
				Axial Dead Load on Stem =			
				* Axial Live Load on Stem =			
				Soil Over Toe =			
				Surcharge Over Toe =			
				Stem Weight(s) =	300.0	0.83	250.0
				Earth @ Stem Transitions =			
				Footing Weight =	600.0	2.00	1,200.0
				Key Weight =			
				Vert. Component =			
Total =	480.0	**O.T.M.** =	640.0	**Total =**	1,835.0 lbs	**R.M.=**	3,865.4

Resisting/Overturning Ratio = **6.04**

Vertical Loads used for Soil Pressure = 1,835.0 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	50.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.065	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.

Project Title:
Engineer:
Project ID:
Project Descr:

DESCRIPTION: 3 ft wall

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height: 0.00 ft above top of footing

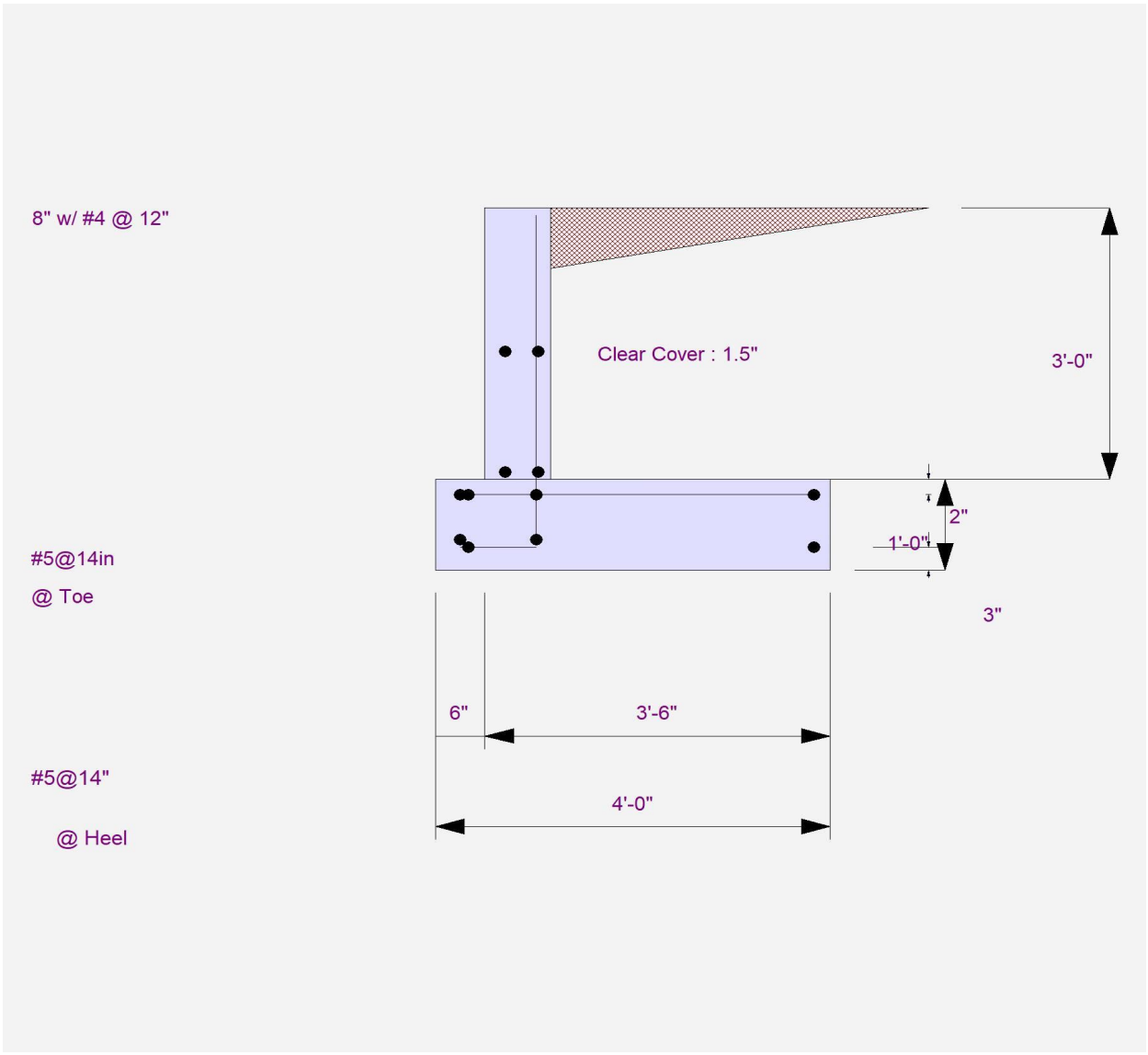
Lap Splice length for #4 bar specified in this stem design segment =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	8.40 in
As Provided =	0.2000 in2/ft
As Required =	0.1728 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 3 ft wall

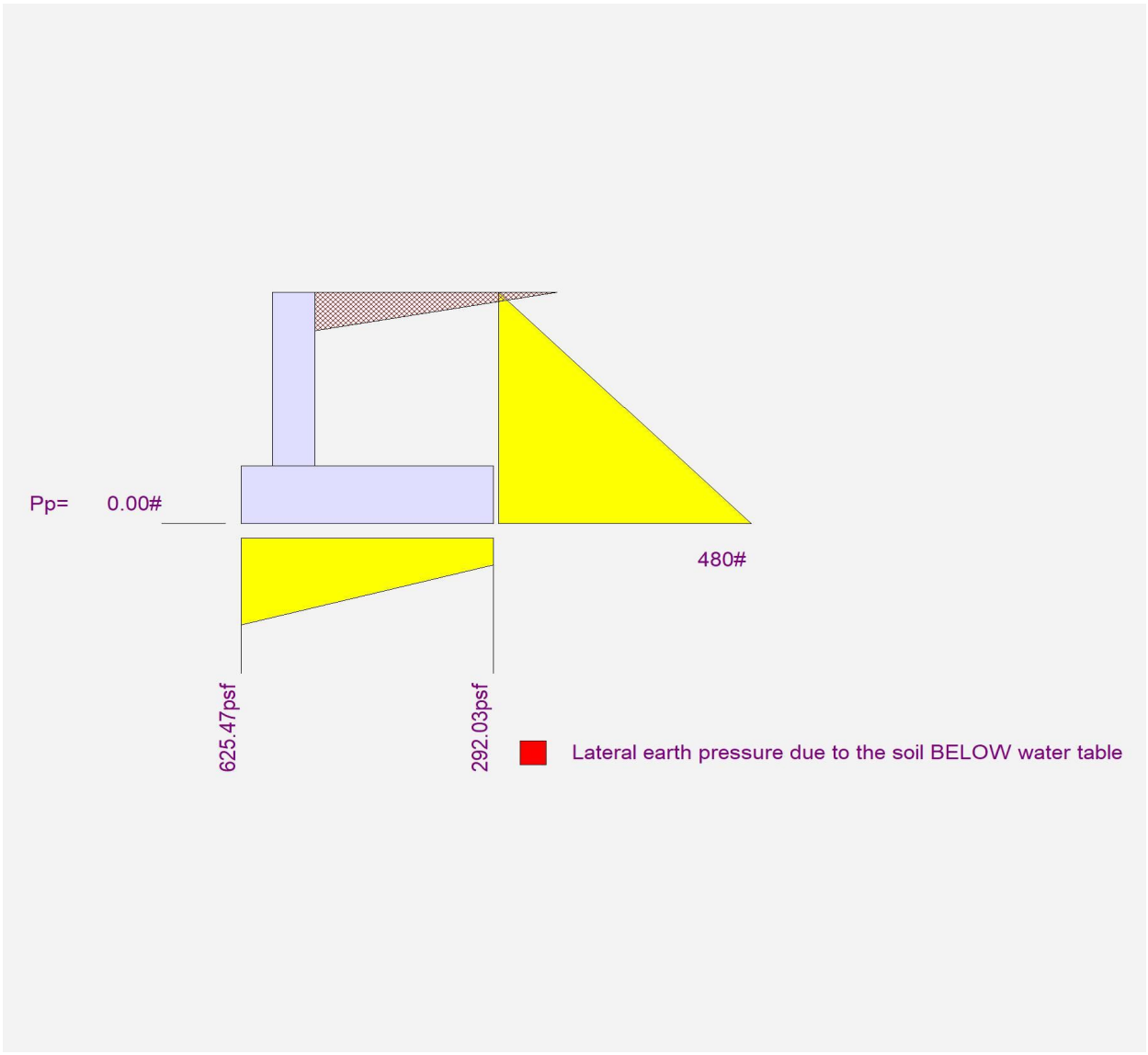


Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 3 ft wall



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 3.5 ft wall

Code Reference

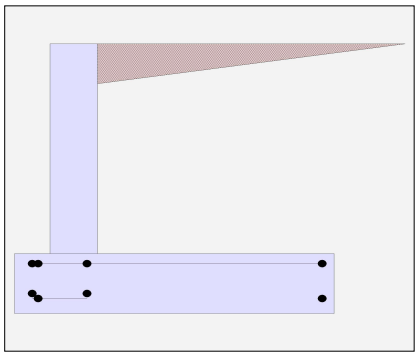
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	3.50 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	60.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
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		

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 (Strength 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		Spread Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 3.5 ft wall

Design Summary

Wall Stability Ratios

Overturning	=	5.98	OK
Sliding	=	1.52	OK
Global Stability	=	1.62	

Total Bearing Load	=	2,308 lbs	
...resultant ecc.	=	3.42 in	
Eccentricity within middle third			
Soil Pressure @ Toe	=	708 psf	OK
Soil Pressure @ Heel	=	318 psf	OK
Allowable	=	2,000 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	991 psf	
ACI Factored @ Heel	=	445 psf	
Footing Shear @ Toe	=	0.4 psi	OK
Footing Shear @ Heel	=	0.2 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	607.5 lbs	
less 100% Passive Force	-	0.0 lbs	
less 100% Friction Force	-	923.3 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	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

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

Design Data

fb/FB + fa/Fa	=	**0.126**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	588.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	686.0
Moment.....Allowable	=	5,412.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	7.8
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.25

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 3.5 ft wall

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0257 in2/ft		
(4/3) * As :	0.0343 in2/ft	Min Stem T&S Reinf Area 0.672 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	0.50 ft
Heel Width	=	4.00
Total Footing Width	=	4.50
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	=	991	445	psf
Mu' : Upward	=	121	3,222	ft-#
Mu' : Downward	=	23	3,567	ft-#
Mu: Design	=	99 OK	345 ft-#	OK
phiMn	=	10,013	11,209	ft-#
Actual 1-Way Shear	=	0.37	0.16	psi
Allow 1-Way Shear	=	75.00	75.00	psi

Toe Reinforcing = # 5 @ 14.00 in
Heel Reinforcing = # 5 @ 14.00 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@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Heel: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Key: No key defined

Min footing T&S reinf Area 1.17 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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 3.5 ft wall

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	607.5	1.50	911.3			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
				Soil Over HL (ab. water tbl)	1,283.3	2.83	3,636.1
				Soil Over HL (bel. water tbl)		2.83	3,636.1
				Watre Table			
				Sloped Soil Over Heel =			
				Surcharge Over Heel =			
				Adjacent Footing Load =			
				Axial Dead Load on Stem =			
				* Axial Live Load on Stem =			
				Soil Over Toe =			
				Surcharge Over Toe =			
				Stem Weight(s) =	350.0	0.83	291.7
				Earth @ Stem Transitions =			
				Footing Weight =	675.0	2.25	1,518.8
				Key Weight =			
				Vert. Component =			
Total =	607.5	**O.T.M.** =	911.3	**Total =**	2,308.3 lbs	**R.M.=**	5,446.5

Resisting/Overturning Ratio = **5.98**

Vertical Loads used for Soil Pressure = 2,308.3 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	50.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.076	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.

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 3.5 ft wall

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

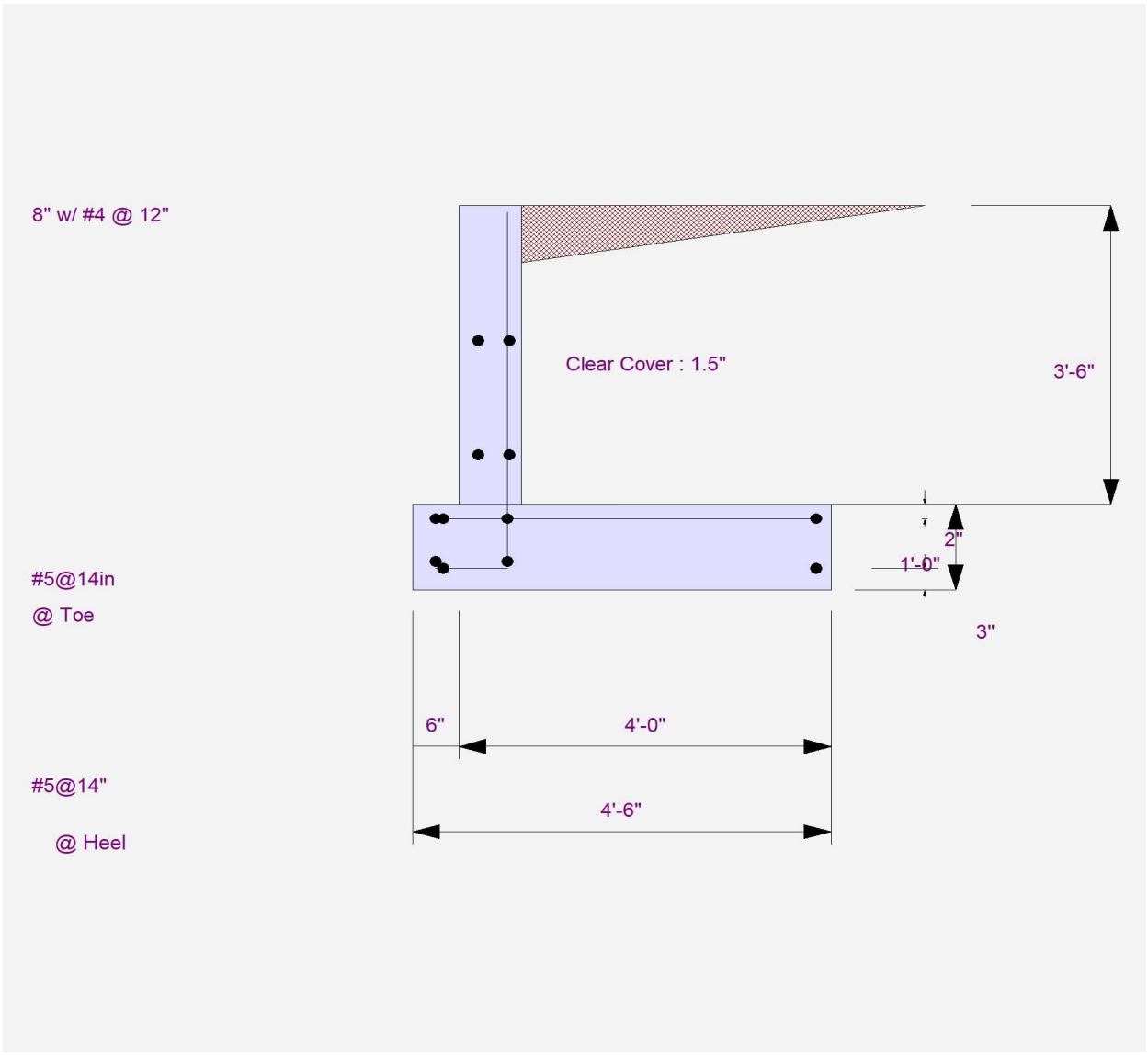
Lap Splice length for #4 bar specified in this stem design segment =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	8.40 in
As Provided =	0.2000 in2/ft
As Required =	0.1728 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 3.5 ft wall

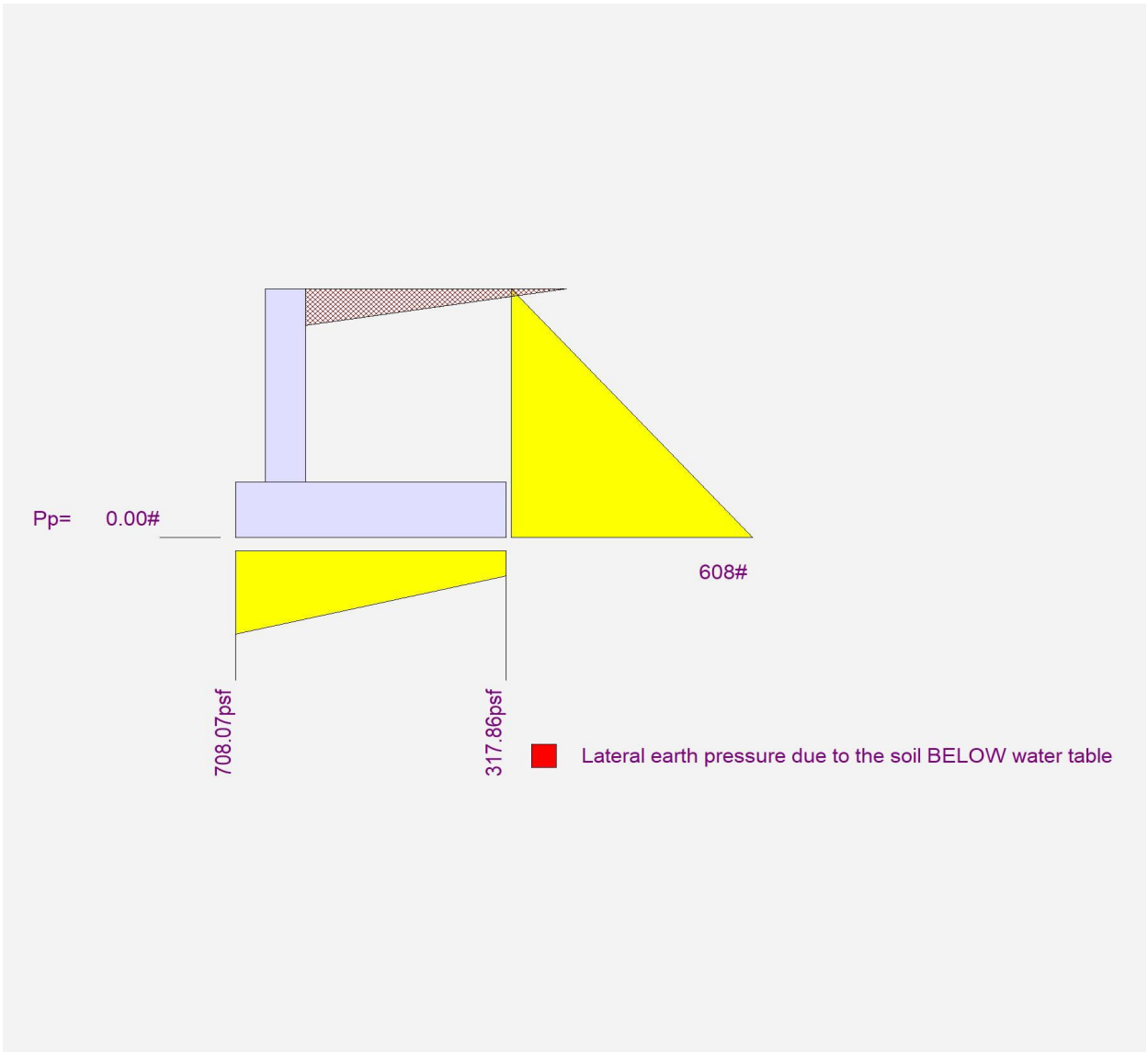


Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 3.5 ft wall



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 4 ft wall

Code Reference

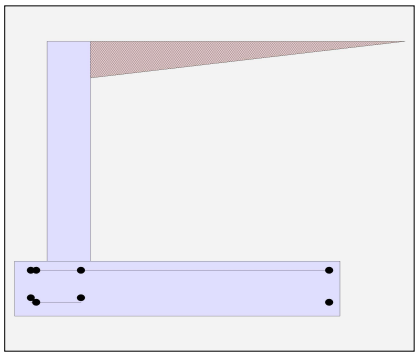
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

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

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	60.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
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		

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 (Strength 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		Spread Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 4 ft wall

Design Summary

Wall Stability Ratios

Overturning	=	5.93	OK
Sliding	=	1.51	OK
Global Stability	=	1.56	

Total Bearing Load	=	2,837	lbs
...resultant ecc.	=	3.95	in

Eccentricity within middle third

Soil Pressure @ Toe	=	791 psf	OK
Soil Pressure @ Heel	=	343 psf	OK
Allowable	=	2,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	1,108 psf	
ACI Factored @ Heel	=	481 psf	
Footing Shear @ Toe	=	0.4 psi	OK
Footing Shear @ Heel	=	0.4 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	750.0 lbs	
less 100% Passive Force	-	0.0 lbs	
less 100% Friction Force	-	1,134.7 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	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

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

Design Data

fb/FB + fa/Fa	=	**0.189**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	768.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	1,024.0
Moment.....Allowable	=	5,412.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	10.2
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.25

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 4 ft wall

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0384 in2/ft		
(4/3) * As :	0.0512 in2/ft	Min Stem T&S Reinf Area 0.768 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	0.50 ft
Heel Width	=	4.50
Total Footing Width	=	5.00
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	=	1,108	481	psf
Mu' : Upward	=	136	4,710	ft-#
Mu' : Downward	=	23	5,202	ft-#
Mu: Design	=	113 OK	492 ft-#	OK
phiMn	=	10,013	11,209	ft-#
Actual 1-Way Shear	=	0.37	0.44	psi
Allow 1-Way Shear	=	75.00	75.00	psi

Toe Reinforcing = # 5 @ 14.00 in
Heel Reinforcing = # 5 @ 14.00 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@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Heel: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Key: No key defined

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

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 9.26 in	#4@ 18.52 in
#5@ 14.35 in	#5@ 28.70 in
#6@ 20.37 in	#6@ 40.74 in

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 4 ft wall

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	750.0	1.67	1,250.0			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				1,686.7	3.08	5,200.6
Soil Over HL (bel. water tbl)					3.08	5,200.6
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =						
Surcharge Over Toe =						
Stem Weight(s) =				400.0	0.83	333.3
Earth @ Stem Transitions =						
Footing Weight =				750.0	2.50	1,875.0
Key Weight =						
Vert. Component =						
Total =	750.0	**O.T.M.** =	1,250.0	**Total =** 2,836.7 lbs	**R.M.=**	7,408.9

Resisting/Overturning Ratio = **5.93**

Vertical Loads used for Soil Pressure = 2,836.7 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	50.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.088	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.

DESCRIPTION: 4 ft wall

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

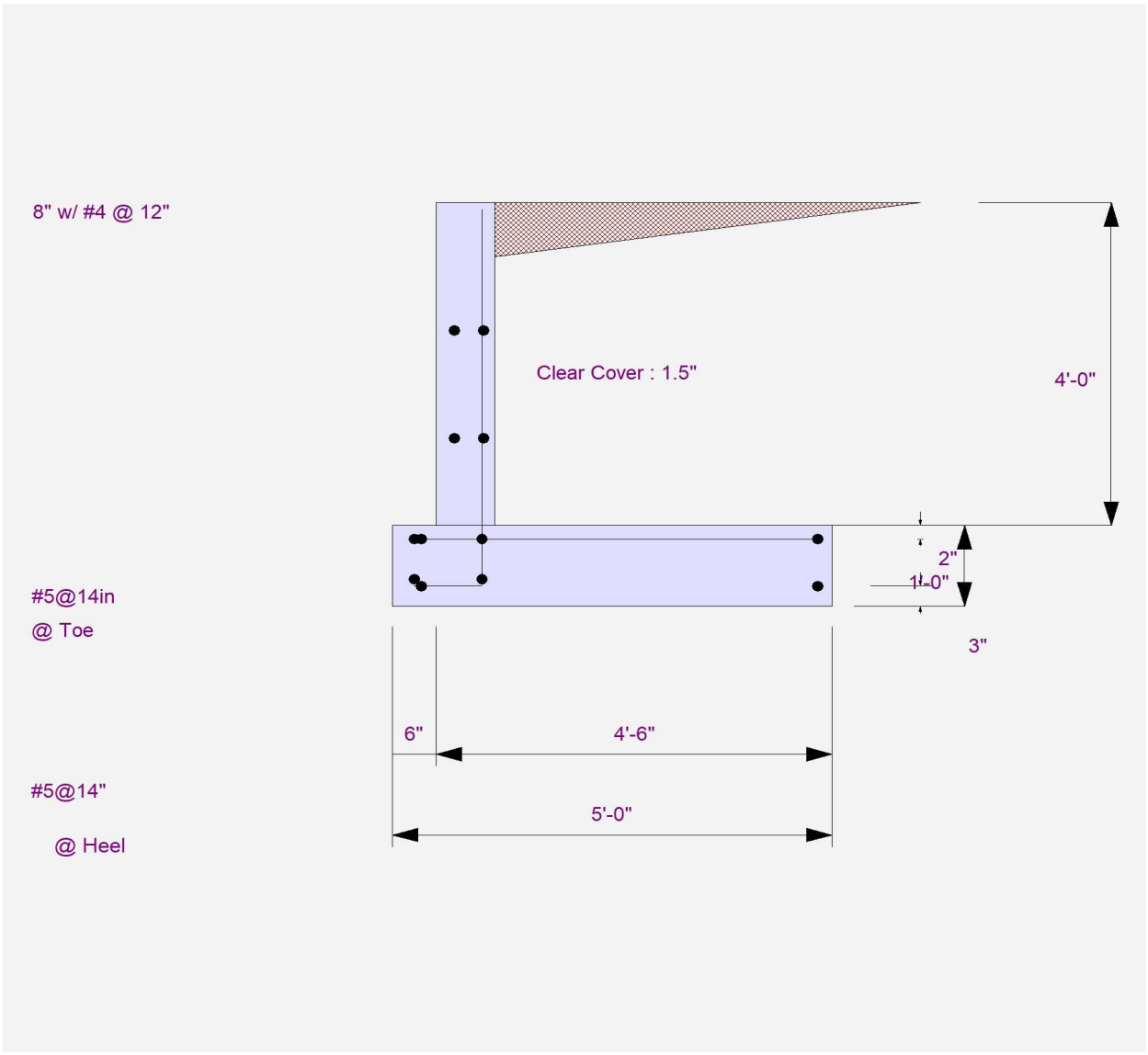
Lap Splice length for #4 bar specified in this stem design segment =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	8.40 in
As Provided =	0.2000 in2/ft
As Required =	0.1728 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 4 ft wall

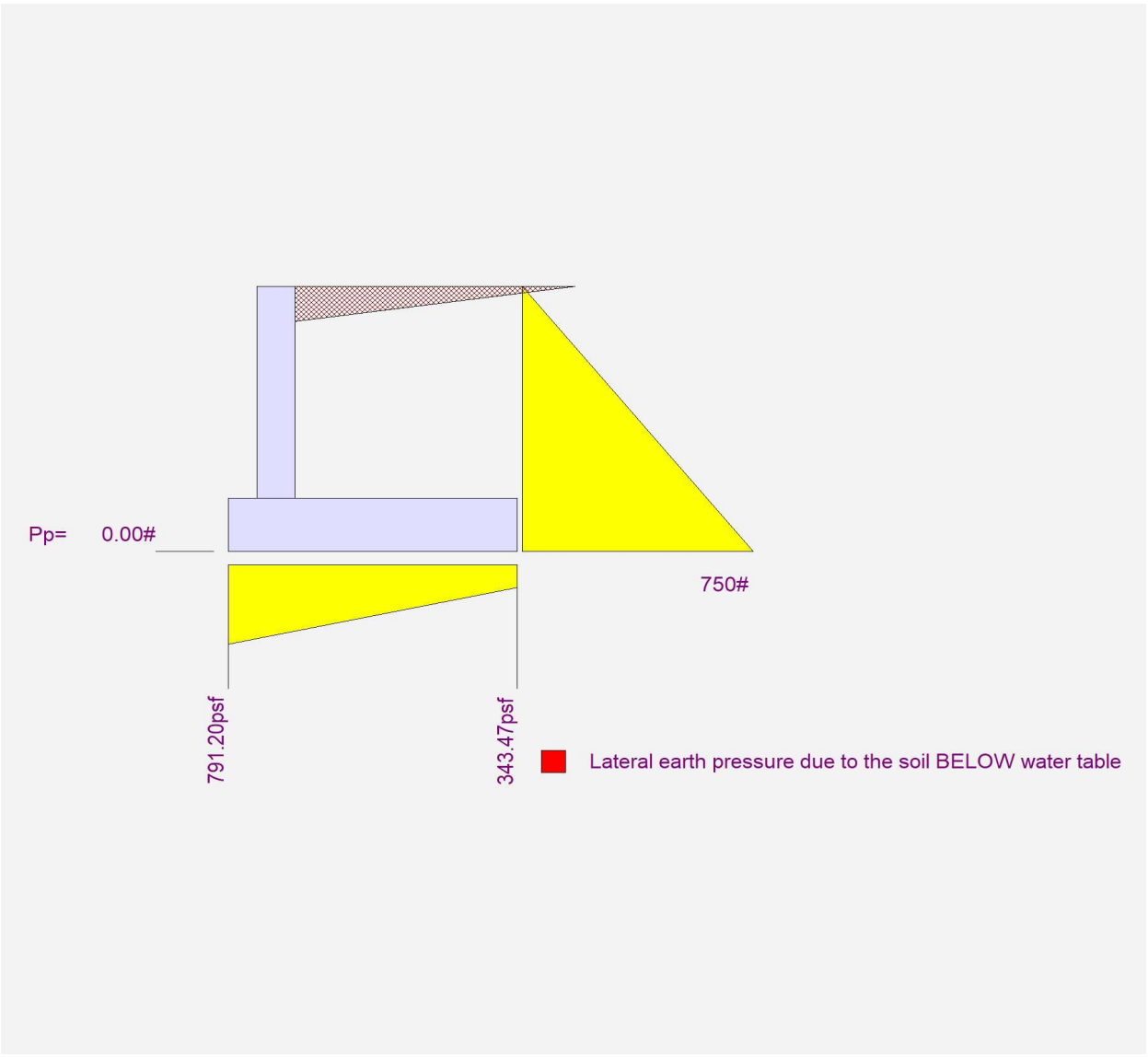


Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 4 ft wall



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 4.5 ft wall

Code Reference

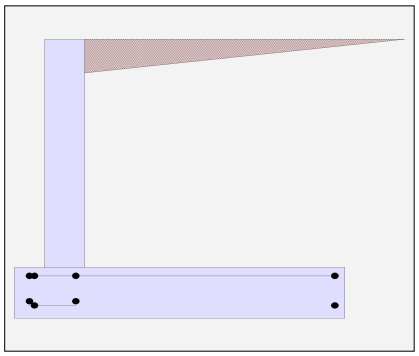
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	4.50 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	60.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
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		

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 (Strength 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		Spread Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 4.5 ft wall

Design Summary

Wall Stability Ratios

Overturning	=	5.89	OK
Sliding	=	1.51	OK
Global Stability	=	1.51	

Total Bearing Load	=	3,420	lbs
...resultant ecc.	=	4.47	in

Eccentricity within middle third

Soil Pressure @ Toe	=	875 psf	OK
Soil Pressure @ Heel	=	369 psf	OK
Allowable	=	2,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	1,225 psf	
ACI Factored @ Heel	=	516 psf	
Footing Shear @ Toe	=	0.4 psi	OK
Footing Shear @ Heel	=	0.8 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	907.5 lbs	
less 100% Passive Force	-	0.0 lbs	
less 100% Friction Force	-	1,368.0 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	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

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

Design Data

fb/FB + fa/Fa	=	**0.269**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	972.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	1,458.0
Moment.....Allowable	=	5,412.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	13.0
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.25

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 4.5 ft wall

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0546 in2/ft		
(4/3) * As :	0.0728 in2/ft	Min Stem T&S Reinf Area 0.864 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	0.50 ft
Heel Width	=	5.00
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	=	1,225	516 psf	
Mu' : Upward	=	150	6,595 ft-#	
Mu' : Downward	=	23	7,267 ft-#	
Mu: Design	=	128 OK	672 ft-#	OK
phiMn	=	10,013	11,209 ft-#	
Actual 1-Way Shear	=	0.37	0.82 psi	
Allow 1-Way Shear	=	75.00	75.00 psi	

Toe Reinforcing = # 5 @ 14.00 in
Heel Reinforcing = # 5 @ 14.00 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@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Heel: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 4.5 ft wall

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	907.5	1.83	1,663.8			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
				Soil Over HL (ab. water tbl)	2,145.0	3.33	7,150.0
				Soil Over HL (bel. water tbl)		3.33	7,150.0
				Watre Table			
				Sloped Soil Over Heel =			
				Surcharge Over Heel =			
				Adjacent Footing Load =			
				Axial Dead Load on Stem =			
				* Axial Live Load on Stem =			
				Soil Over Toe =			
				Surcharge Over Toe =			
				Stem Weight(s) =	450.0	0.83	375.0
				Earth @ Stem Transitions =			
				Footing Weight =	825.0	2.75	2,268.8
				Key Weight =			
				Vert. Component =			
Total =	907.5	**O.T.M.** =	1,663.8	**Total =**	3,420.0 lbs	**R.M.=**	9,793.8

Resisting/Overturning Ratio = **5.89**

Vertical Loads used for Soil Pressure = 3,420.0 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	50.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.099	in

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 4.5 ft wall

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

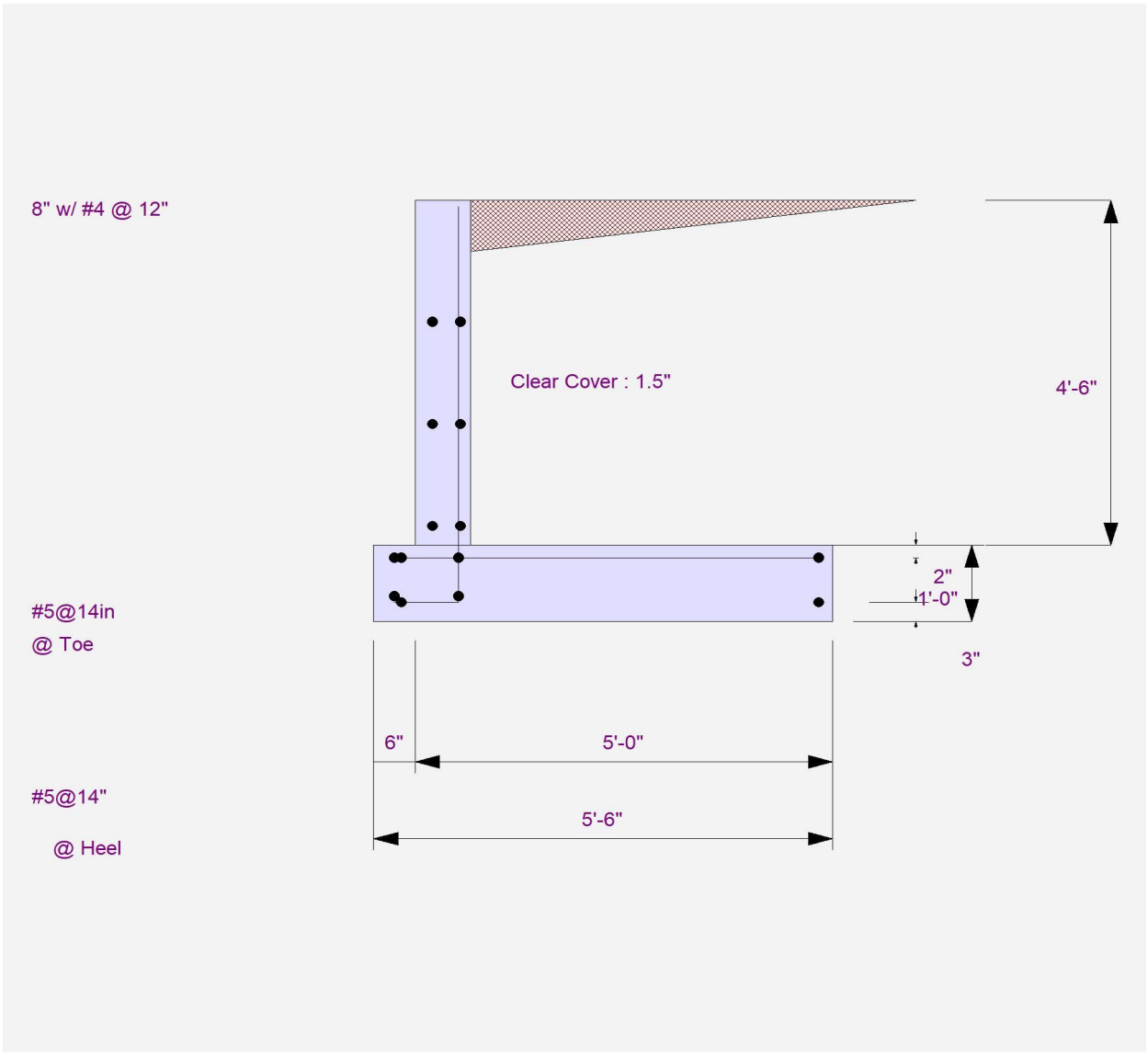
Lap Splice length for #4 bar specified in this stem design segment =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	8.40 in
As Provided =	0.2000 in2/ft
As Required =	0.1728 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 4.5 ft wall

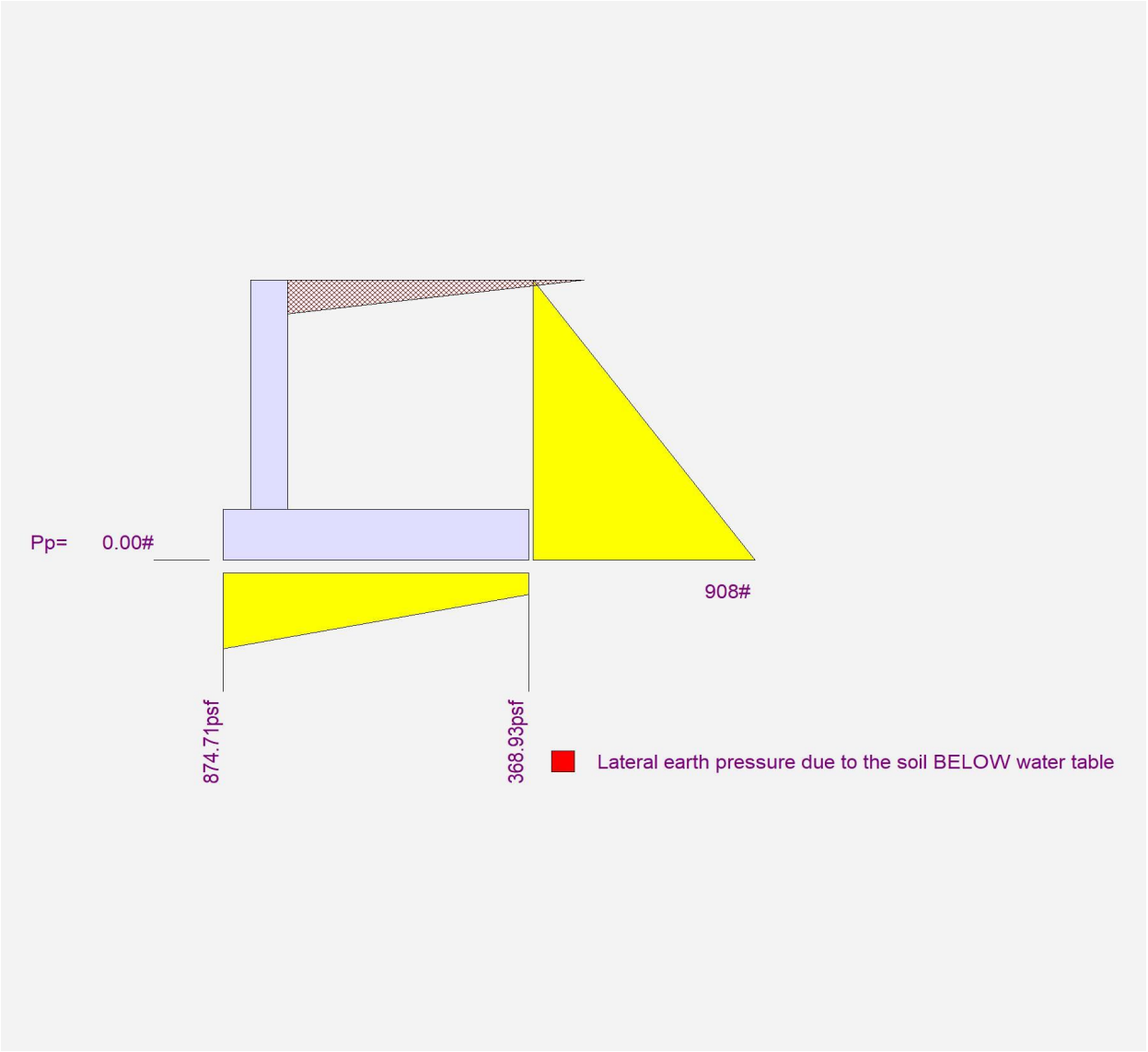


Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 4.5 ft wall



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 5 ft wall

Code Reference

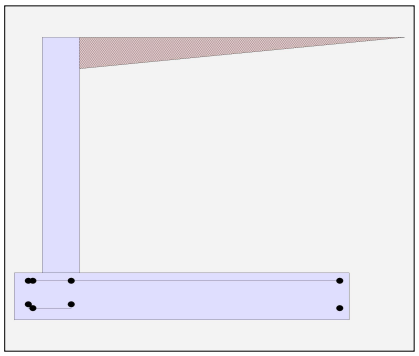
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	5.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	60.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
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		

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 (Strength 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		Spread Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 5 ft wall

Design Summary

Wall Stability Ratios

Overturning	=	5.85	OK
Sliding	=	1.50	OK
Global Stability	=	1.48	

Total Bearing Load	=	4,058	lbs	
...resultant ecc.	=	5.00	in	
Eccentricity within middle third				
Soil Pressure @ Toe	=	958	psf	OK
Soil Pressure @ Heel	=	394	psf	OK
Allowable	=	2,000	psf	
Soil Pressure Less Than Allowable				
ACI Factored @ Toe	=	1,342	psf	
ACI Factored @ Heel	=	552	psf	
Footing Shear @ Toe	=	0.4	psi	OK
Footing Shear @ Heel	=	1.3	psi	OK
Allowable	=	75.0	psi	

Sliding Calcs

Lateral Sliding Force	=	1,080.0	lbs	
less 100% Passive Force	-	0.0	lbs	
less 100% Friction Force	= -	1,623.3	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	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

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

Design Data

fb/FB + fa/Fa	=	**0.369**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,200.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	2,000.0
Moment.....Allowable	=	5,412.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	16.0
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.25

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 5 ft wall

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0749 in2/ft		
(4/3) * As :	0.0999 in2/ft	Min Stem T&S Reinf Area 0.960 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	0.50 ft
Heel Width	=	5.50
Total Footing Width	=	6.00
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	=	1,342	552	psf
Mu' : Upward	=	165	8,925	ft-#
Mu' : Downward	=	23	9,812	ft-#
Mu: Design	=	142 OK	887 ft-#	OK
phiMn	=	10,013	11,209	ft-#
Actual 1-Way Shear	=	0.37	1.28	psi
Allow 1-Way Shear	=	75.00	75.00	psi

Toe Reinforcing = # 5 @ 14.00 in
Heel Reinforcing = # 5 @ 14.00 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@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Heel: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Key: No key defined

Min footing T&S reinf Area 1.56 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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 5 ft wall

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,080.0	2.00	2,160.0			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				2,658.3	3.58	9,525.7
Soil Over HL (bel. water tbl)					3.58	9,525.7
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =						
Surcharge Over Toe =						
Stem Weight(s) =				500.0	0.83	416.7
Earth @ Stem Transitions =						
Footing Weight =				900.0	3.00	2,700.0
Key Weight =						
Vert. Component =						
Total =	1,080.0	**O.T.M.** =	2,160.0	**Total =** 4,058.3 lbs	**R.M.=**	12,642.4

Resisting/Overturning Ratio = **5.85**

Vertical Loads used for Soil Pressure = 4,058.3 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	50.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.111	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.

DESCRIPTION: 5 ft wall

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

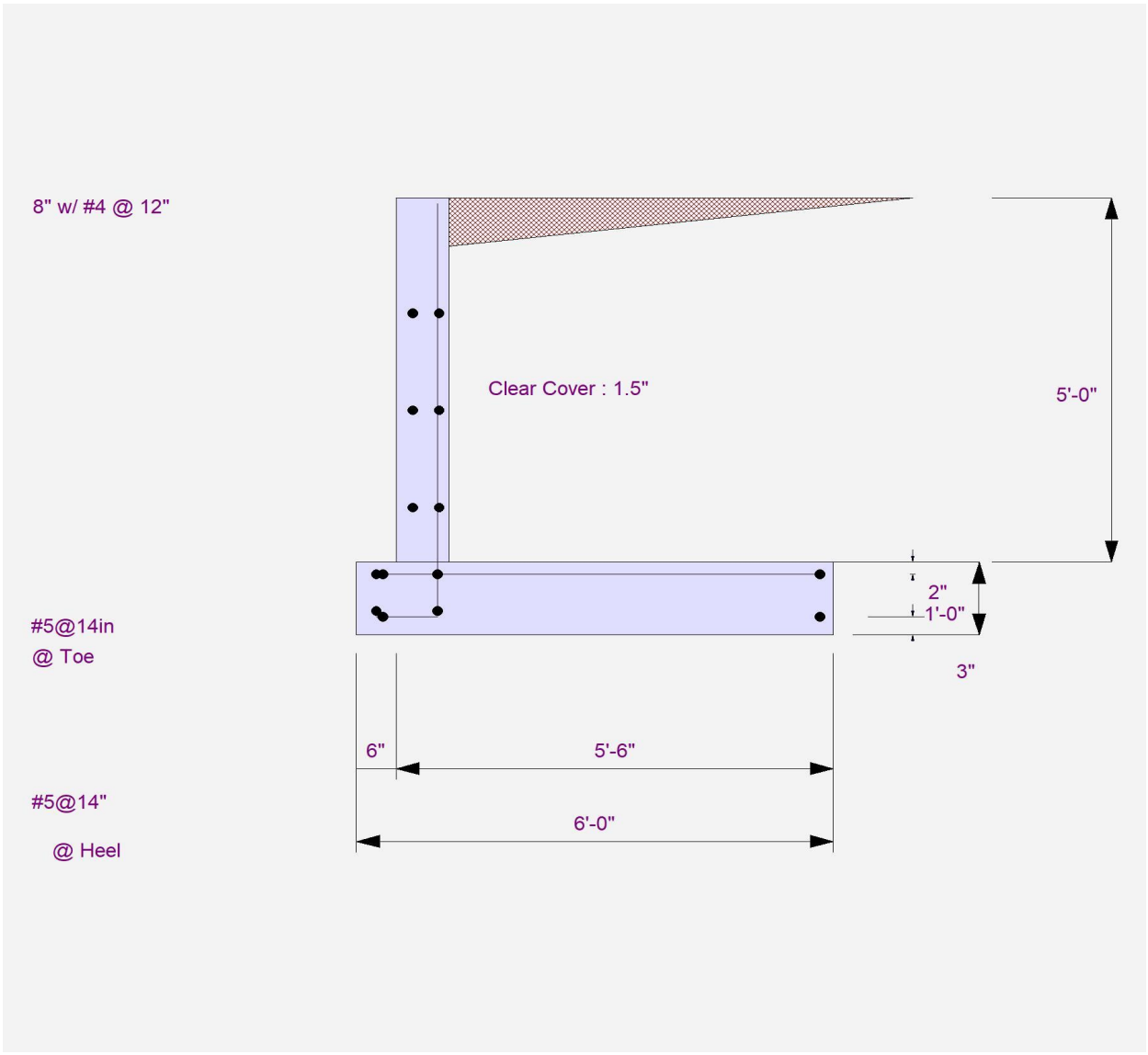
Lap Splice length for #4 bar specified in this stem design segment =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	8.40 in
As Provided =	0.2000 in2/ft
As Required =	0.1728 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 5 ft wall

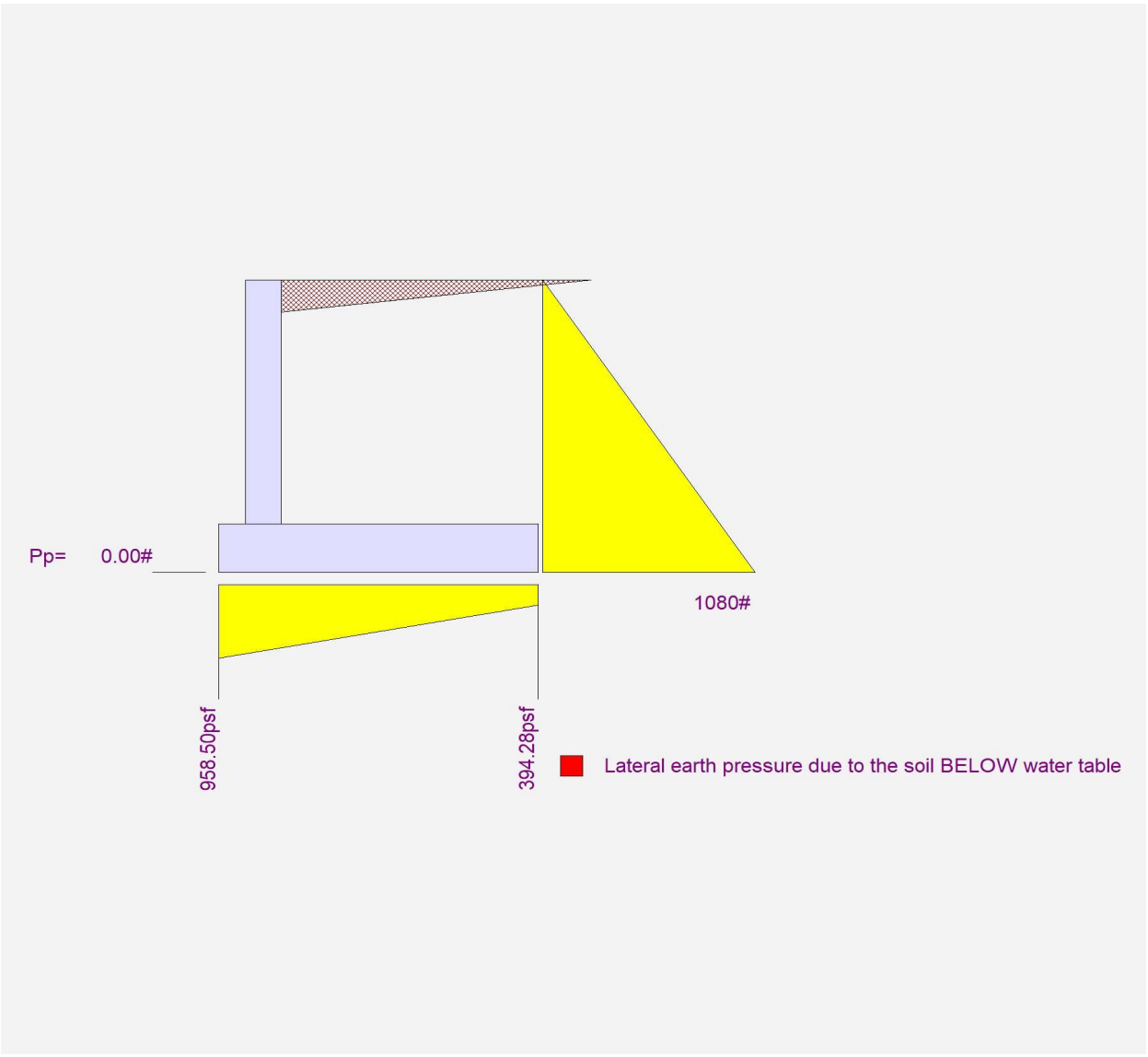


Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 5 ft wall



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 5.5 ft wall

Code Reference

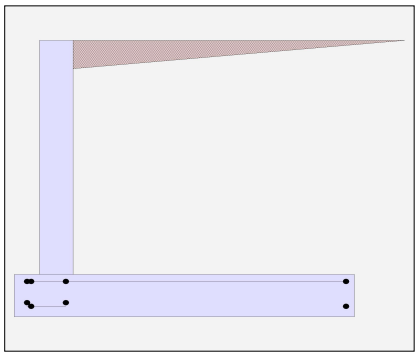
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

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

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	60.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
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		

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 (Strength 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		Spread Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 5.5 ft wall

Design Summary

Wall Stability Ratios

Overturning	=	6.28	OK
Sliding	=	1.56	OK
Global Stability	=	1.48	

Total Bearing Load	=	4,940 lbs	
...resultant ecc.	=	5.28 in	

Eccentricity within middle third

Soil Pressure @ Toe	=	1,018 psf	OK
Soil Pressure @ Heel	=	446 psf	OK
Allowable	=	2,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	1,425 psf	
ACI Factored @ Heel	=	624 psf	
Footing Shear @ Toe	=	0.4 psi	OK
Footing Shear @ Heel	=	2.4 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,267.5 lbs	
less 100% Passive Force	-	0.0 lbs	
less 100% Friction Force	-	1,976.2 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	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

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

Design Data

fb/FB + fa/Fa	=	**0.491**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,452.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	2,662.0
Moment.....Allowable	=	5,412.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	19.4
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.25

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 5.5 ft wall

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.0997 in2/ft		
(4/3) * As :	0.133 in2/ft	Min Stem T&S Reinf Area 1.056 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	0.50 ft
Heel Width	=	6.25
Total Footing Width	=	6.75
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	=	1,425	624	psf
Mu' : Upward	=	176	13,170	ft-#
Mu' : Downward	=	23	14,122	ft-#
Mu: Design	=	153 OK	952	ft-# OK
phiMn	=	10,013	11,209	ft-#
Actual 1-Way Shear	=	0.37	2.42	psi
Allow 1-Way Shear	=	75.00	75.00	psi

Toe Reinforcing = # 5 @ 14.00 in
Heel Reinforcing = # 5 @ 14.00 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@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Heel: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Key: No key defined

Min footing T&S reinf Area 1.75 in2
Min footing T&S reinf Area per foot 0.26 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 9.26 in	#4@ 18.52 in
#5@ 14.35 in	#5@ 28.70 in
#6@ 20.37 in	#6@ 40.74 in

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 5.5 ft wall

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,267.5	2.17	2,746.3	Soil Over HL (ab. water tbl)	3,377.9	3.96	13,370.9
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		3.96	13,370.9
Hydrostatic Force				Watre Table			
Buoyant Force	=			Sloped Soil Over Heel	=		
Surcharge over Heel	=			Surcharge Over Heel	=		
Surcharge Over Toe	=			Adjacent Footing Load	=		
Adjacent Footing Load	=			Axial Dead Load on Stem	=		
Added Lateral Load	=			* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=			Soil Over Toe	=		
	=			Surcharge Over Toe	=		
				Stem Weight(s)	=	550.0	0.83	458.3
				Earth @ Stem Transitions	=		
				Footing Weight	=	1,012.5	3.38	3,417.2
				Key Weight	=			
				Vert. Component	=			
Total	= 1,267.5	**O.T.M.** =	2,746.3	**Total =**	4,940.4 lbs	**R.M.=**	17,246.4

Resisting/Overturning Ratio = **6.28**

Vertical Loads used for Soil Pressure = 4,940.4 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	50.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.115	in

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

Project Title:
Engineer:
Project ID:
Project Descr:

DESCRIPTION: 5.5 ft wall

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height: 0.00 ft above top of footing

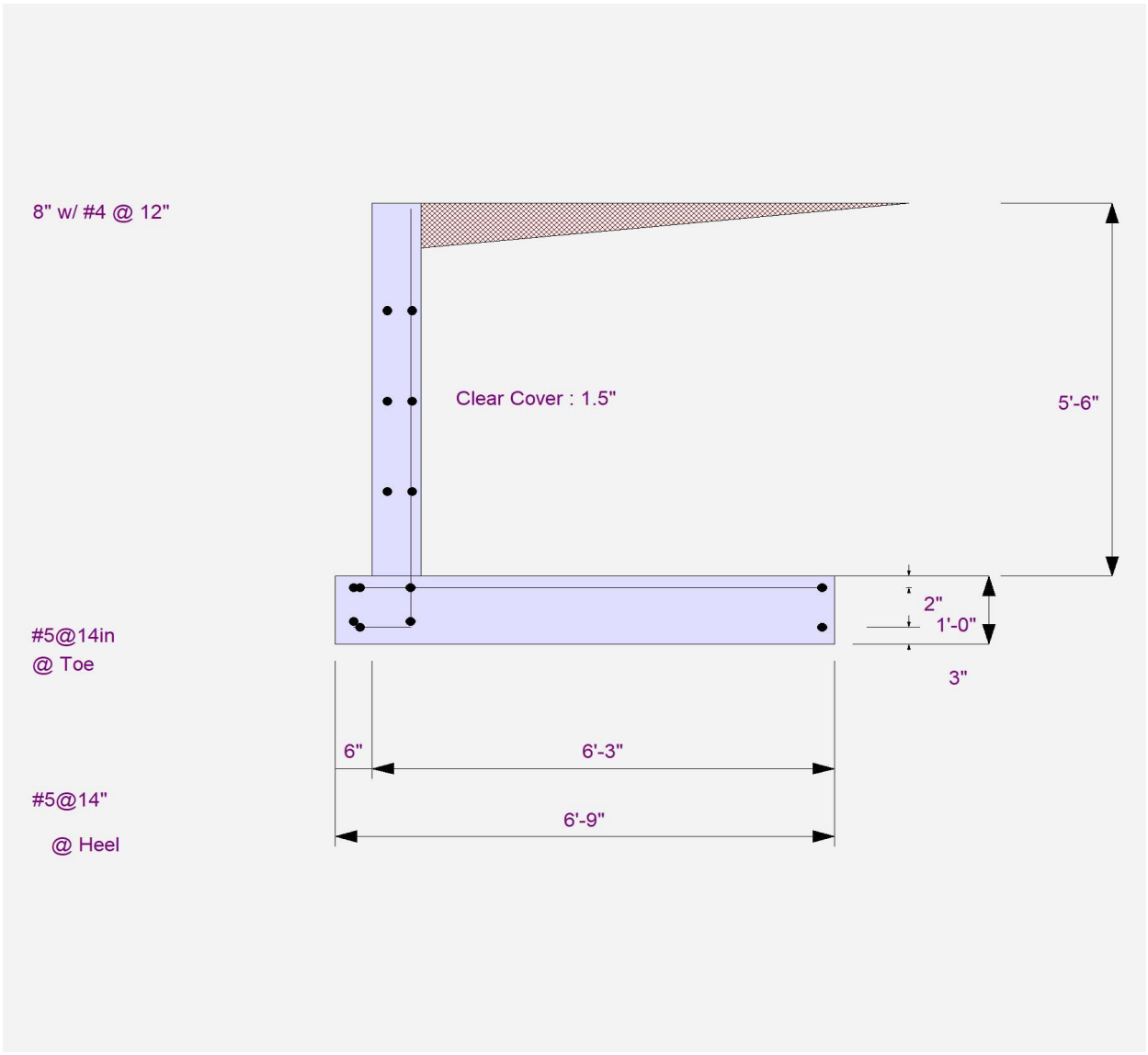
Lap Splice length for #4 bar specified in this stem design segment =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	8.40 in
As Provided =	0.2000 in2/ft
As Required =	0.1728 in2/ft

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 5.5 ft wall

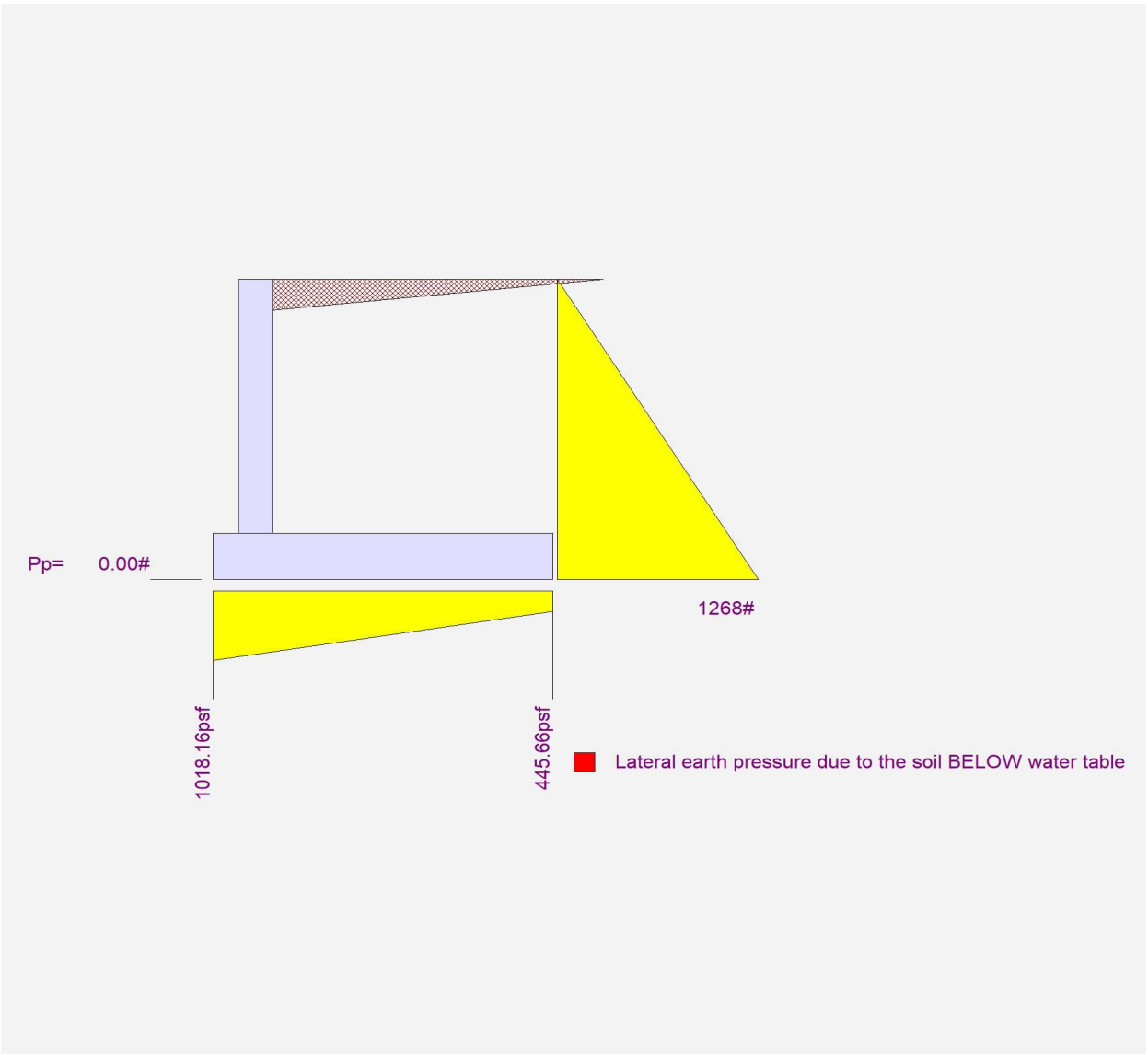


Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 5.5 ft wall



Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 6 ft wall

Code Reference

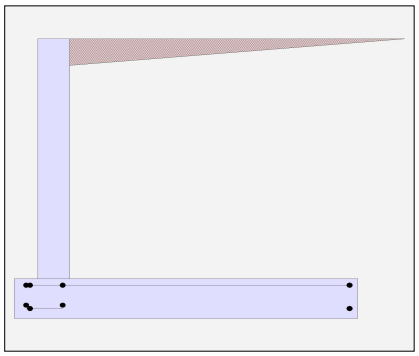
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	60.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
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		

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 (Strength 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		Spread Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 6 ft wall

Design Summary

Wall Stability Ratios

Overturning	=	6.22	OK
Sliding	=	1.55	OK
Global Stability	=	1.46	

Total Bearing Load	=	5,703	lbs	
...resultant ecc.	=	5.81	in	
Eccentricity within middle third				
Soil Pressure @ Toe	=	1,102	psf	OK
Soil Pressure @ Heel	=	471	psf	OK
Allowable	=	2,000	psf	
Soil Pressure Less Than Allowable				
ACI Factored @ Toe	=	1,543	psf	
ACI Factored @ Heel	=	660	psf	
Footing Shear @ Toe	=	0.4	psi	OK
Footing Shear @ Heel	=	3.1	psi	OK
Allowable	=	75.0	psi	

Sliding Calcs

Lateral Sliding Force	=	1,470.0	lbs	
less 100% Passive Force	-	0.0	lbs	
less 100% Friction Force	= -	2,281.0	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	
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

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

Design Data

fb/FB + fa/Fa	=	**0.638**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	1,728.0
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	3,456.0
Moment.....Allowable	=	5,412.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	23.0
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Wall Weight	psf =	100.0
Rebar Depth 'd'	in =	6.25

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	
Masonry Design Method	=	ASD

Concrete Data

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

Project Title:
Engineer:
Project ID:
Project Descr:

Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 6 ft wall

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing	
As (based on applied moment) :	0.1295 in2/ft		
(4/3) * As :	0.1726 in2/ft	Min Stem T&S Reinf Area 1.152 in2	
200bd/fy : 200(12)(6.25)/60000 :	0.25 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft	
0.0018bh : 0.0018(12)(8) :	0.1728 in2/ft	Horizontal Reinforcing Options :	
	==========	One layer of :	Two layers of :
Required Area :	0.1728 in2/ft	#4@ 12.50 in	#4@ 25.00 in
Provided Area :	0.2 in2/ft	#5@ 19.38 in	#5@ 38.75 in
Maximum Area :	0.8467 in2/ft	#6@ 27.50 in	#6@ 55.00 in

Footing Data

Toe Width	=	0.50 ft
Heel Width	=	6.75
Total Footing Width	=	7.25
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	=	1,543	660	psf
Mu' : Upward	=	190	16,776	ft-#
Mu' : Downward	=	23	17,985	ft-#
Mu: Design	=	168 OK	1,210	ft-# OK
phiMn	=	10,013	11,209	ft-#
Actual 1-Way Shear	=	0.37	3.10	psi
Allow 1-Way Shear	=	75.00	75.00	psi

Toe Reinforcing = # 5 @ 14.00 in
Heel Reinforcing = # 5 @ 14.00 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@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Heel: #4@ 9.25 in, #5@ 14.35 in, #6@ 20.37 in, #7@ 27.77 in, #8@ 36.57 in, #9@ 46.29 in, #10@ 58.79 in

Key: No key defined

Min footing T&S reinf Area 1.88 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

Project Title:
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Cantilevered Retaining Wall

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DESCRIPTION: 6 ft wall

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	1,470.0	2.33	3,430.0			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
=						
Soil Over HL (ab. water tbl)				4,015.0	4.21	16,896.5
Soil Over HL (bel. water tbl)					4.21	16,896.5
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =						
Surcharge Over Toe =						
Stem Weight(s) =				600.0	0.83	500.0
Earth @ Stem Transitions =						
Footing Weight =				1,087.5	3.63	3,942.2
Key Weight =						
Vert. Component =						
Total =	1,470.0	**O.T.M.** =	3,430.0	**Total =** 5,702.5 lbs	**R.M.=**	21,338.6

Resisting/Overturning Ratio = **6.22**

Vertical Loads used for Soil Pressure = 5,702.5 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	50.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.127	in

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

DESCRIPTION: 6 ft wall

Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #4 bar specified in this stem design segment =	18.72 in
Development length for #4 bar specified in this stem design segment =	14.40 in
Hooked embedment length into footing for #4 bar specified in this stem design segment =	8.40 in
As Provided =	0.2000 in2/ft
As Required =	0.1728 in2/ft

Project Title:
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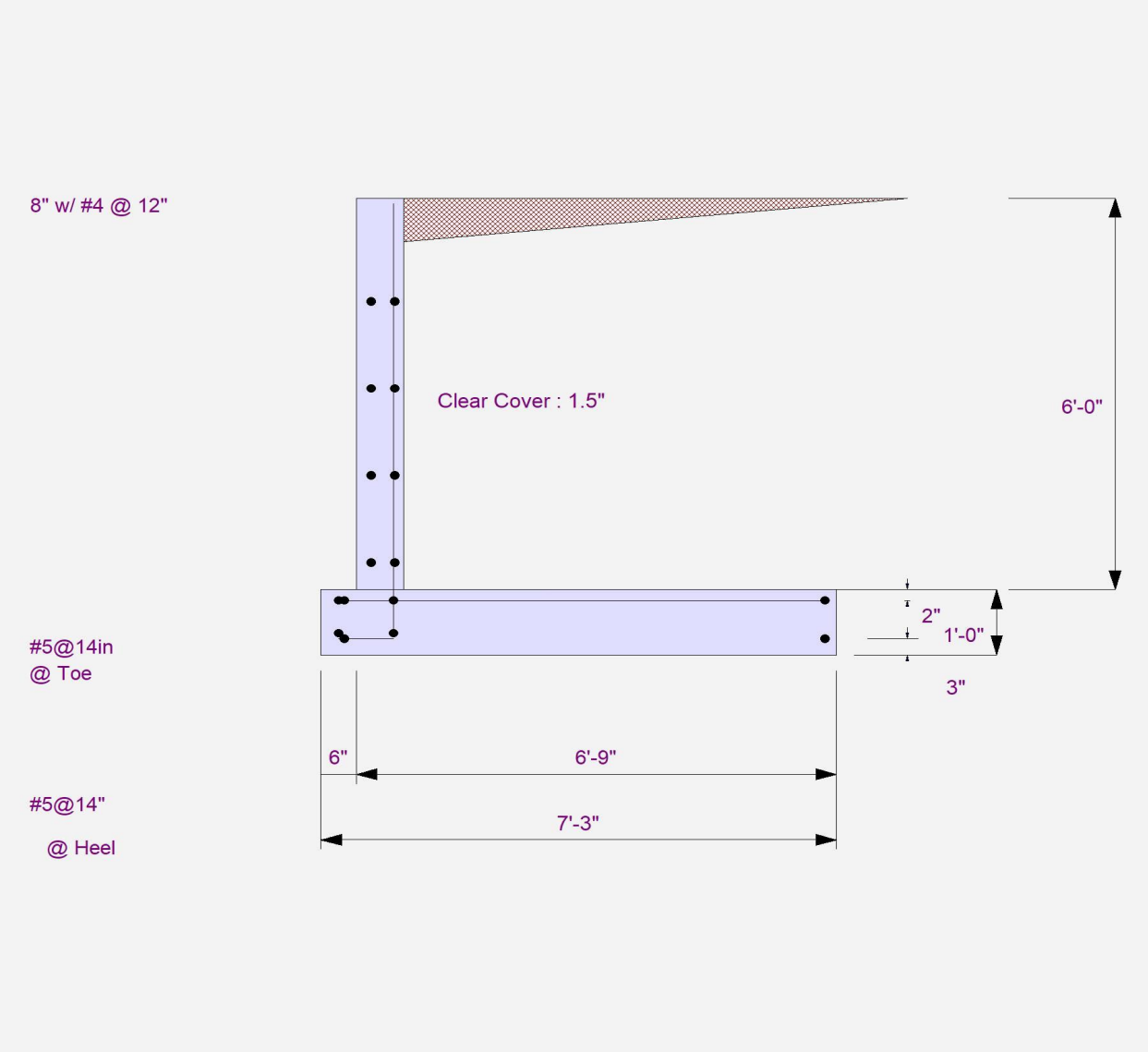
Cantilevered Retaining Wall

Project File: Morgan-Hornsby.ec6

DESCRIPTION: 6 ft wall



Project Title:
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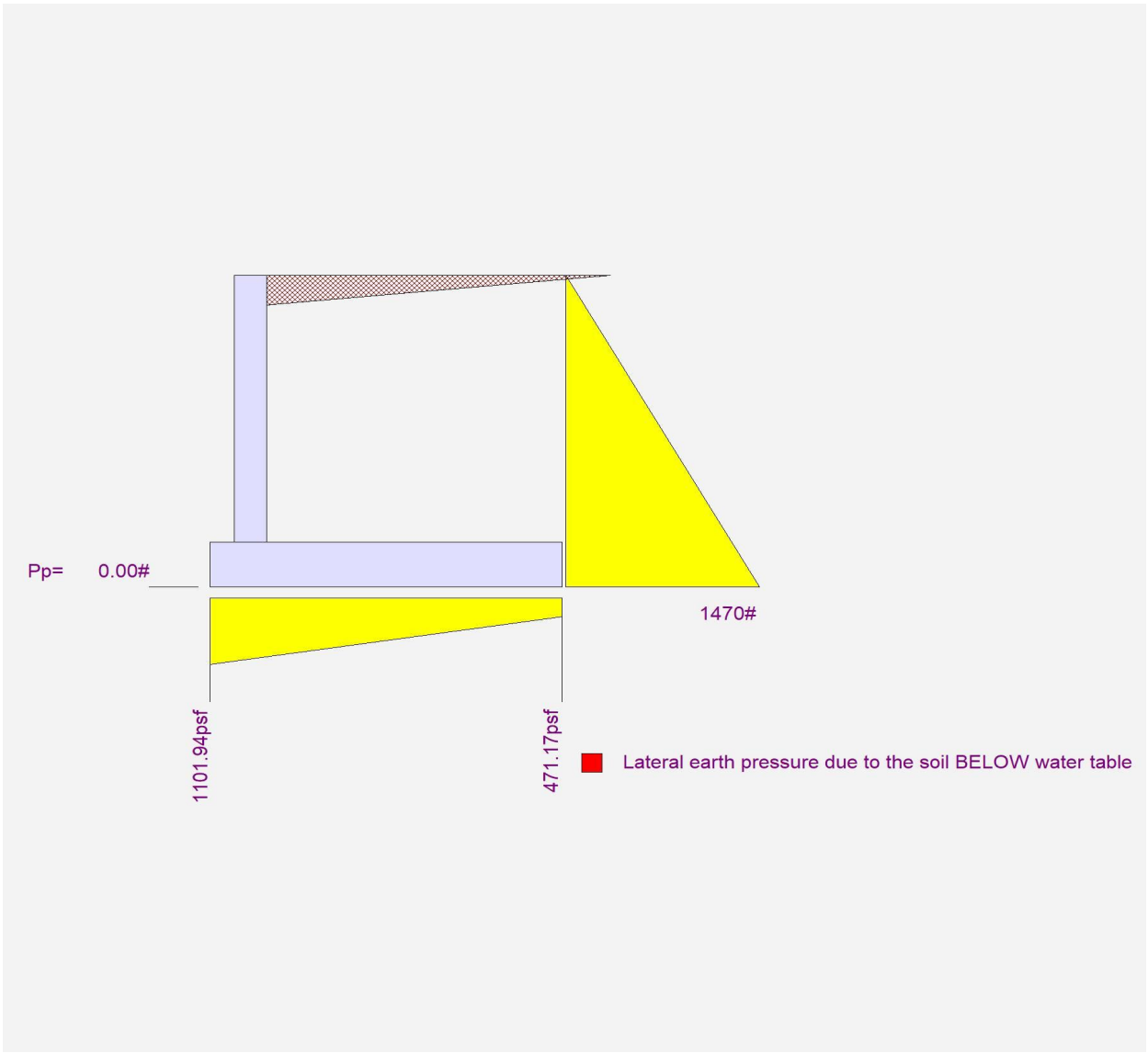
Cantilevered Retaining Wall

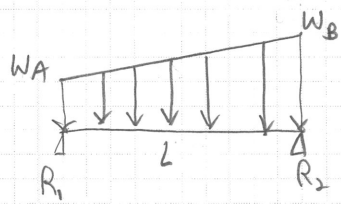
Project File: Morgan-Hornsby.ec6

DESCRIPTION: 6 ft wall



Pin Pile Calcs

2" ø pipe pile = 6000 lb capacity



Example diagram for calcs

- 3 ft Retaining Wall:

$R_1 = \frac{292\ psf(4')}{3} + \frac{625\ psf(4')}{6} = 806\ plf$

$R_2 = \frac{292(4)}{6} + \frac{625(4)}{3} = \underline{1028\ plf}$

Add 1000 plf for bearing walls above

$6000^{lb} / 1028\ plf + 1000\ plf = 2.959\ ft \Rightarrow$ **Space every 2.75 ft**

- 3.5 ft Retaining Wall

$R_2 = \frac{318\ psf(4.5')}{6} + \frac{709\ psf(4.5')}{3} = \underline{1302\ plf}$

$6000^{lb} / 2302\ plf = 2.606\ ft \Rightarrow$ **Space every 2.5 ft**

- 4 ft Retaining Wall

$R_2 = \frac{344\ psf(5')}{6} + \frac{792\ psf(5')}{3} = \underline{1607\ plf}$

$6000^{lb} / 2607\ plf = 2.301\ ft \Rightarrow$ **Space every 2.25 ft**

- 4.5 ft Retaining Wall

$R_2 = \frac{369\ psf(5.5')}{6} + \frac{875\ psf(5.5')}{3} = \underline{1943\ plf}$

$6000^{lb} / 2943\ plf = 2.039\ ft \Rightarrow$ **Space every 2 ft**

- 5 ft Retaining Wall

$R_2 = \frac{395\ psf(6')}{6} + \frac{959\ psf(6')}{3} = \underline{2314\ plf}$

$6000^{lb} / 3314\ plf = 1.811\ ft \Rightarrow$ **Space every 1.75 ft**

- 5.5 ft Retaining Wall

$R_2 = \frac{446\ psf(6.75')}{6} + \frac{1019\ psf(6.75')}{3} = \underline{2795\ plf}$

$6000^{lb} / 3795\ plf = 1.581\ ft \Rightarrow$ **Space every 1.5 ft**

- 6 ft Retaining Wall

$R_2 = \frac{472\ psf(7.25')}{6} + \frac{1102\ psf(7.25')}{3} = \underline{3234\ plf}$

$6000^{lb} / 4234\ plf = 1.417\ ft \Rightarrow$ **Space every 1.25 ft**

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PROJECT: Morgan - Hornsby DATE:

DESIGNER: SHEET #: